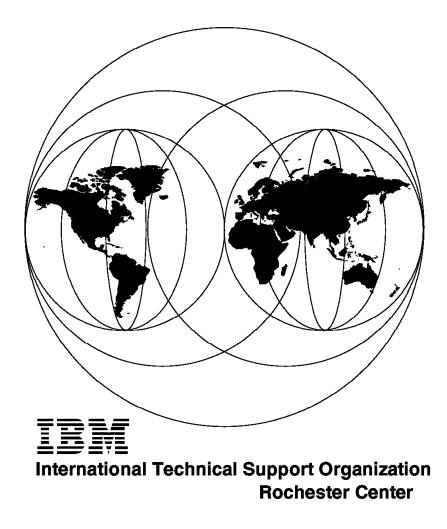
# AS/400 Communication Performance Investigation - V3R6/V3R7

December 1997



# AS/400 Communication Performance Investigation - V3R6/V3R7

December 1997

#### Take Note!

Before using this information and the product it supports, be sure to read the general information in Appendix J, "Special Notices" on page 389.

#### First Edition (December 1997)

This edition applies to Version 3, Release 7, Modification 0 of the AS/400 Operating System and to all subsequent releases until otherwise indicated in new editions or technical bulletins.

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# Contents

Preface	
The Team That Wrote This Redbook	xi
Comments Welcome	xii
Chapter 1. Tools Used for Finding Performance Problems	1
1.1 Usual Symptoms of Degraded Performance	2
1.2 Collecting Communications Performance Data	
1.2.1 Why Collect Performance Data	3
1.2.2 How to Collect Performance Data	3
1.2.3 Automatic Data Collection	5
1.2.4 Performance Management/400	5
1.3 Using CL Commands Interactively	6
1.4 Using Performance Tools/400	6
1.4.1 WRKSYSACT Command	6
1.4.2 PRTACTRPT Command	7
1.4.3 DSPPFRDTA Command	
1.4.4 The Advisor	
1.4.5 Produce Reports	
1.5 What to Look For	
	0
Chapter 2. Using CL Commands to Find Performance Problems	11
2.1 WRKSYSVAL Command	
2.1.1 QTOTJOB	
2.1.2 QACTJOB	
2.1.2 QACTJOB	
2.1.3 QMAAACTEVE	
2.1.4 QMCHFOOL	
2.2 PRTERRLOG Command	
2.3 PTF Commands	
2.3.1 DSPPTF	
2.3.2 SNDPTFORD	
2.4 WRKSYSSTS Command	
2.4.1 WRKSYSSTS	
2.4.2 Information About Activity Level Guidelines	
2.4.3 Information About Transition Guidelines	
2.4.4 Interactive Tuning Roadmap	
	21
2.6 Using WRKDSKSTS	-
2.7 WRKSYSACT Command	24
Chapter 3. Using Performance Tools/400	
3.1 System-Wide Problem Analysis	
3.1.1 Advisor	
3.1.2 Performance Graphics	29
3.1.3 Print Activity Report	
3.1.4 Performance Tools Reports	
3.1.5 Memory Performance Displays and Reports	33
3.1.6 CPU Performance Reports and Displays	34
3.1.7 A Brief Discussion About Program Exceptions Consuming CPU	34
3.1.8 Disk Performance Reports and Displays	37
3.1.9 Communications Performance Data	39

3.1.10 Activity Level Performance Reports and Displays	. 41
3.1.11 Comparing with Activity Level Guidelines	. 42
3.1.12 Comparing W-I and A-W Ratio Guidelines	
3.2 User Level Problem Analysis	. 42
3.2.1 Print Job Summary Report	. 43
3.2.2 Print Transaction Summary Report	. 43
3.3 Application Level Problem Analysis	. 43
3.3.1 Charging Resource Utilization to Interactive Program	. 44
3.3.2 Print Transaction Summary Report	. 44
3.3.3 Print Transaction Detail Report	. 44
3.3.4 Print Transition Report	. 45
3.4 Programmer Performance Utilities	. 46
3.4.1 OS/400 Utilities for Tracing a Job	. 46
3.4.2 Performance Tools/400 Utilities for Tracing a Job	. 48
3.5 Performance Data Conversion	. 51
Chapter 4. Using BEST/1 for Communications Performance Analysis and	
Capacity Planning	. 53
4.1 V3R7 BEST/1 Capacity Planning	
4.1.1 When to Use BEST/1 for Communications Performance Analysis	
4.2 Creating a Model for Communications Analysis	
4.2.1 Assigning Jobs to Workloads by Communications Line	
4.2.2 Creating a Model	
4.3 Using a Model for Communications Analysis	
4.3.1 Displaying Model Reports	
4.3.2 Understanding Recommendations	
4.4 Changing Communications Resources	
4.4.1 Example - Changing the IOP Type	
4.5 BEST/1 Communications Support for Performance Analysis	
4.5.1 Creating a Communications IOP Feature	
4.5.2 Creating a Communications Line Resource	
4.5.3 Distribution of Characters Transferred Across Line Resources	
4.6 Comparing the Model Against the Measured Performance	
4.7 Considerations When Analyzing Communications Data with BEST/1	
Ober (an F. Heimer Over(and Over) a Table	74
Chapter 5. Using System Service Tools	
5.1 Checking the Communications Hardware	
5.2 Working with Communications Traces	
5.2.1 Starting and Stopping the Trace	
5.2.2 Formatting the Trace Data	. 84
Chapter 6. Communications I/O Processor (IOP)	. 89
6.1 Important Fields in the IOP Performance Manager File	. 89
6.1.1 IOP Utilization	
6.2 Communication IOP Recommendations	. 92
6.2.1 Configuring Communication Lines	. 93
6.2.2 Frame Size	
6.2.3 IOP Type	. 94
6.2.4 IOP Assist	
6.2.5 IOP Utilization	
Chapter 7. Local Area Network Performance Analysis	
7.1 LAN Performance Indicators in Performance Monitor Database	
7.2 Line Utilization	
7.2.1 Using Performance Tools/400 to Display Line Utilization	. 97

7.2.2 Performance Monitor Database Fields	. 99
7.2.3 Recommendations	100
7.3 LAN Congestion	100
7.3.1 Not Ready and Sequence Errors	101
7.3.2 Using Performance Tools/400 to Display Congestion	101
7.3.3 Performance Monitor Database Fields	102
7.3.4 Receive Congestion Errors on Token-Rings	104
7.3.5 Ethernet Collision Counters	104
7.3.6 Recommendations to Control Congestion	105
7.4 Medium Access Control (MAC) Errors	106
7.4.1 Using Performance Tools/400 to Display MAC Errors	106
7.4.2 Performance Monitor Database Fields	107
7.4.3 Recommendations	
7.4.4 Token-Ring Network Errors	
7.5 Retransmissions	
7.6 Timeouts	
7.6.1 Using Performance Tools/400 to Display Timeouts and Retries	
7.6.2 Performance Monitor Database Fields	
7.7 LAN Overheads	
7.7.1 Performance Monitor Database Fields	114
7.8 LAN Queries	115
7.9 LAN Performance Tuning Recommendations	115
7.9.1 LAN Controller Performance Parameters	115
7.9.2 LANCNNTMR and LANCNNRTY	116
7.9.3 LANRSPTMR and LANFRMRTY	117
7.9.4 LANACKTMR and LANACKFRQ	118
7.9.5 LANACKTMR and LANRSPTMR Relationship	118
7.9.6 LANACKFRQ and LANMAXOUT Relationship	120 121
7.9.7 LANINACTMR	. – .
7.9.9 LANACCPTY (Token-Ring Networks Only)	
7.10 LAN IOPs	
7.11 Frame Size	
7.11.1 Token-Ring Frame Sizes	
7.11.2 Ethernet Frame Sizes	
7.11.3 Bridge Frame Size Considerations	
7.11.4 ETHSTD Parameter	126
7.11.5 Other Considerations	
	.20
Chapter 8. X.25	127
8.1 High Level Data Link Control (HDLC)	127
8.1.1 Line Utilization	128
8.1.2 Line Errors	131
8.1.3 Congestion	133
8.1.4 Data Link Resets	135
8.2 Packet level Control (PLC)	136
8.2.1 Number of Packets Transmitted	136
8.2.2 Congestion	137
8.3 Logical Link Control (LLC)	137
8.3.1 Data Units Retransmitted and Data Units Received in Error	138
8.3.2 LLC Rejects	139
8.3.3 LLC Protocol Data Units Discarded	140
8.3.4 Timeouts	141
8.3.5 Checksum Errors Detected	
8.3.6 Number of Reset Indications from Packet Link Control	142

8.3.7 LLC Congestion	142
8.4 Important Related Performance Manager Files	143
8.4.1 IOP Utilization	143
8.4.2 Remote Jobs	144
Chapter 9. SDLC	147
9.1 Important Fields in the SDLC Performance Manager File	147
9.1.1 Line Utilization	147
9.1.2 Line Errors	150
9.1.3 Congestion	153
9.1.4 Data Link Resets	155
9.1.5 Connect Poll Retries	155
9.2 Other Related Performance Monitor Files	158
9.2.1 IOP Utilization	159
9.2.2 Remote Jobs	160
Chapter 10. SNA	163
10.1 Important Fields in the SNA Performance Monitor File	
10.1.1 Number of Connections Established	
10.1.2 Number of Sessions and Brackets Started/Ended	
10.1.3 Session Level Pacing Wait Time	
10.1.4 Internal Session Level Pacing	
10.1.5 Transmission Queue Wait Time	
10.1.6 Line Transmission Time	
10.2 Important Related Performance Manager Files	
10.2.1 Line Utilization	
10.2.2 Communications Jobs	
10.3 SNA Traces	
	170
Chapter 11. TCP/IP Performance Investigation	175
11.1 Performance Expectation	
11.2 TCP/IP Overview	
11.2.1 Data Format	-
11.2.2 Flow Control	
11.2.3 Version 3 Performance Improvements	
11.3 Performance Tool/400 Databases	
11.3.1 QAPMSAP	
11.3.2 QAPMJOBS	
11.4 Bottlenecks	
11.5 Tools We Can Use for TCP/IP	
	170
Chapter 12. Analyzing APPN Communications Performance	181
12.1 Advanced Peer-to-Peer Networking (APPN) Performance	
12.1.1 ADVanced Feet-to-Feet Networking (AFFN) Fertormance	
•	
12.1.3 Topology Maintenance	
12.1.4 Directory Services Registrations and Deletions	
12.1.5 Configuration Changes	
12.1.6 Control Point Session Activation and Deactivation	
12.1.7 Control Point Presentation Services (CPPS)	
12.1.8 Session Setup Activities	
12.2 APPN Transmission Priority	195
	407
Chapter 13. AnyNet	197
13.1 MPTN Architecture	197

13.2 Types of MPTN Nodes	197
13.2.2 AnyNet	198
13.2.3 AnyNet/400 Summary	198
13.3 AnyNet Performance Considerations	
13.3.1 Some Guidelines for Performance Analysis	
13.3.2 AnyNet Summary	205
Chapter 14. ISDN	
14.1 Link Access Protocol for D-Channel (LAP-D)	
14.1.1 Line Utilization (LAP-D)	
14.1.2 Line Errors	
14.1.3 Using Performance Tools/400 to Display Line Error Information	
14.1.4 Frame Errors (LAP-D)	
14.1.5 Performance Monitor Database Fields	
14.1.6 Using Performance Tools/400 to Display Frame Error Information	
14.1.7 Call Processing	
14.1.8 Using Performance Monitor/400 to Display Call Information	
14.2 ISDN Data Link Control (IDLC)	
14.2.1 Line Utilization (IDLC)	
14.2.2 Line Errors (IDLC)	
14.2.3 Frame Errors (IDLC)	
14.2.4 Using Performance Tools/400 to Display Frame Errors (IDLC)	
14.3 ISDN Used with X.25 (X.31)	
14.3.1 Circuit Mode	
14.3.2 Packet Mode	
14.3.3 Performance Monitor Database Fields	
14.4 Recommendations	
14.4.1 Frame Size	
14.4.2 Window Size	
14.4.3 Packet Size (X.25 Only)	
14.4.4 A Case Study	226
Appendix A. SDLC Queries	
A.1 SDLC_ALL	
A.2 SDLC_HDLC	
A.3 SDLC_IOP	
A.3.1 IOP Query for a Communications Processor	
A.3.2 IOP Query for MFIO Processor	
A.4 SDLC_JOB	237
Appendix B. Local Area Network Queries	239
B.1 Token-Ring LAN Query	239
B.1.1 Sample Report Output	241
B.1.2 CL Program to Execute the Token-Ring LAN Queries	242
B.1.3 Token-Ring LAN SAP Counter Query	
B.1.4 Token-Ring LAN Performance Indicators Query	244
B.1.5 Token-Ring LAN MAC Error Counters Query	248
B.1.6 Token-Ring LAN Overhead Query	254
B.2 Ethernet LAN Query	258
B.2.1 Sample Report Output	260
B.2.2 CL Program to Execute the Ethernet LAN Queries	261
B.2.3 Ethernet LAN SAP Counter Query	
B.2.4 Ethernet LAN Performance Indicator Report Query	
B.2.5 Ethernet LAN MAC Error Counters Query	267

Appendix C. X.25 Queries	275
C.1 X25_ALL	276
C.2 X25_HDLC	
C.3 X25_PLC	282
C.4 X25_LLC	284
C.5 X25_IOP	286
C.5.1 IOP Query for a Communications Processor	286
C.5.2 IOP Query for MFIO Processor	288
C.6 X25_JOB	290
Appendix D. Queries for APPN Tasks	293
D.1 APPNSYSNAM Query (System Name - Input to Query APPNALL)	295
D.2 APPNJOIN1 Query (APPN Task - Join Input to Query APPNALL)	295
D.3 APPNJOIN2 Query (T2 Station IOM - Join Input to Query APPNALL)	298
D.4 APPNJOIN3 Query (Token-Ring IOM - Join Input to Query APPNALL)	
D.5 CPUALLOC Query (System Processor Usage by Categories)	
D.6 APPNALL Query (ASync Communications I/O Task Activity)	
D.7 APPNDETAIL Query (APPN Tasks - Detailed Resource Usage)	
D.8 APPNT2DTL Query (T2 Station IOP Task Detail)	
Appendix E. SNA Queries	311
E.1 SNA_ALL	312
E.2 SNA_CON	324
E.3 SNA_IPAC	326
E.4 SNA_PAC1	329
E.5 SNA_PAC2	332
E.6 SNA_PAC3	335
E.7 SNA_LIN	338
E.8 SNA_TRQ	341
Appendix F. Integrated PC Server Query	345
F.1 Integrated PC Server Performance Monitor Data Queries	
	010
Appendix G. AnyNet Queries	351
G.1 Sockets over SNA Queries	
G.1.1 SNA Query	352
G.1.2 Sockets Jobs Query	353
G.2 APPC over TCP/IP Queries	359
G.2.1 SNA Query	359
G.2.2 APPC Jobs Query	360
Appendix H. ISDN Queries	361
H.1 NWI_ALL	362
H.2 NWI_CALLS	365
H.3 NWI_ERRORS	367
H.4 NWI_IOP	369
H.5 NWI_LAPD	371
H.6 IDLC_ALL	373
	375
H.8 IDLC_UTIL	377
Appendix I. Guidelines for Interpreting Performance Data	379
Appendix J. Special Notices	389

Appendix K. Related PublicationsK.1 International Technical Support Organization PublicationsK.2 Redbooks on CD-ROMsK.3 Other Publications	391 391
How to Get ITSO Redbooks         How IBM Employees Can Get ITSO Redbooks         How Customers Can Get ITSO Redbooks         IBM Redbook Order Form	393 394
Index	397
ITSO Redbook Evaluation	399

# Preface

Improving communication performance is not a trivial task. The purpose of this redbook is to discuss how to manage communications performance and ways to locate the problem areas in communication performance. This redbook collects a large amount of the performance information from several sources and presents it in an ordered manner. The databases created by the Performance Tools/400 were used to give the key performance indicators.

This redbook is intended for technical professionals including network designers who want to tune the IBM AS/400 system to improve communications performance.

An intermediate knowledge of the Performance Tools/400 (5716-PT1) and Query/400 (5716-QU1) is assumed.

## The Team That Wrote This Redbook

This redbook was produced by a team of specialists from around the world working at the International Technical Support Organization Rochester Center.

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This document is based on the ITSO redbook, *AS/400 Communication Performance Investigation*, GG24-4669.

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# Chapter 1. Tools Used for Finding Performance Problems

Finding a performance problem is similar to solving a three-dimensional crossword puzzle: all of the puzzles are different from each other but after solving several puzzles, you begin to grasp a pattern. For example, you start the puzzle from the lower left-hand corner and continue systematically towards the upper right-hand corner. Solving a communications performance problem is a task even more challenging. You need to have the AS/400 system tuned properly before trying to figure out what is causing the communications performance problem.

As it is impossible to give anyone explicit instructions for solving a crossword puzzle, it is impossible to give you an exact check-list to be followed to find and solve a communications performance problem. In this book, we are leading you to the beginning of a never-ending task of finding the perfect performance.

The first step of solving a communication performance problem is to collect material to be analyzed with the tools available. The collection is done by entering the Start Performance Monitor (STRPFRMON) command that is described in Section 1.2, "Collecting Communications Performance Data" on page 2.

The tools you need to solve a performance problem are:

- CL commands described in more detail in Chapter 2, "Using CL Commands to Find Performance Problems" on page 11:
  - WRKSYSVAL, Work with System Values
  - WRKSYSSTS, Work with System Status
  - WRKACTJOB, Work with Active Jobs
  - WRKDSKSTS, Work with Disk Status
- *Performance tools/400* is described in Chapter 3, "Using Performance Tools/400" on page 27 and consists of the following parts:
  - WRKSYSACT, Work with System Activity command
  - This command differs from the rest of the performance tools because it is the only tool used for a real-time analysis. For information about using this command, see Chapter 2, "Using CL Commands to Find Performance Problems" on page 11.
  - DSPPFRDTA, Display Performance Data command
  - Advisor
  - Reports
  - BEST/1 is used to plan for system growth and analyze the effect of work load and hardware changes. Using this tool is discussed in Chapter 4, "Using BEST/1 for Communications Performance Analysis and Capacity Planning" on page 53.
  - Programmer performance utilities such as:
    - Job trace
    - Disk Data Collection
    - Analyze Process Access Group
    - Performance Explorer
- System Service Tools is discussed in Chapter 5, "Using System Service Tools" on page 71.
- Communications Trace is discussed in Chapter 5, "Using System Service Tools" on page 71.

The tools should be used in sequence from top to bottom. First, use the Work with System Values command to find out the settings of the allocation system values. After that, check the overall performance by using the Work with System Status command. Then find out if any individual jobs are using too much of the systems' resources by using the Work with Active Jobs command. The Work with Disk Status command helps you to determine if any of the actuators are being over-committed or whether the total amount of disk arms is adequate.

By using the Performance tools, you find out the bottlenecks of the performance that can be analyzed more thoroughly by running queries to the performance tools database. Communications trace is used to find out how the data is passed between the AS/400 system and the remote end.

Please note that the users on a local token-ring are considered as remote users.

## 1.1 Usual Symptoms of Degraded Performance

There are several ways of finding out if your AS/400 system is having a performance problem in the communications area, but a good starting point is to ask users what they think about response times. Bear in mind that usually workstation users are not satisfied with the response time even if it were something similar to a sub-second...

The indicators to pay attention to are:

- · Poor response time
- Reduced throughput
- · Heavy faulting rate in the main storage
- High usage of system resources such as CPU, IOP, or DISK

Normally the degradation of response times is the first indication of something getting out of order. Be aware that usually the response times get longer little by little so noticing the degradation is almost impossible without a regular observation of system performance.

## **1.2 Collecting Communications Performance Data**

Before collecting the performance data to solve a communications performance problem, decide what might be the problem to be investigated. The problem description does not need to be overly detailed or technical, just try to simply describe one problem. For example:

- Remote response time seems too slow.
- File transfer should go faster.
- · At times, the entire system seems sluggish.

Next, determine when the problem usually occurs. Maybe remote response time is slow the first thing in the morning, or the file transfers seem slow late in the afternoon.

When you can describe the communications performance problem and have determined when it seems to occur, you are ready to collect communications performance data for your analysis.

If possible, focus on collecting data for one problem at a time. Of course, try to collect the data when the problem is the most likely to appear. You can decide

later how much of the data you want to analyze. For more information about when to collect performance data and how much to collect, see the first few pages of Chapter 4 in the *AS/400 Performance Tools/400 Guide*.

## **1.2.1 Why Collect Performance Data**

Collect performance data on a **regular basis** and create historical data out of the material collected. For example, you can run the performance data collection for two hours on every Wednesday afternoon with the default parameters; the trace data is not needed for the historical data. The reason for doing this is that viewing the historical data graphics is the easiest way to notice any trends in system performance if you are not using the Performance Monitor/400 software.

Another reason for collecting data regularly is that without having a baseline to compare your performance data with, you have no way of telling whether the performance is improving or degrading.

## 1.2.2 How to Collect Performance Data

You do not need Performance Tools/400 to collect the data, the collection part is done by entering the Start Performance Monitor (STRPFRMON) command. This generates several performance database files that contain statistics for each communications protocol used. When collecting performance data to analyze a communications performance problem, set the sampling interval to the smallest value possible.

## 1.2.2.1 Start Performance Monitor (STRPFRMON) Command

Figure 1 shows an example of how to collect performance data to generate communications statistics to be analyzed either by the advisor or Performance Tools/400

Start Performance Monitor	(STRPFRMON)
Type choices, press Enter.	
Member MBR Library LIB Text 'description' TEXT <u>10/25/96</u> Time interval (in minutes) INTERVAL	*GEN QPFRxx 1 Comm. PFR Analysis 2 5 3
Stops data collection ENDTYPE Days from current day DAY Hour HOUR Minutes MINUTE	<u>*ELAPSED</u> 0 2 0
Data type DATA Trace type TRACE Dump the trace DMPTRC Job trace interval JOBTRCITV	*ALL 4 *NONE *YES .5
Job types JOBTYPE + for more values Start database monitor STRDBMON	<u>*DFT</u> <u>*NO</u> <b>5</b> More
F3=Exit F4=Prompt F5=Refresh F12=Cancel F24=More keys	F13=How to use this display

Figure 1. STRPFRMON Command

Notes:

When collecting performance data, you can use the default library QPFRDATA or you can create a specific library for your data. For example, you can create a library with your customer name.

As you may have several performance members in that library, put a text description of each member collected to help identify them. Usually, it is a good idea to include the date of the collection in the description field.

3 Set the time interval to five minutes.

4 This specifies the type of information collected. The possible values are:

- \*ALL All of the information is collected including system information, communications information, and input/output processor (IOP) information.
- **\*SYS** Only system information is collected. IOP information is not collected.

**5** This parameter is new from Version 3 Release 6. Specifying \*YES starts Database monitoring for all the jobs in the system and that usually is not preferable.

## 1.2.2.2 Start Database Monitor (STRDBMON) Command

You may use the STRDBMON command to start monitoring database activities if special information is required. Entering the STRDBMON command provides you with the following display:

File to receive outputLibrary	1Name Name, *LIBL, *CURLIB*FIRST *REPLACEName, *FIRST *REPLACE, *ADD Name, *, *ALL Name 000000-999999*SUMMARY *CALC *BLANK3
	Boj

Figure 2. STRDBMON Command

Notes:

Use this parameter to specify both the library and the file name to which the performance statistics are written. If the file does not exist, one is created based on the QAQQDBMN file in library QSYS.

**2** Use this parameter to choose the job or jobs whose database activities are to be monitored.

3 Enter up to 100 characters of descriptive text on this input field.

Please note that at the time this publication was being written, there were no tools available for analyzing the data collected. Be extremely careful when collecting data because there is no way of knowing whether database monitoring is active or not.

Usually the data collected through the STRDBMON command includes no data directly related to communications performance.

- IMPORTANT! -

If you forget to turn the monitoring off, you may eventually fill up all of the disk space on the AS/400 system.

## **1.2.3 Automatic Data Collection**

Automatic data collection allows you to select specific days of the week to collect the data using the OS/400 performance monitor. Use the Add Performance Collection (ADDPFRCOL) command or choose option 1 (add) on the Work with Performance Collection menu (achieved by entering WRKPFRCOL command) to establish a regular schedule for collecting performance data automatically on any day of the week.

You may either specify the day and the time to collect the performance data or just specify starting and ending times and run it every day of the week. Please make sure that the collection time includes the peak hours or the period you want to monitor.

**Note:** The default value of the RMTRSPTIME (Remote Response Time) parameter is \*NONE which means that remote workstation response time is **not** collected unless otherwise specified.

## 1.2.4 Performance Management/400

One tool that is completely different from all the other tools discussed in this publication is Performance Management/400. It is a tool that is a combination of both collecting and analyzing the performance data.

Performance Management/400 (PM/400) is an IBM system management service offering that assists customers by helping them to plan and manage system resources through regular analysis of key performance indicators.

The service uses a set of software and procedures installed on the customer's system. The software collects performance data and summarizes and transmits the summarized data weekly to your local service provider.

PM/400 automates these functions and provides a summary of capacity and performance information. Reports and graphs are produced in a format that both non-technical and technical persons can understand.

Performance data is both analyzed and maintained by IBM. Contact your local service provider for more information about using PM/400.

PM/400 does not require Performance Tools/400 (5716-PT1) and has no intention to replace that product.

## 1.3 Using CL Commands Interactively

You have several commands to use for identifying the performance problem interactively:

- **WRKSYSSTS** This command is used to get a quick look at the system wide performance figures such as:
  - · CPU usage
  - Disk usage
  - Memory usage

**Note:** There is no way of knowing the amount of memory used; you can only observe the rate of paging, which indirectly tells you whether there is enough storage available or not.

- Job State transition rates
- **WRKACTJOB** With this command, you can easily find out how the individual jobs are using system resources.
- **WRKDSKSTS** With this command, you can observe the performance of each disk arm on the system.
- **WRKSYSACT** With this command, you can observe both external jobs and internal task or processes. This command is actually the two previous commands in one package and is **only** available as a part of the Performance Tools/400 licensed program.

#### - NOTICE! -

Please bear in mind that using these commands can add a significant amount of workload to the system, especially if you are using the console display. In other words, analyzing a performance problem can cause more performance problems.

## 1.4 Using Performance Tools/400

Performance Tools/400 provides more ways for you to display performance related information about the system being analyzed.

## 1.4.1 WRKSYSACT Command

The Work with System Activity display allows you to view performance data in a real-time fashion. The data is reported for any selected job or task that is currently active on the system. Besides having the capacity to view this data on the display station, you may also direct the data to be stored in a database file for future use.

## 1.4.2 PRTACTRPT Command

The Print Activity Report (PRTACTRPT) command generates reports based on the data collected by the Work With System Activity (WRKSYSACT) command.

## 1.4.3 DSPPFRDTA Command

The Display Performance Data (DSPPFRDTA) command starts the interactive displays that are used for showing the performance data.

**Note:** This command can **only** be used when previously collected performance data is available.

## 1.4.4 The Advisor

Pay attention to any communications related recommendations or conclusions.

## 1.4.5 Produce Reports

The following list contains reports that you can produce by using the Performance Tools/400 licensed software.

System report Prints an overview of what happened on the system.

#### **Component report**

Prints performance data by job, user, pool, disk, IOP, local workstation, and exception.

#### **Transaction report**

Prints information about the transactions that occurred during the time that the performance data was collected.

The transaction report may be extended to print:

- Transaction detail report
- Transition detail report

**Note:** The transaction detail and transition detail reports are quite detailed. Use select/omit parameters to choose specific jobs, users, and time intervals only.

- Lock report Prints a report that is used to determine whether jobs are delayed during processing because of unsatisfied lock requests or internal machine waits.
- **Job report** Prints performance data about jobs that were active during the time that the performance data was collected.
- **Pool report** Prints performance data about pools.

#### **Resource report**

Prints performance data about the system resources such as disks and workstation controllers.

#### Batch job report

Prints performance data about batch jobs traced through time. Resources utilized, exceptions, and state transitions are reported.

## 1.5 What to Look For

Follow the flow chart shown in Figure 3 on page 9 to solve your communication performance problem.

Questions to ask yourself about the performance problems are:

- · Is the performance always unacceptable?
- Is the AS/400 system balanced? If it is not, follow the map in Figure 7 on page 20 or contact your service provider to get assistance with tuning the system.
- · Is there a specific time of day/week/month when performance is poor?
- Are there batch jobs or file transfer jobs running during the poor performance time?
  - If the answer is yes, are the batch jobs running in the same storage pool as the communication jobs?
  - If the answer is yes, consider creating a separate storage pool for either batch jobs or the communication jobs.
- · Are all of the users affected?
- · Are only remote users affected?
- · What do the complaining users have in common?
  - Is the same application used both in remote locations and locally?
  - Are all of the users for this application complaining?
  - Is there only one group of users having a problem?
  - Are all of the users connected to the same controller/line/IOP?

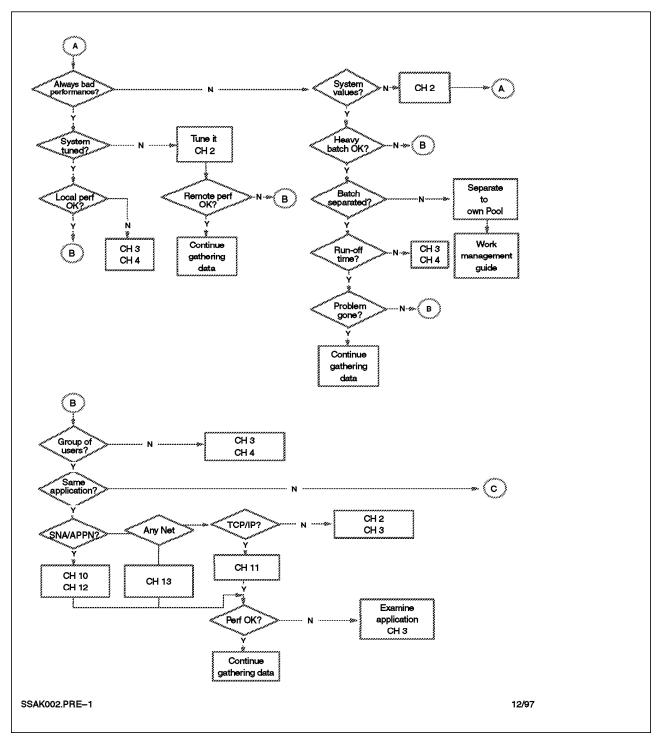


Figure 3. Where to Read, 1 of 2

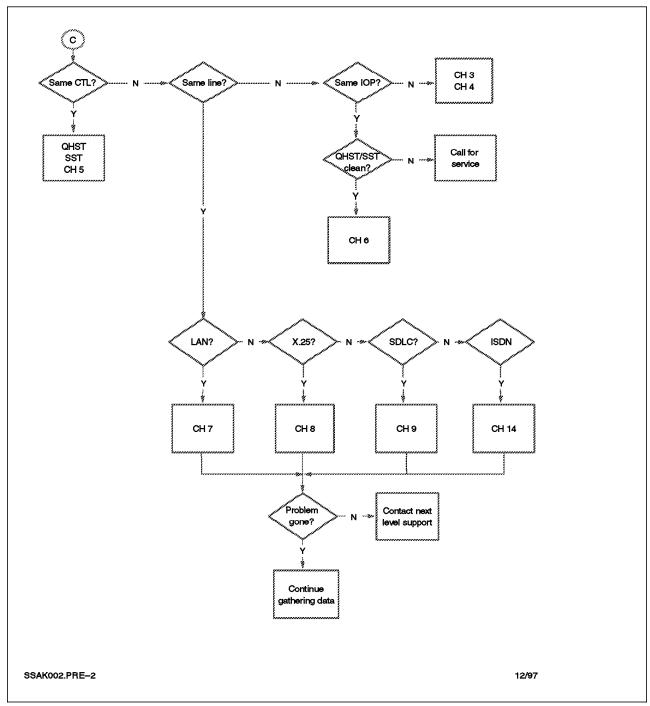


Figure 4. Where to Read, 2 of 2

# Chapter 2. Using CL Commands to Find Performance Problems

This chapter provides information about identifying a communications performance problem by using command language (CL) commands interactively.

Please bear in mind that using these commands can add a significant amount of workload to the system, especially if you are using the console display. In other words, analyzing a performance problem can cause more performance problems.

## 2.1 WRKSYSVAL Command

System values are pieces of information that affect the operating environment in the entire system. System values are **not** objects and, therefore, they cannot be passed as parameter values the same as CL variables.

There are some system values that affect performance such as QTOTJOB, QACTJOB, QMAXACTLVL, QMCHPOOL, and QCMNRCYLMT. Review these values first because they can relate to your situation.

# 2.1.1 QTOTJOB

This value controls the **total** number of jobs for which the storage is allocated during IPL.

The correct setting of this system value can be obtained by entering the WRKSYSSTS command. Pay attention to the value displayed in the "Jobs in system" field because the amount of jobs in the system should never be greater than the value of QTOTJOB. Add 15% to the number of "Jobs in system" field and set this to be the system value QTOTJOB provided that the following cautions are followed:

- Remember to clear output queues regularly because OS/400 reserves storage for a job as long as there is at least one spooled output file for that job even though the job is inactive. The more files there are in output queues, the more jobs you see on the Work with System Status display.
- If you have a high number of spooled files on the system while using the WRKSYSSTS command and you add 15% more to set the QTOTJOB value, you significantly increase the time it takes to IPL the system. Performance is also affected at run time of any system functions that search through the system wide Work Control Block Table (WCBT). These functions include the WRKACTJOB command, WRKJOB command, and STRSBS command.
- Consider using the AS/400 Operational Assistant options to clean the obsolete spooled files such as old job logs and program dumps from the system. This can be done by entering G0 CLEANUP on any command line.

If the amount of "Jobs in system" reaches this value, all of the jobs are paged out from the main storage and the amount of job structures given with the QADLTOTJ system value (the shipped value is 10) is created before all of the jobs are paged into the main storage and normal processing continues.

You can suspect a wrong setting of QTOTJOB if the system seems to "slow down" periodically with no apparent reason such as a heavy batch job visible. The "hang up" situation normally lasts a couple minutes after which normal processing continues until the previously created job structures are used up and a new "hang up" situation arises.

The value shipped with the operating system is 30 which normally is not large enough.

Note: A change of this system value is effective only after the next IPL.

## 2.1.2 QACTJOB

This value controls the initial number of **active** jobs for which storage is to be allocated during IPL. The amount of storage allocated for each active job is approximately 110K.

The correct setting for this value can be determined by entering the WRKACTJOB command; on the right-hand top corner of the display is the amount of active jobs in the system. Find out what is the highest amount of the active jobs during a busy day, add 10% to the number, and you have found the correct setting for the QACTJOB system value. The number of active jobs should not exceed this value, or all of the jobs are paged out from main storage until a number of job structures given with QADLACTJ are created.

You can suspect a wrong setting of QACTJOB if the system seems to "fall asleep" periodically with no apparent reason visible. The "sluggish performance" situation normally lasts a couple of minutes after which normal processing continues **until** the amount of previously created job structures are used up and a new "hang up" situation arises.

The value shipped with the operating system is 20 which normally is not large enough.

Note: A change of this system value is effective only after the next IPL.

— Do Not Set the Values Too Large! -

You must keep QACTJOB, QTOTJOB, QADLACTJ, and QADLTOTJ at reasonable values. If you make QACTJOB and QTOTJOB excessively high, the IPL is slower due to excessive storage allocation. If you make QACTJOB and QTOTJOB too small for your environment and you make QADLTOTJ and QADLACTJ excessively large, run-time performance can be impacted.

## 2.1.3 QMAXACTLVL

This value determines the maximum activity level of the system. This is the number of all the jobs that can compete at the same time for main storage and processor resources. If a job cannot be processed because no activity levels are available, the job is held until another job reaches a time slice end or a long wait. See Chapter 14 in the *Work Management Guide* for information about job state transitions.

Even though the value shipped with V3R7 is \*NOMAX, ensure that this is the setting on your AS/400 system. This is because the value shipped with the previous releases (prior to V3R1M0) was 100 and **normally** the system values are not changed during the update of the operating system. A change to this system value takes effect immediately.

## 2.1.4 QMCHPOOL

This system value affects the size of the \*MACHINE storage pool. The machine storage pool contains the highly-shared microcode and operating system programs. Some of the programs are pageable and some of them are not pageable. This means that you must be careful when changing the size for this storage pool because system performance may be impaired if the storage pool is too small.

#### Notes:

- 1. A change to this system value takes effect immediately. The shipped value is 20000KB.
- 2. This value may be changed by the performance adjust support when the system value QPFRADJ is set to 1, 2, or 3.

You can also change the setting of the QMCHPOOL system value by using the Work with System Status display as described in the Section 2.4, "WRKSYSSTS Command" on page 16.

The third way of changing this system value is done by using the WRKSHRPOOL (Work with Shared Pools) command.

## 2.1.5 QCMNRCYLMT

This system value provides recovery limits for system communications recovery. It specifies the number of recovery attempts to make and when to send an inquiry message to the system operator if the specified number of recovery attempts has been reached.

The recommended value is (2 5), which means that two communication line or control unit retries are tried within a 5-minute interval. Never set the first value (count limit) equal to or greater than the second value (time interval) excluding (0 0).

If the count limit is 0, regardless of the time interval, no recovery attempts are made. When the count limit is greater than 0 and the time interval is 0, **infinite recovery** attempts are being made. If the count limit is greater than 0 and the time interval is greater than 0, the specified number of recovery attempts are made and an inquiry message is sent to the operator after the specified time interval.

Table	1.	QCMNRCYLMT	Settings	Examples
-------	----	------------	----------	----------

Count Limit	Time Interval	Action
0	0	No recovery
0	1 through 120	No recovery
1 through 99	0	Infinite recovery
1 through 99	1 through 120	Count and time recovery

An incorrect setting of a QCMNRCYLMT value can cause the system to perform the line or controller recovery continuously. Under some conditions, the continuous retries can consume a significant amount of system resources. If this occurs, stop the process by varying the configuration object off.

## 2.2 PRTERRLOG Command

The next step of solving a communications performance problem is to verify that the hardware is functioning properly. This can be done with the PRTERRLOG (Print Error Log) command that is used **primarily** for problem analysis tasks. The command places a formatted printer file of the data in the system error log (in case there are errors reported) into a spooled printer device file named QPCSMPRT or into a specified output file.

This command is shipped with public \*EXCLUDE authority. The following user profiles have private authorities to use the command: QPGMR, QSYSOPR, QSRV, and QSRVBAS.

The first page of the PRTERRLOG command prompt looks similar to the following display:

Print Error Log (PRTERRLOG) Type choices, press Enter.				
Resource name		Name		
Error log identifier + for more values		Hexadecimal value		
Output	*PRINT	*PRINT, *OUTFILE		
Beginning time	*AVAIL	Time, *AVAIL		
Beginning date	<u>*CURRENT</u>	Date, *CURRENT		
Ending time	*AVAIL	Time, *AVAIL		
Ending date	*CURRENT	Date, *CURRENT		
Print format	<u>*CHAR</u>	*CHAR, *HEX More		
F3=Exit F4=Prompt F5=Refresh F24=More keys	F12=Cancel			

Figure 5. PRTERRLOG Command Prompt

You can also view the error log by using the System Service Tool as described in Chapter 5, "Using System Service Tools" on page 71.

If the list produced with the Print Error Log command contains no hardware errors in lines, controllers, or IOPs, proceed with the next topic. Otherwise, contact your hardware service provider.

## 2.3 PTF Commands

This topic provides only part of the information about working with PTFs. For more information, see Chapter 4 in *AS/400 System Startup and Problem Handling*, SC41-4206.

Install the latest cumulative PTF package about every four months or at least twice a year. This is to ensure that your system has the latest level of code

installed, and usually most of the so-called "performance PTFs" are included in the cumulative PTF packages.

IBM creates PTFs to correct problems or potential problems found within IBM licensed programs. PTFs may fix problems that appear to be hardware failures, or they may provide new or enhanced functions.

## 2.3.1 DSPPTF

The Display Program Temporary Fix (DSPPTF) command shows the program temporary fixes (PTFs) for a specified product.

To find out what level of code is running on the system, type the DSPPTF 5716999 command on any command line and you receive the "Display PTF Status" display. The first line displayed shows you the latest cumulative PTF package installed on your system.

## 2.3.2 SNDPTFORD

To find out what the latest PTF package is, enter the SNDPTFORD PTFID((SF98370)) command and press Enter. If you have a maintenance agreement with IBM, you receive a file that has information about:

- PTF packages available for Version 3 Release 7
- · Installing the latest cumulative package
- Preventive service planning (PSP) information for installing the latest cumulative PTF package
- PSP information for installing Version 3 Release 7
- · IBM frequently-asked questions about the AS/400 system
- Summary of the Version 3 Release 7 High Impact/Pervasive (HIPER) PTFs and PTFs that are in error (PE)
- Complete detailed list of the Version 3 Release 7 PTFs that are in error (PE)
- Complete detailed list of the Version 3 Release 7 High Impact/Pervasive (HIPER) problems
- · Summary of the generally available Version 3 Release 7 PTFs

Enter the SNDPTFORD PTFID((SF97370)) command to obtain a listing that provides you with a convenient reference of the License Internal Code fixes and program temporary fixes (PTFs) that are available by IBM licensed program categories. This listing is updated regularly. You may choose to order a PTF/FIX that effects one of your IBM licensed programs.

Enter the SNDPTFORD PTFID((SF99370)) command to order the latest cumulative PTF package that is available in your country.

Information about the latest performance PTFs can also be obtained by reading item 130NC in HONE.

## 2.4 WRKSYSSTS Command

Observe and balance the **overall (system wide) performance** before focusing on a communications performance problem. The reason for this is that the communications performance is only a relatively small part of the overall performance. If the entire system is functioning poorly, there normally is no use trying to figure out what might be wrong with communications.

## 2.4.1 WRKSYSSTS

The Work with System Status display shows the current status of the system in real time. Use this display to observe the paging fault rates and job transitions. The indicators you need to pay special attention to (in order of priority) are:

- 1. Non database fault rates in the machine pool
- 2. Non database fault rates in all the other pools
- 3. Page rates in all the pools
- 4. Transition rates in all the pools

**Note:** When tuning the system, make sure that the machine pool is treated separately from the other pools.

Use the faulting guidelines in the *Work Management Guide* manual and Appendix I, "Guidelines for Interpreting Performance Data" on page 379 to determine the effects that faulting has on performance. The following examples may help you to understand the faulting guidelines:

- The response time of an interactive transaction is affected by any faults that occur during that transaction. Each fault adds from 10 to 30 milliseconds to the end-user's response time. For example, if the disk response time is 20 milliseconds and the transaction has five faults per transaction, add about 0.1 seconds to the total response time.
- Each fault consumes a certain amount of the CPU power: the more faults that occur, the more CPU is being consumed for unproductive work. In the following examples, processing the transactions consumes 70% of the CPU capability and the faulting rate is 100.
  - On a 9401 class (CPW close to 7) processor, these faults use CPU for 0.6 seconds.
  - On an 9402 model 2130 class (CPW close to 12) processor, these faults use CPU for 0.3 seconds.
  - On an 9406 530 class (CPW close to 132) processor, these faults use CPU for 0.02 seconds.

If the faulting rate of your system is close to the poor end of the faulting guidelines tables, approximately 10% to 20% of the CPU is used for faulting. Adding main storage to reduce the faulting rate also lowers the CPU utilization, thus leaving more processing power available to handle more transactions.

• With the increasing faulting rate, the amount of disk I/O also increases. If you have only a few actuators, these faults can cause the disk utilizations to increase more rapidly than if you have many disk arms. As your disk arm (actuator) utilization increases, the time to process disk I/Os increases and the response times get longer.

While using the Work with System Status display to analyze a communication performance problem, concentrate on two storage pools:

#### \*MACHINE pool

This is the pool in which the OS/400 jobs and microcode tasks run. Normally this is the pool that should have the rate of non-DB faults below 10 faults per second.

#### **OTHER** pool

This is the pool in which the communications jobs are routed to. The shipped value for this is the \*BASE pool. Investigate the subsystem descriptions for QCMN and QSERVER subsystems to see which storage pool is being used by the jobs and focus on that storage pool.

- What is the faulting rate in the \*MACHINE pool? See Table 17 on page 379 for guidelines of non-database page faults in the storage pool. If the rate is not acceptable, see the map in Figure 7 on page 20.
- What is the faulting rate in the storage pool used for communications jobs?
- A rule of thumb for the initial Activity Level Factor used for the communications subsystem is 500K per activity level (for example, 4000K of memory and an activity level of 8 should provide adequate resources for interactive work). If 500K per activity level is not enough, add memory to the pool or decrease the activity level in the pool.

Remember to provide enough activity levels in the pool where the communication jobs are running or you may experience a significant performance degradation. Please note that file transfer jobs require considerably more memory than interactive jobs so a rule of thumb for a **file transfer job** is a 2000K per transfer.

• If you have Client Access/400 users running critical file transfer functions, consider separating the transfer jobs to a storage pool of their own. Create a new storage pool for subsystem QCMN and direct the routing entry having the compare value QTFDWNLD to that pool. The following table describes the routing entries that you may work with to override the IBM supplied default values:

Compare Value	Subsystem Description	Function
'QCNPCSUP '	QBASE, QCMN	CLIENT ACCESS/400 SHARED FOLDERS 0, 1
'QCNTEDDM '	QSYSWRK	DDM
'QHQTRGT '	QBASE, QCMN	CLIENT ACCESS/400 REMOTE DATA QUEUE
'QLZPSERV '	QBASE, QCMN	CLIENT ACCESS/400 LICENSE MANAGER (ORIGINAL CLIENTS)
'QMFRCVR '	QBASE, QCMN	CLIENT ACCESS/400 MESSAGE SENDER
'QMFSNDR '	QBASE, QCMN	CLIENT ACCESS/400 MESSAGE RECEIVER
'QNPSERVR '	QBASE, QCMN	CLIENT ACCESS/400 NETWORK PRINT SERVER
QOCEVOKE '	QBASE, QCMN	CROSS-SYSTEM CALENDARING
'QOQSESRV '	QBASE, QCMN	DIA VERSION 2 (Prestart Job Entry)
'QRQSRV '	QBASE, QCMN	REMOTE SQL - DRDA
'QTFDWNLD '	QBASE, QCMN	CLIENT ACCESS/ 400 FILE TRANSFER FACILITY
'QZDAINIT '	QSERVER	DATABASE SERVERS (ODBC and Remote SQL)
'QZHQTRG '	QBASE, QCMN	CLIENT ACCESS/400 REMOTE DATA QUEUE SERVER
'QZRCSRVR '	QBASE, QCMN	CLIENT ACCESS/400 REMOTE COMMAND SERVER
'QZSCSRVR '	QBASE, QSRV	CLIENT ACCESS/400 CENTRAL SERVER
'QVPPRINT '	QBASE, QCMN	CLIENT ACCESS/ 400 VIRTUAL PRINT

			W	ork wit	h Syste	m Statu	S			SYSNMOO
								-		11:48:3
	used					ystem A				
Elapse	ed time .		. : 6	00:22:	59 %	system	ASP us	ed	. :	77.030
Jobs '	in system		. :	56	11 T	otal au	x stg		. :	11.80
	m address					urrent	unprote	ct used	I.:	315
% tem	p address	es	. :	.0	16 M	laximum	unprote	ct	.:_	695
									5	
Sys	Poo1	Rsrv	Max	D	B	Non	-DB	Act-	Wait-	Act-
Pool	_	Size K	Act			Fault			Inel	Inel
1		2 33980	+++	.0		<b>1</b> 1.2		8.9	.0	.0
2	73564	0	19	.2		.4		12.3	.1	.0
3	512	0	1	.0	.0	.0	.0	.0	.0	.0
4	183352	0	5	.0		.4	5.5	11.4	.0	.0
5	12300	0	$     \frac{1}{5}     \frac{3}{8} $	0		0		.0	.0	.0
6	64000	0	8	4.0	.0	3.1	.2	1.4	.0	.0
										Botto
===>										20110
$F21 = S_{1}^{-1}$	elect ass	istance l	evel							



Notes:

This column is the most important column of this display. Because the machine pool contains objects used system-wide, page faulting in this pool affects **all** of the jobs in the system. Therefore, it is desirable to maintain a low page fault rate in this pool. **The only way to affect the paging in the machine pool is to adjust the size of the pool**.

See Table 17 on page 379 for guidelines of non-database page faults in the \*MACHINE pool.

**2** The rule of thumb for adjusting the **machine pool size** is to multiply the number in the "Reserved Size" field by one and a half.

3 This column represents the sum of non-database faults in all of the storage pools and this is the column you need to focus your attention on. The non database faults include program code (jobs' work areas and variables, for example). To affect the faulting rate in the pool (except machine pool), you can change either the size or the activity level of the pool.

See Table 18 on page 379 and Table 19 on page 380 for guidelines about the amount of faults in storage pools.

This column represents the sum of database faults in all of the storage pools. Please remember that a system with no database faults is a "dead" system. This is because the data may be changed only when the data is in the main storage and if the data is **not** in the main storage, the system issues a fault. When no database pages are brought into the main storage, not a single piece of data is being changed and no work is done with the system.

Basically, a fault is an order to go and get a piece of data from a disk to main storage so that the data can be changed. Technically speaking, a page fault is a program notification that occurs when a page that is marked as not in main storage is referred to by an active program.

**5** These last three columns (from left to right) represent the job's state transitions. When the pool size and activity level settings are in balance with each other, the ratio of columns (from left to right) should be 10 to one. Usually, when the pool size and activity level settings are correct for the workload, the transition rates fall within the guidelines.

A job running on the system is in one of the following states:

- Active The job is in main storage and it is processing work that is requested by the application.Wait The job needs to use a resource that is momentarily unavailable.
- Ineligible The job has all of the resources required to do the processing, but it is waiting for a free activity level.

Wait-to-ineligible transitions need not be zero all of the time. When there is a momentary period of heavy usage, it may be better to let the jobs become ineligible to avoid excessive page fault rates or thrashing.

See Table 20 on page 380 for guidelines of the ratio of Wait-to-Ineligible/Active-to-Wait transitions.

**6** The time frame of the observation period should be kept between five and 30 minutes. If the observation period is less than five minutes, the occasional peak loads tend to distract the rates of both faults and pages. On the other hand, if the time period is over 30 minutes, the important data may be lost because the counters holding the data may get wrapped.

# 2.4.2 Information About Activity Level Guidelines

Table 3. Activity Level						
Resource Description	Where to Look	Compare With				
Activity Level for *BASE and QSPL pool	System Report: Storage Pool Utilization, WRKSYSSTS, ADVISOR	Figures given in Chapter 14 in the <i>Work</i> <i>Management Guide</i> .				
QINTER Activity Level	System Report: Storage Pool Utilization, WRKSYSSTS, ADVISOR	See Table 22 on page 380.				

# 2.4.3 Information About Transition Guidelines

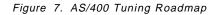
Table 4. W-I and A-W Ratio					
Resource Description	Where to Look	Compare With			
W-I/A-W	System Report: Storage Pool Utilization, WRKSYSSTS	See Table 20 on page 380.			

## 2.4.4 Interactive Tuning Roadmap

Balancing your main memory and CPU utilization is accomplished by allocating the memory available and setting the activity levels in the storage pools. Refer to the *Work Management Guide* for the guidelines of both the memory and activity level settings.

**Note:** You have to repeat Step 4 through Step 7 for all of the other pools in your AS/400 system; Step 3 is for the \*MACHINE pool only. Follow the road map during periods of high system's activity because there is no use tuning the system when there is only a relatively light workload on the system. Make sure that system value QPFRADJ is set to zero before following the tuning road map.

```
Interactive AS/400 Tuning Roadmap
1. Enter command WRKSYSSTS.
   Press PF21 to set assistance level to Intermediate.
2. Wait 2-3 minutes and press PF5 to refresh.
3. Does *MACHINE NDB faults meet the guidelines?
   a. Yes ... Press PF10 and go to step 4.
   b. No .... Adjust QMCHPOOL:
       1) -50K if fault rate = 0
       2) +50K if fault rate > 3.0
       3) Press PF10 to reset and go to step 2.
4. Is the DB fault + NDB fault > 20 in any pool?
   a. Yes ... Increase pool size by 50KB, press PF10 and repeat
               Step 4 (repeat until all pools are less than 20).
  b. No .... Go to step 5.
5. Wait 2-5 minutes, press PF5. Press PF21 to set the Assistance
  level to Advanced.
   Is the Wait to Ineligible state = 0?
   a. Yes ... Reduce Activity level by 2, press PF10 to reset, and
               repeat step 5.
   b. No .... Go to step 6.
6. Is the Active to Wait state 10x the activity level?
   a. No ....System not heavily used or complex application mix,
               go to step 4.
  b. Yes ... Go to step 7.
7. Is the sum of all fault rates for all pools within guidelines?
   a. No .... Go to step 4.
  b. Yes ... Go to step 8.
8. Activity levels and pool sizes probably OK. Continue monitoring
   WRKSYSSTS display regularly.
```



## 2.5 WRKACTJOB Command

The Work with Active Jobs command measures system performance by measuring aspects such as the CPU usage and response time. The following examples show the different Work with Active Jobs displays.

To view the Work with Active Jobs display, type WRKACTJOB on any command line and press the Enter key. Press the PF21 key to show more jobs on one display as in the following example:

CPU	%: 3.4 E	lapsed time:	00:	22:42	Active jobs:	119	
Opt	Subsystem/Job	User	Туре	CPU %	Function	Status	
•	QBATCH	QSYS	SBS	.0		DEQW	
	QCMN	QSYS	SBS	.0		DEQW	
	USERPC	ĊOOK	EVK	.0	* -PASSTHRU	EVTW	
	USERPC	СООК	EVK	.0	* -PASSTHRU	EVTW	
	P23ARTYC	AS0219R	EVK	.0	* -PASSTHRU	EVTW	
	P23ARTYC	AS0219R	EVK	.0	* -PASSTHRU	EVTW	
	QCTL	QSYS	SBS	.0		DEQW	
	QJSCCPY	A960303A	BCH	.0	PGM-QSCCPY	DEQW	
	QSYSSCD	QPGMR	BCH	.0	PGM-QEZSCNEP	EVTW	
	QINTER	QSYS	SBS	.0		DEQW	
	USERPCF	USER	INT	.0	CMD-STRSST	DEQW	
	USERPCI	USER	INT	.2	CMD-DSPLOG	DSPW	
	QPADEV0006	A960303A	INT	.0	CMD-WRKSYSSTS	RUN	
	QPADEV0016	A960303B	INT	.0	CMD-DSPMSG	DSPW	
	QPADEV0017	A960303B	INT	.0	MNU-MAIN	DSPW	
	QPADEV0021	A960303C	INT	.2	CMD-WRKQRY	DSPW	
							More
==>							

Figure 8. WRKACTJOB after Pressing PF21

More information is displayed after pressing the PF11 (Display elapsed data) key:

3.4 osystem/Job ATCH 4N	Elapsed <b>Type</b> SBS	Poo1	Pty	:22:42 CPU	Int	ve job			
ATCH		0			111 L	кэр	AuxI0	CPU %	
1N		2	0	.6		•	3	.0	
	SBS	2	0	2.9			1	.0	
JSERPC	EVK	2	20	.0			0	.0	
JSERPC	EVK	2	20	.0			0	.0	
23ARTYC	EVK	2	20	.1			0	.0	
23ARTYC	EVK	2	20	.0			0	.0	
٢L	SBS	2	0	1.0			6	.0	
)JSCCPY	BCH	2	10	.1			78	.0	
)SYSSCD	BCH	2	10	.3			0	.0	
NTER	SBS	2	0	2.8			0	.0	
JSERPCF	INT	4	20	2.7	0	.0	0	.0	
JSERPCI	INT	4	20	14.7	140	.2	428	.2	
PADEV0006	INT	4	20	15.6	19	.1	218	.0	
PADEV0016	INT	4	20	21.0	0	.0	0	.0	
PADEV0017	INT	4	20	.4	0	.0	0	.0	
PADEV0021	INT	4	20	17.8	160	.0	524	.2	
									More
	223ARTYC 223ARTYC 23ARTYC 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2	223ARTYCEVK223ARTYCEVK223ARTYCEVK223ARTYCBCK21000000000000000000000000000000000000	223ARTYCEVK2223ARTYCEVK2223ARTYCEVK221SBS220JSCCPYBCH220JSCCDBCH221SERPCFINT4JSERPCIINT4PADEV0006INT4PADEV0016INT4PADEV0017INT	223ARTYC       EVK       2       20         210       SBS       2       0         QSYSSCD       BCH       2       10         NTER       SBS       2       0         JSERPCF       INT       4       20         QPADEV0006       INT       4       20         QPADEV0016       INT       4       20	223ARTYC       EVK       2       20       .1         223ARTYC       EVK       2       20       .0         223ARTYC       EVK       2       20       .0         CL       SBS       2       0       1.0         QJSCCPY       BCH       2       10       .1         QSYSSCD       BCH       2       10       .3         NTER       SBS       2       0       2.8         JSERPCF       INT       4       20       2.7         JSERPCI       INT       4       20       14.7         QPADEV0006       INT       4       20       15.6         QPADEV0016       INT       4       20       .4	223ARTYC       EVK       2       20       .1         223ARTYC       EVK       2       20       .0         7L       SBS       2       0       1.0         QJSCCPY       BCH       2       10       .1         QSYSSCD       BCH       2       10       .3         NTER       SBS       2       0       2.8         JSERPCF       INT       4       20       2.7       0         JSERPCI       INT       4       20       14.7       140         QPADEV0006       INT       4       20       15.6       19         QPADEV0016       INT       4       20       .4       0	223ARTYC       EVK       2       20       .1         223ARTYC       EVK       2       20       .0         7L       SBS       2       0       1.0         QJSCCPY       BCH       2       10       .1         QSYSSCD       BCH       2       10       .3         NTER       SBS       2       0       2.8         JSERPCF       INT       4       20       2.7       0       .0         JSERPCI       INT       4       20       14.7       140       .2         QPADEV0006       INT       4       20       15.6       19       .1         QPADEV0016       INT       4       20       .4       0       .0	223ARTYC       EVK       2       20       .1       0         223ARTYC       EVK       2       20       .0       0         223ARTYC       EVK       2       20       .0       0         223ARTYC       EVK       2       20       .0       0         7L       SBS       2       0       1.0       6         QSCCPY       BCH       2       10       .1       78         QSYSSCD       BCH       2       10       .3       0         NTER       SBS       2       0       2.8       0         JSERPCF       INT       4       20       2.7       0       0         JSERPCI       INT       4       20       14.7       140       .2       428         QPADEV0006       INT       4       20       15.6       19       .1       218         QPADEV0016       INT       4       20       .4       0       0	223ARTYC       EVK       2       20       .1       0       .0         223ARTYC       EVK       2       20       .0       0       .0         QSSCPY       BCH       2       10       .1       78       .0         QSYSSCD       BCH       2       10       .3       0       .0         VTER       SBS       2       0       2.8       0       .0         JSERPCF       INT       4       20       14.7       140       .2       428       .2         QPADEV0006       INT       4       20       15.6       19       .1       218       .0         QPADEV0016       INT       4       20       .4       0       .0       0

Figure 9. WRKACTJOB after Pressing PF11

You may place the cursor on any column and arrange the display in a descending sequence, for example:

- CPU %
- Response time
- · DISK I/O

CPU 🦻	k: 3.4 E	lapsed	time:	00:	22:56	Acti	ve job	s: 11	9
0pt	Subsystem/Job	Туре	Poo1	Pty	CPU	Int	Rsp	Aux10	CPU %
	USERPCI	INT	4	20	14.7	142	.2	431	.2
	QPADEV0006	INT	4	20	15.8	21	.1	228	.0
	QPADEV0021	INT	4	20	17.9	161	.0	524	.2
	QPADEV0017	INT	4	20	.4	0	.0	0	.0
	QPADEV0016	INT	4	20	21.0	0	.0	0	.0
	USERPCF	INT	4	20	2.7	0	.0	0	.0
	X2507	BCH	2	40	2.5			25	.0
	X2506	BCH	2	40	.0			0	.0
	TCPIPLOC	BCH	2	40	.0			0	.0
	TARGET2	BCH	2	40	.0			0	.0
	TARGET1	BCH	2	40	.0			0	.0
_	SCPF	SYS	2	40	38.9			24	.0
	SYSTEM49	BCH	2	40	.1			0	.0
	SYSTEM40	BCH	2	40	.0			0	.0
	ARHIPPA3	BCH	2	40	.0			0	.0
	SYSTEM12	BCH	2	40	.0			0	.0
===>									More

Figure 10. WRKACTJOB Sequenced by Response Time

Pay attention to the following subjects:

- · Is a communications job consuming a relatively great deal of CPU?
- · Are there any communications jobs creating lots of I/O?
  - If there is, display the job by entering a number five in front of the job and you receive the "Work with Job" display.
  - Are there many files opened?
  - Are there many logical files opened?
  - Can a similar task be done on a locally attached terminal?
  - Is the response time the same in both cases?
  - If it is, go and see what the application is doing.
  - Can the application itself be modified?

#### 2.6 Using WRKDSKSTS

The Work with Disk Status display shows performance and status information about the disk units on the system. Type the WRKDSKSTS command on the command line and press the Enter key. The Work with Disk Status display is shown:

		Size	%	I/0	Request	Read	Write	Read	Write	%
Unit	Туре	(M)	Used	Rqs	Size (K)	Rqs	Rqs	(K)	(K)	Busy
1	6606	1967	82.0	.0	.0	.0	.0	.0	.0	0
1	6606	1967	82.0	.0	.0	.0	.0	.0	.0	0
3	6606	1475	75.9	.0	.0	.0	.0	.0	.0	0
4	6606	1475	76.0	.0	.0	.0	.0	.0	.0	0
5	6606	1967	76.0	.0	.0	.0	.0	.0	.0	0
6	6606	1967	76.0	.0	.0	.0	.0	.0	.0	0
7	6606	1475	75.9	.0	.0	.0	.0	.0	.0	0
8	6606	1475	76.0	.0	.0	.0	.0	.0	.0	0
										Botton

Figure 11. The WRKDSKSTS Display

**Note:** Before observing disk status, have your system tuned according to either Figure 7 on page 20 or as described in Chapter 14 in the *Work Management Guide*.

When viewing the Work with Disk Status display, pay attention to the percent busy data that is actually the estimated percentage of time the disk unit is being used during the elapsed time. This estimate is based on:

- The number of I/O requests
- · The amount of data transferred
- · The performance characteristics of the type of disk unit

Each unit (actuator) should be less than 50% busy. An **actuator** is the device within an auxiliary storage device that moves the read and write heads. If each unit is between 50% and 70% busy, you may experience variable response times. In case all the units are more than 70% busy, the amount of actuators is inadequate for the workload in the system. If you have a well-tuned system with actuators exceeding the 50% busy guideline, increase the number of disk actuators.

It is possible to experience unacceptable performance even if only one actuator exceeds the 50% busy guideline. This usually happens when frequently-used data is placed on a single actuator. If this happens on your system, use the Performance Tools/400 licensed program to run the disk report to find out which data is frequently used. After identifying the data causing the bottleneck, you can save the data, delete the data, and restore the data to spread it across all of the actuators.

A batch job accessing the data can cause a short time period of an actuator exceeding the 50% guideline. If the data is not concentrated on a single actuator, you notice the high percentage of the utilization moving from one unit to another unit.

**Note:** Please remember that observation periods of less than five minutes usually do not provide reliable results.

To notice either improving or degrading trends in the disk performance, observe the historical data created from the regularly collected performance data.

#### 2.7 WRKSYSACT Command

This command is a part of the Performance Tools/400 licensed program and is actually an enhancement of the Work with Active Jobs display. It is the only tool that shows both external jobs and internal tasks at the same time on the display. By default, the jobs are sequenced by CPU usage but you can also sequence the display by I/O.

- · Are there any communications related modules consuming CPU?
- · Are there any communications related modules consuming Disk?
  - If the answer is yes, contact your service provider to find out if there are any Program Temporary Fixes available for these modules.

#### – Notice! -

The performance statistics reported by this function represent activity that has occurred **since a previous collection**. This implementation may be different from other system functions that generally provide cumulative values until specifically reset.

If the Performance Tools/400 licensed program is installed on your system, enter the WRKSYSACT command on any command line to receive the following display:

Elap	matic refres sed time						 til		.6
• •	e options, pr Monitor job		th iob	0	2	3	4		
1	-	5 WOLK WI	CH 305	-	E	Total	Total		
	Job or				CPU	-	Async	PAG	
)pt_	Task	User	Number	Pty		-	I/0	Fault	
_ 5	QPADEV0006	A960303A	060789	1	.9	0	0	0	
_	QPADEV0021	A960303C	060812	20	.5	0	0	0	
_	QTGTELNETS	QTCP	060229	20	.4	2	0	1	
_	QJSCCPY	A960303A	060839	10	.1	0	1	0	
_	VTMTS1			0	.1	0	0	0	
	IPR2050103			0	.1	0	0	0	
_	SMP00006			0	.1	15	0	0	
_	CFINT1			0	.1	0	0	0	
									Botto

Figure 12. WRKSYSACT Display View 1 is a Summary Display

Notes:

**1** This column displays the run priority of the job.

2 This column displays the CPU utilization of the job.

This column displays the total amount of **synchronous** I/O the job is causing. Having a low amount of synchronous I/O is important because a job has to **wait** for the completion of the synchronous I/O operation before continuing.

This column displays the total amount of **asynchronous** I/O caused by the job. The amount of asynchronous I/O is of less importance than the amount of synchronous I/O because a job can continue processing immediately after requesting an asynchronous I/O. In a way, an asynchronous I/O is similar to a batch job; after having submitted it, you do not have to wait for its completion.

**5** By entering "1" in this field, you can monitor this job **only** and by entering "5", you access the "Work With Job" display. You can monitor up to 20 jobs and tasks at a single time.

**6** By pressing the PF11 key, you can select from three different displays: the summary, Synchronous I/O details, and Asynchronous I/O details.

Press the PF24 key for additional function keys to use. Press the PF14 key to display jobs only and exclude the information for tasks. Press the PF15 key to display tasks only and exclude the information for jobs. You can also use the PF16 key to display the jobs/tasks in a descending order of disk I/O operations.

Elap	matic refres sed time	: 00	:00:03	•••	Overall	CPU u	 til	: <u>-</u> 3	
Type	options, pr	ess Enter.							
• •	Monitor job		th job				<b>C</b>		
	Job or				CPU	DB	Syncn DB	ronous Non-DB	
0pt		User	Number	Ptv		Read			
-	QPADEV0006			1		0	0	0	0
_	QPADEV0021	A960303C	060812	20	.5	0	0	0	0
_	QTGTELNETS	QTCP	060229	20	.4	0	0	2	0
_	QJSCCPY	A960303A	060839	10	.1	0	0	0	0
_	VTMTS1			0	.1	0	0	0	0
_	IPR2050103			0	.1	0	0	0	0
_	SMP00006			0	.1	0	0	0	15
_	CFINT1			0	.1	0	0	0	0
									Botto

Figure 13. WRKSYSACT Display View 2, Details of Synchronous I/O

DNOUS
onous
onous
on-DB Non-DB
Read Write
0 0
0 0
0 0
0 0
0 0
0 0
0 0
0 0
0 0

Figure 14. WRKSYSACT Display View 3, Details of Asynchronous I/O

# Chapter 3. Using Performance Tools/400

Performance analysis is a method of investigating, measuring, and correcting deficiencies so that system performance meets the user's expectations. The problem solving cycle should be similar to:

- 1. Understand the symptoms of the problem.
- 2. Use tools to measure and define the problem.
- 3. Isolate the cause.
- 4. Correct the problem.
- 5. Use tools to verify the correction.

Once the apparent cause (or causes) is isolated, you can propose a solution. The solution can be something simple such as tuning the storage pools, or a complex one that requires application recoding.

To achieve the optimum performance, you must understand the relationships between critical system resources and attempt to balance the use of the resources that are the CPU, the main storage, the disk units, and the communication lines. However, any improvement can only come through analyzing the critical resources and contention for both system and application objects.

# 3.1 System-Wide Problem Analysis

The ways to analyze the system-wide performance are:

- Using the CL commands as described in Chapter 2, "Using CL Commands to Find Performance Problems" on page 11.
- Using the Performance Tools/400 reports and displays as described in this chapter.

# 3.1.1 Advisor

The Advisor provides the easiest way of evaluating the performance data. It is a tool located between automatic system tuning and performance reports. You can either enter the Analyze Performance Data (ANZPFRDTA) command or choose option 10 on the PERFORM menu to start the advisor.

The Advisor uses data collected by the Performance Monitor to recommend performance tuning changes, and it can also point out other problems affecting system performance. You can use the Advisor to analyze the performance data collected from other systems.

The Advisor analyzes one member set of performance data at a time. Select the member that was collected when the performance problem occurred.

It is easy to find the right time interval to analyze by using the display histogram function. For example, if you need a time interval when the transactions had the longest response times, select the transaction response time option on the Display Histogram display. From the chart, select a time interval by moving the cursor to that interval, type 1, and press the Enter key. The Advisor analyzes the

performance data collected during that particular interval and gives you recommendations and conclusions.

The Advisor analyzes performance data, including:

- · Storage pool sizes
- · Activity levels
- · Disk and CPU utilization percentages
- · Communications line utilization percentages and error rates
- · IOP utilization percentages
- Unusual job activities such as exceptions or excessive use of system resources
- Interactive trace data (when collected)

#### - Note! -

To avoid causing a serious performance impact while running the Advisor interactively, start the advisor by entering the ANZPFRDTA command. Press the PF4 (prompt) key followed by the PF10 (additional parameters) key to change the value of the DATATYPE parameter from \*ALL to \*SAMPLE. If you need to analyze the trace data with Advisor, consider submitting the job or running it when your system has a light workload.

You can either select all of the intervals or a subset of the time intervals for analysis. You can run the Advisor either interactively or as a batch job. The output of using the Advisor is grouped under the following headings:

- Recommendations
- Conclusions
- Interval conclusions

All of the headings have information about:

- · CPU utilization of high priority (with a run priority 20 or higher) jobs
- Performance analysis of interactive transactions by using the trace data collected with the performance monitor
- Main storage utilization and Wait-To-Ineligible versus Active-To-Wait ratio. This addresses page faulting and activity-level analysis.
- · Disk utilization and other disk activities
- IOP utilization
- · System impact of authority lookups
- System impact of exceptions
- · Communication line utilization and error percentages

#### The Advisor does not:

- Make any recommendations for modifying specific programs to improve their performance.
- Analyze noninteractive trace data.

The recommendations may include changes to the system's basic tuning values that can improve performance. They also may list problems that (when solved) can solve other performance problems.

The conclusions display lists conditions that may have affected performance during the data collection. Good examples of conclusions are:

- Thresholds reached
- · Save and restore activities
- · Communications line errors

You can use the conclusions that are not related to recommendations as guides for collecting more performance data or for adjusting the system.

The Advisor may suggest changes to pool sizes and activity levels. These changes are not made dynamically but only after the operator tells the advisor to make the changes or to ignore the recommendations. The tuning is done by pressing the PF9 key on the display recommendations display. Pool and activity level changes can be made to all of the main storage pools on the system.

The Advisor also suggests which report to run to get more information for your problem analysis. See the "Advisor" chapter of the *Performance Tools Guide*, SC41-4340, for detailed information.

#### 3.1.2 Performance Graphics

Performance data collected by the performance monitor can also be displayed in a graphical format. The graphs can either be displayed interactively, or printed or plotted to hardcopy. The printing option of the graphs is recommended because the graphics on the paper are more descriptive. The best printouts are created by using an \*IPDS printer. If you must use a conventional printer, please check the PAGESIZE parameter of the printer file QPPGGPH in the QPFR library.

You can enter the DSPPFRGPH command or the DSPHSTGPH command, or you may choose option 9 (Performance graphics) on the PERFORM menu. You have two types of performance graphics to choose from:

• Option 1. Display performance data graphics:

Performance data graphs are graphs that:

- Use select/omit criteria.
- Are run against the original performance data.
- Are used to show the performance during one data collection only.
- · Option 2. Display historical data graphics:

Historical data graphs are graphs that:

- Use performance data from several collections.
- Are useful when tracking performance trends.

The Display Historical Graph (DSPHSTGPH) command produces a graph from the historical data created by the Create Historical Data (CRTHSTDTA) command. The DSPHSTGPH command is intended to give you a historical perspective of the system performance in a graphical presentation.

You must run the Create Historical Data (CRTHSTDTA) command for each member that you want to include in the graph. If no historical data has been created for a member, it is not included in the graph unless you specify \*YES on the CRTHSTDTA parameter of the DSPHSTGPH command. You can use the IBM-supplied format (in the QPFRDATA library) or you can create a format of your own.

#### 3.1.3 Print Activity Report

The print activity report (PRTACTRPT) command creates a report using the performance data collected by the WRKSYSACT command.

You may produce two different reports:

#### Summary report

This prints out a report showing the top 10 list of:

- · CPU intensive jobs and tasks
- I/O intensive jobs and tasks

#### **Detailed report**

 $\overline{}$ 

This prints out either:

- Selected numbers of entries for each interval specified by the PERIOD parameter.
- The number of entries specified by the NBRJOBS parameter that are listed in the order specified by the SEQ parameter.

The following example shows a summary report:

						Sys	tem Act	ivity R	eport					10/2	22/96 12:45
Member Library	: QP	FRDATA	Repor	⁺t Type		. : SU	IMMARY		ion ase		3 6.0				Page 22/96 12:42 22/96 12:44
Order by CP	U Utilizat	ion:													
				CPU		Total				onous I,				onous I/	
Job or Task	User	Number	Pty	Util	Sync I/O	Async I/O	PAG Fault	DB Read	DB Write	Non-DB Read	Non-DB Write	DB Read	DB Write	Non-DB Read	Non-DB Write
1456	user	Nulliber	r L y		1/0	1/0	Fault	Reau	write	Redu	write	Redu	write	Reau	write
QPADEV0002	A960303A	059734	20	2.1	574	364	232	0	0	571	3	0	0	358	6
SMA10004			0	1.6	1	0	0	0	0	0	1	0	0	0	0
SMA10007			0	1.5	0	0	0	0	0	0	0	0	0	0	0
WRKSYSACT	A960303A	059747	1	.5	0	0	0	0	0	0	0	0	0	0	0
IOSTATSTAS	K		0	.3	0	0	0	0	0	0	0	0	0	0	0
CFINT1			0	.3	0	0	0	0	0	0	0	0	0	0	0
QBRMNET	QPGMR	059270	30	.2	0	0	0	0	0	0	0	0	0	0	0
QTGTELNETS	QTCP	059276	20	.1	0	0	0	0	0	0	0	0	0	0	0
IOP6512010	003		0	.1	0	0	0	0	0	0	0	0	0	0	0
SMXCSPRVSR			0	.0	0	0	0	0	0	0	0	0	0	0	0
Order by To	tal I/O:														
Job or				CPU	Sync	Total Async	PAG	DB	-Synchr DB	onous I,	Non-DB	DB	Asynchr DB	onous I/	Non-DB
Task	User	Number	Ptv	Util	I/O	I/O	Fault		Write	Read	Write	Read		Read	Write
1836					1/0				write		wille		wille		wille
QPADEV0002	A960303A	059734	20	2.1	574	364	232	0	0	571	3	0	0	358	6
QTGTELNETS	QTCP	059276	20	.1	0	0	0	0	0	0	0	0	0	0	0
WRKSYSACT	A960303A	059747	1	.5	0	0	0	0	0	0	0	0	0	0	0
SMAI0007			0	1.5	0	0	0	0	0	0	0	0	0	0	0
SMA10004			0	1.6	1	0	0	0	0	0	1	0	0	0	0
QBRMNET	QPGMR	059270	30	.2	0	0	0	0	0	0	0	0	0	0	0
IOSTATSTAS	ĸ		0	.3	0	0	0	0	0	0	0	0	0	0	0
IPR0050103			0	.0	0	0	0	0	0	0	0	0	0	0	0
10P9162010 VTMTS1	001		0	.0 .0	0	0	0	0	0	0	0	0	0	0	0
Job or Task		Job or tas	•		0	0	0	0	0	0	0	0	0	0	0
User		User profi			d with	the iob									
Number		Job number				0									
Pty		Job or tas	k prid	ority											
CPU Util		Percent of	CPU u	used by	the jo	ob or ta	ısk								
Total Sync	I/0	Total numb	er of	synchr	onous 1	/O oper	ations								
Total Async		Total numb													
PAG Fault		Number of	fault	s invol	ving th	ne proce	ess acce	ss grou	р						
Synchronous															
DB Read		Number of													
DB Write		Number of	-												
Non-DB Re Non-DB Wr		Number of													
Non-DB Wr Asvnchronou		Number of	synchi	ronous	non-dat	abase W	rites								
DB Read		Number of	asvnel	ronous	databa	ico road	le.								
DB Kead DB Write		Number of	-												
Non-DB Re		Number of													
							writes								

Figure 15. An Example of PRTACTRPT Output

Notes:

The upper part of the list shows the jobs sequenced by the CPU utilization.

The lower part of the list shows the jobs sequenced by the disk I/O.

#### 3.1.4 Performance Tools Reports

Printing performance reports extracts information from previously collected performance data. You can review the performance of specific jobs or transactions, or other performance elements. This can be done by choosing option 3 (print performance report) on the PERFORM menu. This leads you to the print performance report display. You may also issue any of the following commands:

PRTSYSRPT	Print System Report
PRTCPTRPT	Print Component Report
PRTTNSRPT	Print Transaction Report
PRTLCKRPT	Print Lock Report
PRTJOBRPT	Print Job Interval Report
PRTPOLRPT	Print Pool Report
PRTRSCRPT	Print Resource Report
PRTTRCRPT	Print Batch Job Trace Report

Each of these commands provides you with a different level of information. The following reports are produced from the **sample data** collected with the performance monitor:

- · System report
- Component report
- Job report
- · Pool report
- Resource report

If you collected trace data with the performance monitor, you can produce:

- · Transaction report that can further be extended to:
  - Transaction detail report
  - Transition detail report
- · Lock report
- Batch job trace report

In the early stages of problem determination, print only the first two reports (system report and component report). These help you to determine whether you need to analyze the problem in more detail or not.

The system report and the component report provide information to evaluate your system-wide performance. Pay attention to the following items:

- · Average response time in the system report workload
- Number of transactions for total run time and per hour
- CPU percent for all levels of priority and also cumulative. The cumulative value up to and including priority 20 should not exceed 60 per cents provided no queries are run interactively.
- Number of database/non-database page faults in each storage pool

- Disk (percentage used and utilization of the actuators)
- · Communication lines traffic and IOP utilization

#### 3.1.4.1 System Report

In the system report, you find the basic set of information to compare against your predefined performance objectives and the guideline tables as shown in *Work Management Guide* manual.

- The system overview workload and resource utilization part shows you what the system workload is and what is the cost of processing the workload. The CPU utilization shows the percentage of processing unit time used by each job type. According to the guidelines, the total CPU utilization should not continuously exceed 81% (for four-way processors). See Table 16 on page 379 for other CPU categories.
- Check the percent of space in use and the utilization of disk on the utilization part of report; compare those values to Table 16 on page 379. Column "ops per second" and number of disk IOPs installed on the system show whether or not you are overdriving the IOPs. On a normal distribution of disk operations, each IOP's average should be between 30 to 60 per second.
- Avg util and max util column on the communication part gives you the average and maximum percentage of the line capacity used during the measured interval. Compare those values to Table 16 on page 379.

If you find any discrepancies between the system performance report and the guidelines, go to the component report to find out whether you need to do a problem analysis on the system performance.

#### 3.1.4.2 Component Report

The component report provides information about the same components as the system report but at a greater level of detail.

- Component interval activity shows the use of CPU, disk, and pools at selected time intervals. For example:
  - Is the transaction rate high in all the intervals?
  - Is the same disk unit suffering from high utilization during all of the intervals?
  - Which of the memory pools has the highest faulting rate?
- Job workload activity shows the activities of each job. You need to perform problem analysis on a particular job if you find that a job used most of the disk I/O operation (under column disk I/O) or CPU utilization (CPU util).
- In the pools storage activity part, you need to look at the columns DB faults and Non-DB faults. Compare those values to Table 18 on page 379 and Table 19 on page 380. Wait-to-ineligible need not be zero all of the time, but it must be less than .25 for good performance. See Table 20 on page 380 for the guidelines of activity level changes.
- Disk activity shows average disk activity per hour and the capacity of each disk. Batch processing may cause a high utilization of individual disk drives. Batch sequential processing can stay on one drive for some time. Interactive performance is not normally degraded if the batch jobs are running in a storage pool of their own. However, if there are many interactive jobs, a high disk utilization can indicate a performance problem.

 The database journal summary includes user journal and system journaling of access paths disk write counts. No guidelines are provided so you must record this information over time to determine any increase in the disk I/O as a result of journaling.

If you need more data on your current system performance before you decide to analyze, issue the WRKSYSACT command. Refer to Chapter 2, "Using CL Commands to Find Performance Problems" on page 11 for more information about that command.

Based on this information, you can decide if there is a problem with the overall performance of the system.

# 3.1.5 Memory Performance Displays and Reports

You cannot measure the amount of memory currently in use; you only can observe the amount of faults that **indirectly** tell you whether there is enough main storage or not. The tools used for finding out the memory performance are:

• The WRKSYSSTS command

The Work with System Status display shows you in real time what the demand for main storage is. See Chapter 2, "Using CL Commands to Find Performance Problems" on page 11 for information about using this command.

• The DSPPFRDTA command

The Display Performance Data command provides an interactive interface to the previously collected data given in the system, component, and interval reports.

• DSPACCGRP command and ANZACCGRP command

These commands show for a job or a group of jobs:

- The temporary storage used
- Open files
- File I/O counts
- Active programs

The Display command and Analyze Access Group command provide data on the size of the "currently in use" part of the PAG. The PAG size can be affected by reducing the number of active programs, the number of display and database files open, and the number of display formats and database buffers allocated for the files. See Section 3.4.2.1, "DSPACCGRP and ANZACCGRP" on page 51 for more information about displaying and analyzing the access groups.

Table 5 (Page 1 of 2).       Memory Utilization Information					
Resource Description	Where to Look	Compare With			
Machine pool NDB page fault	System Report: Storage Pool Utilization, WRKSYSSTS, Advisor	Table 17 on page 379			
Sum of DB and NDB page faults for each pool	System Report: Storage Pool Utilization, WRKSYSSTS, Advisor	Table 18 on page 379			

Table 5 (Page 2 of 2).       Memory Utilization Information						
Resource Description	Where to Look	Compare With				
Sum of DB and NDB page faults in all pools	System Report: Storage Pool Utilization, WRKSYSSTS, Advisor	Table 19 on page 380				
Pool size By interval	Pool Report: Pool Activity					
The pool with the highest fault rate for each time interval	Component Report: Component Interval Activity					

# 3.1.6 CPU Performance Reports and Displays

- System report
- Component report
- Transaction report

If the interactive utilization percentage of CPU is always more than 85, try modeling to see if a faster CPU can help.

• The WRKACTJOB command:

This command allows you to determine:

- What is the utilization percentage of CPU?
- How much does each job use CPU, both in terms of percentage and for how long a time total?
- The WRKSYSACT command

# 3.1.7 A Brief Discussion About Program Exceptions Consuming CPU

Pre-V3R6 systems report a number of exceptions types by the performance tools Component Report and the Advisor. The reports showed the number of exceptions per second per interval that occurred; the Advisor shows the percent of the CPU used by exceptions in an interval. In addition, there are a set of charts that show the percent of the CPU used as a result of "n" number of exceptions by type per second.

From V3R6, some of the exceptions have been eliminated for one reason or another, and some of the exception CPU overhead has changed as a result of the machine implementation or the type of program in which they occur.

#### 3.1.7.1 Program Exceptions

- EAO These are gone from V3R6 as a result of the difference in PowerPC hardware addressing structure. Any data field or report that had them has been changed to indicate their absence. See Section 3.1.7.3, "Removal of Effective Address Overflow (EAO) Exceptions in V3R6" on page 36 for more details on why we used to have EAO exceptions and why now when we use PowerPC technology and 64-bit addressing, they no longer occur.
- **Size** These are the result of an arithmetic operation in which the receiving field is too small for the result. They are an application programming problem and still occur.

The programs should be reviewed and changed to ensure that the proper receiver field specification is used or that the programming algorithm is doing the function in a manner to avoid size exceptions. Using Performance Monitor trace data and Transaction Report (PRTTNSRPT RPTTYPE \*TRSIT) may provide additional information about which programs are getting size exceptions.

Verify Verify exceptions occur when trying to resolve an as yet unresolved pointer.

This exception can occur on the RISC machine and is an application programming problem. The program should be changed to ensure that the variable used in a CALL instruction does not change from one use to the next. Use PEX STATS and PEX TRACE to find out where it is occurring.

Authority These can occur on the RISC machine and are the result of a system security setup mismatch.

The same rules apply to fixing these as on pre-V3R6 systems. Use authorization lists instead of group profiles and ensure that objects do not have private authorities on them that are less than the PUBLIC authority. For example, PUBAUT(\*CHANGE) and QPGMR(\*USE) causes authority checking to be done.

**Decimal Data** This can occur on PowerPC AS/400 systems. It is usually related to incorrect data specification in application data migrated from other systems, especially the System/36.

#### 3.1.7.2 CPU Cost Variations

What has changed is the CPU cost for each exception. For the program exceptions that were tested (Authority, Size, Verify) that can occur on the RISC machine, the CPU costs varied depending on the type of program model used when the program was built.

There are three different options that affect the cost:

- 1. OPM (Original Program Model)
- 2. ILE with DFTACTGRP(\*YES) where the activation group is not already created
- 3. ILE with DFTACTGRP(\*NO)

The results of testing the different exceptions and program models showed inconsistent variations in the CPU/exception cost. For that reason, there are multiple costs shown in this document for each type of exception.

The challenge is to know what types of programs are generating the exceptions on the machine. The exception reporting mechanism does not discriminate between the types of programs so, in some cases, you have to make an intelligent guess about the possible severity of the problem.

The test results in Appendix I, "Guidelines for Interpreting Performance Data" on page 379 were generated by running each type of program on an AS/400 model 500-2142. There were two programs for each case, one that did not get the exception and one that did. The results were calculated by computing the difference between the two test cases, calculating the CPU time used per exception, and extrapolating the results to other PowerPC models using the ratio of the relative performance ratings between the measured system model and the other models.

# 3.1.7.3 Removal of Effective Address Overflow (EAO) Exceptions in V3R6

Effective Address Overflow exceptions on the S/38 and CISC AS/400 systems result from two different views of the six-byte address. This address really has two parts, the segment identifier that identifies a unique group of virtual addresses (called a segment or segment group) and an offset that identifies specific locations within the segment.

S/38 hardware was designed with the assumption that the system would use a larger number of smaller segments. Thus, the hardware treated the six-byte address as four bytes of segment identifier and two bytes of offset. This allows over one trillion segments each with a maximum size of 64KB. The software designers felt that the system needed a smaller number of larger segments and treated the address as three bytes of segment identifier and three bytes of offset that allows over 16 million segments each with a maximum size of 16MB.

The hardware detected any operation that spanned a 64K boundary and raised an Effective Address Overflow exception when this happened. According to the hardware's view of the address, this was always a bad thing in that someone had tried to cross from their segment into what was potentially someone else's segment. But due to the software design, this was generally not a problem. For example, a program could be storing a piece of data that crossed from the first 64K of a segment into the second 64K of the segment. (Note that the 16MB segment viewed by the software can contain up to 256 of the 64K "hardware" segments.) Thus, the software needed to look at EAO exceptions and decide if they were bad or not. Because IMPI operations cannot use operands spanning a 64K boundary, this handler also needed to look at the good exceptions and decompose the instruction into pieces that does not span a 64K boundary. For example, a Move Character operation might have a target operand of 10 bytes that spanned a 64K boundary. This move needs to be split into two Move Character operations, one to move the first part prior to the 64K boundary and one to move the second part after the 64K boundary. Needless to say, this software EAO exception handler could and did impact performance at times.

Because the AS/400 PowerPC hardware is a new design using eight-byte addresses, there is no longer a mismatch between the hardware and software views of the address. There is no longer any need for the software handler previously described and no corresponding performance impact. Hence, EAO exceptions are not reported for PowerPC AS/400 system.

Table 6 (Page 1 of 2). CPU Utilization Information						
Resource Description	Where to Look	Compare With				
Interactive CPU	System Report: Resource Utilization Expansion, DSPPFRDTA, Transaction Report	Table 16 on page 379				
CPU Queuing Multiplier	Transaction Report: Job Summary, System Summary Data, System Report	Table 34 on page 386				
CPU Queuing Multiplier by Job Priority	System Report					
Total CPU usage by job type	System Report: Resource utilization expansion					

# 3.1.7.4 Where to Find Information About CPU Usage

Table 6 (Page 2 of 2). CPU Utilization Information						
Resource Description	Where to Look	Compare With				
Total CPU usage by individual jobs	Component report: Job Workload Activity,Transaction Report					
CPU utilization and seconds per job and system task	Transaction Report: Job Summary, System Summary Data	Historical Data				
CPU Usage by Subsystem and Pool by Interval	Pool Report: Subsystem activity	Historical Data				
Job Maximums of CPU, I/O, Transactions and Response Time by Pool	Pool Report: Subsystem Activity					
CPU Time by Job Per Interval	PRTACTRPT, Component Report					
CPU Time by LIC Task Per Interval	PRTACTRPT, Component Report					

Table 7. Information about Exceptions Consuming CPU						
Resource Description	Where to Look	Compare With				
Authority Lookup	Component Report: Exception Occurrence Summary	Table 26 on page 382				
Size (Arithmetic Overflow and Binary Overflow)	Component Report: Exception Occurrence Summary	Table 28 on page 383				
Verify	Component Report: Exception Occurrence Summary	Table 31 on page 384				
	<b>Note:</b> Even though one exception consumes only a relatively small amount of CPU at a time, the cumulative effect of exceptions can add a significant workload to the CPU.					

# 3.1.8 Disk Performance Reports and Displays

- The system report shows you:
  - The disk I/O by job type (batch, system, interactive, pass-through, and so on)
  - The IOP utilization percentage
  - The ASP number and mirrored units
  - The disk unit size
  - The I/O rate per a disk unit
  - The disk IOP and device service time
- The component report shows you:
  - The synchronous and asynchronous disk I/O per second, displayed by interval.
  - The summary of the highest used device in the interval.
  - The synchronous and asynchronous disk I/O per job total.
  - The summary of database journal deposits (entries), bundle (blocks of deposits) writes for both user journaling and for system managed access path protection (SMAPP) support, system access path journal deposits and bundle writes, and access path recovery time estimates.
  - Per interval and by unit:

- The utilization percentage
- The size
- The number of overruns and underruns
- The seek activity
- Transaction report summary report
  - Shows synchronous and asynchronous disk I/O per transaction per job
- · Resource report
  - Shows you by interval:
    - The number of disk I/O per second
    - The number of reads and writes per second
    - The average amount of data transferred per disk I/O
    - The highest utilization and service time disk unit
    - The total disk space used
  - Shows per unit and interval:
    - The unit identification data per disk unit including:
      - Bus
      - IOP
      - ASP
    - The number of reads and writes per second
    - The average data transfer size
    - The unit service time average
    - The IOP service time average
    - The average device I/O queue depth
- Pool report
  - Shows the highest number of disk I/O operations by a job running in a pool during an interval
- The WRKSYSACT command:
  - Shows the number of disk I/O operations by job and LIC task. These are further separated as synchronous and asynchronous operations.
- The WRKDSKSTS command:
  - The Work with Disk Status display shows performance and status information about the disk units on the system. It displays the:
    - Number of units currently on the system
    - Type of each disk unit
    - Size of disk space
    - Percentage of disk space used
    - I/O requests per second
    - Average size of the I/O requests
    - Average number of read and write requests
    - Average amount of data read and written
    - Percentage of time the disk is being used

# 3.1.8.1 Where to Find Information About Disk Performance

Table 8 (Page 1 of 2). Disk Utilization Information							
Resource Description	Where to Look	Compare With					
Disk Arm Utilization	System Report: Disk Utilization, WRKDSKSTS	Table 16 on page 379					

Table 8 (Page 2 of 2). Disk Utilizat	tion Information					
Resource Description	Where to Look	Compare With				
Disk IOP Utilization	Component Report: IOP Utilization	Table 16 on page 379				
Disk Physical I/O per Transaction (Average)	System Report: Resource Utilization, Transaction Report	Table 35 on page 386				
Disk Physical I/O per Transaction per Job.	Transaction Report: Job Summary	Table 35 on page 386				
Synchronous and Asynchronous DB and NDB I/O per Job by Interval	Job Interval Report	Historical Data				
Sync and Async Disk I/O per Job or LIC Task per Interval	PRTACTRPT					
Database journal deposits and bundle writes to user and system (SMAPP) journals	Component Report: Database Journal Summary					
Sync and Async Disk I/O by Subsystems and Pools by Interval	Pool Report: Subsystem activity					

#### Note:

Use the Write, Read, and Total Physical Disk I/O per transaction values shown in Table 35 on page 386 as a "reasonability measure". Verify that any job exceeding the values is performing the work required.

Note that any asynchronous disk I/O performed by the system QDBSRVnn jobs on behalf of a user job are not included in the job's asynchronous I/O totals shown on performance reports.

See Table 36 on page 387 to find where the different types of job and disk I/O activities are counted in.

# **3.1.9 Communications Performance Data**

The performance monitor can optionally collect remote response time data from 5494 remote controllers with Microcode Release 1.1 or later installed on the 5494. Communication IOP and line performance data is always collected.

If you have 5494 workstation controllers included in the data collection, you have information about:

- The number of active workstations on each controller
- The range of response times for the remote workstations
- The average response time for the remote workstations

The Performance Tools/400 system report and resource report list this 5494 response time data. Note that while entering the STRPFRMON command, you must set the RRSPTIME (remote response time) parameter value other than the default \*NONE to have the response time data collected from the active 5494 controllers. A value of \*SYS uses the same response time slots (0-1 seconds, and so on) as for the LRSPTIME (local response time) parameter.

- The component report shows you:
  - The workstation IOP utilization
  - The multifunction IOP utilizations
  - The twinaxial line utilization for local workstation IOPs

It is possible to have either high local workstation IOP utilization and low twinaxial utilization **or** low local workstation IOP utilization and high twinaxial utilization. High IOP utilization can occur if there is heavy use of the text assist functions for an OV/400 editor. High twinaxial utilization can occur if

there is a significant amount of high-speed printer output, Client Access/400 shared folder activities, or file transfer work going on.

- The system report shows you:
  - Both the average and peak line utilization over the report period
- The resource interval report shows communication line details per time interval selected.
- Resource Report:
  - Additional line utilization data by interval
  - Response time counts per "response time buckets" for local workstations and optionally for remote 5494-attached workstations
- Query:
  - The performance tools reports do not include all data or they show certain combinations of data. A common use of a query is to tie together more complex analysis structures such as jobs, pools, lines, and so on.
  - Display Performance Data (DSPPFRDTA) command:
    - Provides an interactive access to information contained in system, component, and resource reports.
  - Work with System Activity (WRKSYSACT) command:
    - LIC communication task activity (CPU, disk I/O, frequency)
  - QSYSOPR message queue:
    - Error failure, threshold, and communication job start and end messages are found in the system operators message queue.
  - QHST log:
    - Error failure, threshold, and communication job start and end messages are found in the history log.
  - Communication error log:
    - Communication errors are logged in the system error log regardless of Performance Monitor activity. Each entry is time stamped. Use the STRSST command to view the logged data. Assistance from your service provider in interpreting the log data is needed in most cases. See Chapter 5, "Using System Service Tools" on page 71 for information about using the service tools.

# **3.1.9.1** Where to Look for Information About Communications Performance

Table 9 (Page 1 of 2). Line and IOP Utilization Information							
Resource Description	Where to Look	Compare With					
Local WS IOP	Component Report: IOP Utilization	Table 16 on page 379					
Multifunction IOP	Component Report: IOP Utilization	Table 16 on page 379					
Communication IOP	Component Report: IOP Utilization	Table 16 on page 379					

Table 9 (Page 2 of 2). Line and IC         Resource Description	Where to Look	Compare With		
File Server IOP	Component Report: IOP Utilization	IOP reported is the one for exchanging data between the Integrated PC Server and AS/400 Disk. No guideline available at this time. Attached LAN lines are reported under remote lines, LAN lines. See Appendix F, "Integrated PC Server Query" on page 345 for information on cache read/write hit and 486 CPU utilization percentage guidelines.		
Remote Lines, LAN Lines	System Report: Communication Summary, Resource Report	Table 16 on page 379		
Communications I/O Count by Job Type	System Report: Resource Utilization			
Line Utilization and Activity (input/output)	System Report: Communications Summary	Historical Data		
Communications Gets and Puts per Transaction by Job type	System Report: Resource Utilization Expansion			
Communication I/O Per Job	Component Report: Job Workload Activity			
Local and Remote Workstation Response Time Distribution	Component Report: Local Work Stations - Response Time Buckets			
Local and Remote Workstation Response Time Distribution By Interval	Resource Report: Local Workstation IOP Utilization and Remote Workstation Response Times			

# 3.1.10 Activity Level Performance Reports and Displays

- System report:
  - Displays Job State changes (movement in and out of activity level) per pool for the total collection period.
- Component report shows you:
  - Job State changes by pool summarized over selected time intervals.
- Pool report shows you:
  - Job State changes by subsystem and pool for each selected time interval.
  - Pool activity level for each interval. This may change during the time period due to operator action, an OEM automatic tuner, or the OS/400 automatic tuning through QPFRADJ. The value shown is the value at the time of the sample.
- The DSPPFRDTA command:
  - Provides interactive access to database including system, component, and pool interval report data.

- The WRKSYSSTS command
  - Provides real-time information on activity level usage and job state changes. See Chapter 2, "Using CL Commands to Find Performance Problems" on page 11 for information about using this command.

# 3.1.11 Comparing with Activity Level Guidelines

Table 10. Activity Level Information							
Resource Description	Where to Look	Compare With					
Activity Level for *BASE and Spooled Writer pool	System Report: Storage Pool Utilization, WRKSYSSTS, ADVISOR	Figures 14-8, 14-9, and 14-10 in the <i>Work</i> <i>Management Guide</i> , page 14-10.					
QINTER Activity Level.	System Report: Storage Pool Utilization, WRKSYSSTS, ADVISOR	See Table 22 on page 380.					

# 3.1.12 Comparing W-I and A-W Ratio Guidelines

Table 11. W to I and A to W Ratio Information						
Resource Description	Where to Look	Compare With				
W-I/A-W	System Report: Storage Pool Utilization, WRKSYSSTS	Table 20 on page 380				

#### 3.2 User Level Problem Analysis

The first step in determining a user level problem is to identify the affected user or users. The following questions are good examples of how to start the user level problem analysis:

- Are all of the users affected by poor performance or is there only a small, easily-defined group of users affected?
- · What do these users have in common?
- Are they using the same application?
- Are they sharing the same (possibly small) memory pool?
- · Is there only one user suffering from poor performance?
  - How does this user differ from the rest of the users?

After answering these questions, the solution is much closer.

User level problem analysis is done by:

• Using the WRKACTJOB command:

For information about using this command, see Section 2.5, "WRKACTJOB Command" on page 21.

• Using the WRKSYSACT command:

For information about using this command, see Section 2.7, "WRKSYSACT Command" on page 24.

- Using DSPPFRDTA command
- Analyzing Performance Tools/400 reports.

#### 3.2.1 Print Job Summary Report

Find out if the user appears in the "job statistics" section of the "job summary report". Next look at the "individual transaction statistics" section to see what programs are used. Is this user the only one using this program? If no, is this user the only one with a performance problem? If all of the users of this program have problems with performance, see Section 3.3, "Application Level Problem Analysis" for more information.

Refer to the "system summary data" section, ("analysis by interactive response time") to see how your response time objectives are met.

#### 3.2.2 Print Transaction Summary Report

The transaction summary report provides you with information about response times, CPU utilization, and disk I/O by job. This report can be used for both user-level problem analysis and application-level problem analysis.

If the job summary section shows jobs that have high response times, high disk I/O activity, or high CPU utilization, use the transaction detail report to investigate further. However, **always print the summary report first** because both the transaction detail report and the transition report provide detailed information. By using the summary report, you can choose to print only the intervals or users that have performance problems instead of printing thousands of pages of irrelevant data.

#### 3.3 Application Level Problem Analysis

Is there a problem with one application only?

Are there only some operations that are slow?

Application level analysis is based on the Performance Tools/400 reports.

See the "Interactive Program Statistics" section of Job Report for the top 10 programs with the highest resource utilization such as:

- CPU per transaction
- Disk I/O per transaction
- · Response time per transaction
- Database reads/writes per transaction
- Non-database reads/writes per transaction

Compare this information with Table 35 on page 386 to see if values are acceptable.

Please note that values shown are guidelines only so you must verify that each transaction exceeding the values is performing the work required.

# 3.3.1 Charging Resource Utilization to Interactive Program

The Job Summary report, Individual Transaction Statistics, and Interactive Program Statistics data list several categories of performance metrics commonly referred as the 10 worst. Some of these metrics are the transactions with the longest CPU service time and transactions with the longest lock wait time. Each of these categories identifies a program that is charged with consuming that resource.

The program name listed is the program first doing a workstation output operation following the receipt of the workstation input. The receipt of the input is used to signal to the system the beginning of a transaction. In many application environments, this accurately reflects the program doing the work. On the other hand, in many application environments, the program actually consumes the system resource. Therefore, further analysis of the identified program (and programs it called) is required to find out what program really consumes the resources.

A good example of this kind of situation is the OS/400 User Interface Manager program appearing in the list showing the worst 10 programs. Frequently the QUIINMGR and QUIMNDRV are in this list even though these programs are almost never responsible for high consumption of a system resource. Usually, the functions and programs called from a menu display are the ones responsible for consuming the system resources. You need to choose one specific job and print the Transition Detail Report to see what is happening **below** the QUIxxxxx program falsely accused of stealing the systems resources.

One example of this false interpretation is doing a Send Network File command from any system menu. The SNDNETF function does no workstation I/O but it may lock the display station while copying a file to an internal space (on disk) for a later delivery done by SNADS functions. When the SNDNETF command completes its work, a user receives a message indicating the results and this message is written by QUIINMGR.

# 3.3.2 Print Transaction Summary Report

From the transaction report, you can select those programs that show a frequent high resource utilization. These programs should be analyzed in deeper detail using the other tools listed in Section 3.4, "Programmer Performance Utilities" to find out the cause of the problem.

# 3.3.3 Print Transaction Detail Report

If you need a more detailed problem analysis, print a transaction detail report by specifying RPTTYPE(\*TNSACT) on the PRTTNSRPT command. The transaction report output has two parts:

- The details, which show data about every transaction in the job.
- The summary, which shows data about overall job operation.

If there are response times that are not acceptable compared to your objectives, read the report further.

The next section to look at is the job summary data and especially the synchronous disk I/O counts. If there are, for example, 200 DB Reads (database read operations) per transaction, the response times are surely unacceptable.

# 3.3.4 Print Transition Report

If you want to know all of the state changes within a transaction, run the Transaction report by specifying RPTTYPE(\*TRSIT) on the PRTTNSRPT command.

— Be Careful! –

Remember to use the select/omit parameters or you receive several thousand pages of printout while adding a significant workload to your system.

The transition report is composed of two sections:

- Transition detail, which shows each state transition made by the job, for example, active-to-ineligible and transaction boundaries. For a brief discussion about transaction boundaries, see the index entry for trace points.
- Summary, which shows the same data as the summary output from the transaction report.

You may see in the transaction report (seize/lock conflict reports) that object "ADDR 00000E00 0002IUSE" is being held for a relatively long time. This refers to the internal object "database file in use table", which indicates frequent occurrences of one of the following conditions:

- · File opens/closes
- File creates/deletes
- Clear physical file member
- · Reorganize physical file member, and so on.

Since these functions have a significant impact on system and job performance, reduce their usage.

You may also see the I/O transaction boundaries in the transaction report. They indicate the trace points such as:

- SOTn
  - Start of a transaction
  - Start of the response time for that transaction
  - N represents various transaction types.
- SOR
  - Start of resource utilization time
- EORn
  - End of response time for the transaction
- EOTn
  - End of resource usage time
  - End of the transaction

See the Performance Tools/400 Guide, SC41-4340, for more details.

#### 3.4 Programmer Performance Utilities

The tools described in this part are not meant to be used for all of the cases with performance problems. These tools are meant to be used only as a last resort if none of the other tools provide you with the information required.

Usually the data acquired by using these tools is used for tuning the application only. These tools normally provide a limited amount of data of the performance on the communications area.

# 3.4.1 OS/400 Utilities for Tracing a Job

The following OS/400 commands may be used to produce trace job information:

STRSRVJOB

The Start Service Job command starts the remote service operation for a specified job (other than the job issuing the command) so that other service commands can be entered to service the specified job. Any dump, debug, and trace commands can be run in that job until the service operation ends. The service operation continues until the End Service Job command is run.

To use this command, you must be signed on as QPGMR, QSYSOPR, QSRV, or QSRVBAS, or have \*ALLOBJ authority.

• ENDSRVJOB

The End Service Job command ends the remote job service operation. This command stops the service operation that began when the Start Service Job command was entered.

To use this command, you must be signed on as QPGMR, QSYSOPR, QSRV, or QSRVBAS, or have \*ALLOBJ authority.

TRCJOB

The Trace Job command controls traces of Original Program Model (OPM) programs and Integrated Language Environment (ILE) procedure calls and returns that occur in the current job or in the job being serviced as a result of the Start Service Job command directed to that job. The command, which sets a trace on or off, can trace module flow, operating system data acquisition (including CL command traces), or both.

Restrictions for using the TRCJOB command:

- 1. The record format of the database output file must match the record format of the IBM-supplied output file QATRCJOB.
- 2. The number of trace records processed between the start and end of the trace must not exceed one million.
- 3. This command is shipped with public \*EXCLUDE authority.

The following user profiles are authorized to use this command: QPGMR, QSRV, QSRVBAS, QSYSOPR, and QRJE.

The following display is an example of starting a job trace:

Trace Job (TRCJOE	3)
Type choices, press Enter.	
Trace option setting       1       *ON         Trace type       *ALL       *ALL         Maximum storage to use       2       4096         Trace full       3       *WRAP         Program to call before trace       *NONE       *NONE         Library            Select procedures to trace:	*ON, *OFF, *END *ALL, *FLOW, *DATA 1-16000 K *WRAP, *STOPTRC Name, *NONE _ Name, *LIBL, *CURLIB
Program	Name, *ALL, *NONE _ Name, *LIBL, *CURLIB *PGM, *SRVPGM
Output	*PRINT, *OUTFILE Name _ Name, *LIBL, *CURLIB
F3=Exit F4=Prompt F5=Refresh F12=Cancel F24=More keys	<b>More</b> F13=How to use this display

Figure 16. How to Start a Job Trace

Notes:

When starting the trace, enter \*0N and when ending the trace, enter \*0FF.

**2** Use the default setting of 4096K (4 megabytes). This size can handle about 14000 trace records, which is sufficient in most cases.

Use the option \*STOPTRC to stop the trace when the trace file is full of trace records; otherwise valuable data may be lost. If you enter option \*WRAP, the oldest trace records are written over by new ones as they are collected.

The following printout is an example of output produced by using the OS/400 TRCJOB \*OFF command:

5716SS1 V3R6	MO 9509	29		AS/40	0 TRACE	JOB IN	FORMATION			10/31/	96 24:13:2	4 PAGE	1
TRACE TYPE	- *ALL	MAX ST	ORAGE- 0409	6 EXIT	PROGRAM	-	*N	DNE					
RECORD COUN	T- 00040	7 START	TIME - 24:1	3:24 STAR	T DATE	- 10/3	1/96		JOB- 06 DB	52603 NON-DB	/A960303A PAGES	/QPADEV0006 NUMBER	
IME	SEQNBR	FUNCTION	PROGRAM	LIBRARY	ENTRY	EXIT	CALL LVL	CPU TIME	READS	READS	WRITTEN	WAITS	
0:03:09.626	000001	RETURN	QUICMD	QSYS	03FF	0678	05	0.002	0	0	0	0	
:03:09.630	000002	CALL	QMHRCVPM	QSYS	0001	001E	06	0.000	0	0	0	0	
:03:09.632	000003	RETURN	QUICMD	QSYS	0679	0311	05	0.000	0	0	0	0	
:03:09.633	000004	CALL	QMHFLTR	QSYS	0001	001A	06	0.000	0	0	0	0	
:03:09.633	000005	RETURN	QUICMD	QSYS	0311	0311	05	0.000	0	0	0	0	
:03:09.633	000006	RETURN	QUIMGFLW	QSYS	0499	0369	04	0.000	0	0	0	0	
:03:09.634	000007	CALL	QUIICHK	QSYS	0001	004D	05	0.000	0	0	0	0	
0:03:09.635	000008	RETURN	QUIMGFLW	QSYS	036A	0388	04	0.000	0	0	0	0	
0:03:09.636	000009	CALL	QUIEXFMT	QSYS	0001	03E5	05	0.000	0	0	0	0	
0:03:09.636	000010	CALL	QMHRCVPM	QSYS	0001	001E	06	0.000	0	0	0	0	
0:03:09.637	000011	RETURN	QUIEXFMT	QSYS	03E6	0072	05	0.000	0	0	0	0	
0:03:09.637	000012	CALL	QUIOCNV	QSYS	0001	0082	06	0.000	0	0	0	0	
:03:09.638	000013	RETURN	QUIEXFMT	QSYS	0073	0080	05	0.000	0 0	0	0	0	
):03:09.638	000014	CALL	QUIINMGR	QSYS	0001	020A	06	0.000	0	0	0	0	
0:03:09.640	000015	CALL	QWSPUDDS	QSYS	0001	08BC	07	0.000	0	0	0	0	
:03:09.640	000016	CALL	QWSMISC	QSYS	0001	003D	08	0.000	0	0	0	0	
:03:09.641	000017	DATA	FF					209090304	40404040	- 100 *F=	QDUI132	R=USRRCD	*
):03:09.642	000018	DATA	FF					000000000000000000000000000000000000000			ADEV0006 I		*
):03:09.643	000019	RETURN	QWSPUDDS	QSYS	08BD	0661	07	0.000	0	0	0	0	
):03:09.644	000020	CALL	QWSRST	QSYS	0001	01E8	08	0.000	0	0	0	ő	
):03:09.644	000021	CALL	QWSNJISC	QSYS	0001	003D	09	0.000	0	0	0	0	
):03:09.644	000022	DATA	FF					C4E4C9F1F3	-		OPADEV0006		*
):03:09.645	000022	RETURN	QWSRST	OSYS	01E9	011A	0400071200	0.000	0 0	00 0	0	0 1-0001132	
):03:09.645	000023	CALL	QT3REQIO	05YS	0001		09	0.000	0	0	0	0	
):03:09.645	000024	DATA	FF	<b>4</b> · · ·					-	-	-ENTRY Ï	-	
):03:09.645	000025	DATA	FF	E3F360C5D5E3D9E8404000770000000000000000000000000000 *T3-ENTRY Ï D8D7C1C4C5E5F0F0F0F60000000000000000000C3F6400000000 *QPADEV0006 C6						*			
):03:09.645	000020	RETURN	QWSRST	QSYS	011B	0047	08	0.000	40000000	,00 Qr 0	0	0	
):03:09.648	000027	RETURN	QWSRUDDS	QSYS	0662	0724	07	0.000	0	0	0	0	
):03:09.648	000028	XCTL	QWSF0005	QSYS	0002	0569	07	0.000	0	0	0	0	
):03:09.648	000029	CALL	QWSMISC	QSYS	0001	003D	08	0.000	0	0	0	0	
):03:09.649	000030	RETURN		QSYS	056A	003D 056F	07	0.000	0	0	0	0	
	000031	CALL	QWSGET						0	0	0	1	
0:03:09.650	000032	DATA	QT3REQIO FF	QSYS	0001	007F	08	0.024 0000123002		•	-ENTRY Ë		*
0:03:09.650												g	
0:03:09.651	000034	DATA	FF					000000C3F6			ADEV0006	C6	*
0:03:09.651	000035	DATA	FF					0000008800			-REQIO	h	÷
0:03:13.545	000036	DATA	FF					000000000000000000000000000000000000000			-DEQUEUE	0	î
03:13.546	000037	RETURN	QWSGET	QSYS	0570	057B	07	0.000	0	0	0	0	
0:03:13.546	000038	CALL	QWSMISC	QSYS	0001	003D	08	0.000	0	0	0	0	
0:03:13.547	000039	RETURN	QWSGET	QSYS	0570	0216	07	0.000	0	0	0	0	
0:03:13.547	000040	RETURN	QUIINMGR	QSYS	020B	0102	06	0.000	0	0	0	0	
0:03:13.548	000041	RETURN	QUIEXFMT	QSYS	008D	008D	05	0.000	0	0	0	0	
0:03:13.548	000042	RETURN	QUIMGFLW	QSYS	0389	038C	04	0.000	0	0	0	0	
0:03:13.549	000043	CALL	QUIACT	QSYS	0001	04DD	05	0.000	0	0	0	0	
0:03:13.549	000044	CALL	QMHRMVPM	QSYS	0001	00A3	06	0.006	0	1	0	0	
0:03:13.552	000045	RETURN	QUIACT	QSYS	04DE	016A	05	0.000	0	0	0	0	
0:03:13.553	000046	RETURN	QUIMGFLW	QSYS	038D	055D	04	0.000	0	0	0	0	
0:03:13.553	000047	CALL	QUIICHK	QSYS	0001	004D	05	0.000	0	0	0	0	
0:03:13.554	000048	RETURN	QUIMGFLW	QSYS	055E	0498	04	0.000	0	0	0	0	
0:03:13.554	000049	CALL	QUICMD	QSYS	0001	03FE	05	0.000	0	0	0	0	
0:03:13.555	000050	CALL	QCADRV2	QSYS	0001	005E	06	0.000	0	0	0	0	

Figure 17. An Example of Output Created with TRCJOB Command

**Note:** This is the first of the eight pages produced by tracing the Display Job command so please be careful when tracing a job. To avoid producing thousands of pages of printout, run the job trace for a short period of time only.

# 3.4.2 Performance Tools/400 Utilities for Tracing a Job

The performance tools provides some additional commands for gathering trace information:

• STRJOBTRC

The Start Job Trace command starts the job tracing function to collect performance statistics for the specified job. After job tracing is started, a trace record is generated for every:

- External (program) call and return
- Exception
- Message
- Workstation wait in the job

At least two (usually more) trace records are generated for every I/O statement (open, close, read, and write) in a high-level language program.

ENDJOBTRC

The End Job Trace command turns off the job tracing function. It also:

- Saves all of the collected trace records in a database file.
- Optionally produces reports.

You may also use the Print Job Trace (PRTJOBTRC) command to produce reports from the same data.

- Notice! -

Tracing has a significant effect on the performance of the job being traced. It also affects the performance of the system in general, but to a lesser extent.

The following trace examples are produced by using the Start Job Trace (STRJOBTRC) command followed by End Job Trace (ENDJOBTRC) command.

End Job Trace (El	IDJOBTRC)	
Type choices, press Enter.		
Output file member MBR	QAJOBTRC	
Output file library LIB	QPFRDATA	
Report type RPTTYPE	1 *SUMMARY	
Report title TITLE		
Starting sequence number STRSEQ	*FIRST	
Ending sequence number ENDSEQ	*LAST	
Transaction ending program ENDTNS	QT3REQI0	
Transaction starting program STRTNS	QWSGET	
Job name JOB	ENDJOBTRC	
Job description JOBD	QPFRJOBD	
Library	*LIBL	



Note:

By entering \*SUMMARY, you submit two reports to be produced summarizing the job trace data by workstation transaction. One report shows primarily physical disk activity; its printer file is QPPTTRC1, and its page heading includes the text "Trace Analysis Summary". The other report concentrates on higher level activities such as database I/O and inter-program transfers of control; its printer file is QPPTTRC2, and its page heading includes the text "Trace Analysis I/O Summary".

Based on your needs, you may use either of the job tracing functions because they show a different kind of data. The OS/400 Job Trace shows the job flow and the trace obtained with the Performance Tools/400 shows the number of different disk I/O operations.

			TRACE ANAL	YSIS SUMMARY			10/31	/96	
FILE-Q/	APTTRCJ I	LIBRARY-QPFRDATA	MBR-QAJOBTRC		J	OB- QPADEVOO6 .A96	0303A	.058608	
			PHYSICAL	I / 0					
	SECONDS	CPU SECONDS	DB READS NON-DB RDS	WRITES WA	ITS	SEQUENCE			
WAIT-ACT	34.193	.001				45			
ACTIVE	.442	.245	2		3	145			
WAIT-ACT	1.154	.001				150			
ACTIVE	.319	.109	1		4	208			
WAIT-ACT	10.354	.002				213			
ACTIVE	.663	.410	3		3	441			
WAIT-ACT	23.624	.002				446			
ACTIVE	.480	.218	10		3	555			
WAIT-ACT	17.752	.002				560			
ACTIVE	.601	.388	2		3	779			
WAIT-ACT	20.577	.001				784			
ACTIVE	.619	.453	5		2	1046			
WAIT-ACT	3.371					1051			
ACTIVE	.536	.330	2		3	1247			
WAIT-ACT	1.797	.001				1252			
AVERAGE	.523	.309	4		3	7			
TOTAL	3.660	2.162	25		21				

Figure 19. Trace Analysis Summary

FILE-QA	APTTRCJ L	.IBRARY-QPFRD/	.TA MBR-QAJ		ANALYSIS	/O SUMMAR				.058608			
		P F	OGRAM	******	PROGRAM [	ATA BASE	I/0 ****	*** FULI	SHAR	E SUBFI	LE		
	SECONDS	SEQNCE NAME	CALL INI	T GETDR GE	TSQ GETKY	GETM PU	T PUTM	UDR OPN O	LS OPN C	LS READS W	RITES	MSGS	
WAIT-ACT	34.193	45											
ACTIVE	.442	145						1				1	
WAIT-ACT	1.154	150											
ACTIVE	.319	208							1				
WAIT-ACT	10.354	213											
ACTIVE	.663	441						1		1	12	1	
WAIT-ACT	23.624	446											
ACTIVE	.480	555								1	4	2	
WAIT-ACT	17.752	560											
ACTIVE	.601	779								1	12		
WAIT-ACT	20.577	784											
ACTIVE	.619	1046								3	13	2	
VAIT-ACT	3.371	1051											
ACTIVE	.536	1247								2	12	1	
VAIT-ACT	1.797	1252											
AVERAGE	.523	7								1	8	1	
TOTAL	3.660							2	1	8	53	7	

Figure 20. Trace Analysis I/O Summary

The trace job outputs are used to determine the following information that can be used to analyze job performance:

- · Programs called and calling sequence and frequency
- · Wall clock time of the program call and return sequence
- · CPU time used by each program
- · The number of synchronous DB and NDB disk I/Os per program called
- The number of full and shared file opens
- · Messages received by each program

Do not use the wall clock time (TIME heading) or CPU time (CPU TIME heading) to estimate the actual time used by each program. The implementation of a trace job inflates the real values to those shown in the trace job data. However, you can use the time values to identify **relative** differences among the programs listed.

#### - Attention! -

Be aware that tracing a job with hundreds of user program or procedure calls may have a significant impact on CPU utilization.

#### 3.4.2.1 DSPACCGRP and ANZACCGRP

Analyzing Process Access Group activity is done by using these commands. Collect the data with the DSPACCGRP command and direct the output to a database file. The command lets you select jobs by generic job or user name, or by type (interactive or all).

Use the ANZACCGRP command to print a summary of the data in the file. For each job type, it shows:

- · How many jobs exist
- The number of files that are in use in each job, and the amount of I/O done by the job
- What files are open in the system, what duplicate files a job may have, and the amount of I/O going on for each file
- · The active programs within the jobs selected

Analyze job PAGs to see if savings can be made. Opening and closing seldom-used files each time they are used saves buffer space. In some cases, display files have many formats but a job uses only one or two. Placing these formats into a separate display file (for example, based on application function) can reduce PAG size. This reduces the number of disk I/O operations to read and write the PAG and saves space while the PAG is in memory. This is valuable on a system with limited main storage.

#### 3.4.2.2 The Performance Explorer

If the tools introduced earlier in this chapter do not give you enough information, you might consider using the Performance Explorer. The Performance Explorer is a combination of Timing and Paging Statistics Tool and Sampled Access Monitor. The use of Performance Explorer is beyond the scope of this publication but if you have used either TPST or SAM earlier, you should have no problems with Performance Explorer. For detailed information about using the Performance Explorer, see the *AS/400 Performance Tools/400 Guide*, SC41-4340.

#### 3.5 Performance Data Conversion

You can analyze performance data collected on a system running an earlier release of the OS/400 but the files must be converted before the current (V3R7) level of Performance Tools can use them.

This is done by running the Convert Performance Data (CVTPFRDTA) command against the down-level performance data.

The conversion may be done in the library in which the current data resides, or to a different library. If the conversion is done in the same library, the current data is replaced by the new data. If the conversion is done to a different library, the new data exists in the new library while the "back level" data continues to exist in the "old" library.

**Note:** To avoid the risk of destroying the old data if the command ends abnormally, convert the data into a different library (To library prompt (TOLIB parameter)), and later, delete the data from the old library (From library prompt (FROMLIB parameter)). Data conversion may affect the other transaction response times. You may consider submitting it during a low period of CPU utilization.

To be able to analyze performance data collected on a V3R2 level operating system you must specify either TGTRLS(V3R1M0) or TGTRLS(\*PRV) when saving the performance data library.

# Chapter 4. Using BEST/1 for Communications Performance Analysis and Capacity Planning

This chapter discusses using the BEST/1 function of the Performance Tools to analyze communications performance problems. The following major topics are covered in this chapter:

- V3R7 AS/400 capacity planning
- · Creating a model for communications capacity planning analysis
- · Using a model for communications capacity planning analysis
- · Changing communications resources
- BEST/1 communications support for performance capacity analysis
- · BEST/1 considerations when analyzing communications data

#### 4.1 V3R7 BEST/1 Capacity Planning

Creating a model of the current system is the most common use of the capacity planning tool. Use the model to see how changing either the system configuration or the workload affects the performance. You may find out the affect on remote response time, line utilization, IOP utilization, CPU utilization, and other parameters.

The scenario of changing either hardware or workload and re-analyzing the data and viewing the results is discussed in this chapter.

If you are interested in seeing how the changes to your hardware configuration affect communications performance, you can do so by using the V3R7 BEST/1 Capacity Planning, which is a part of the Performance Tools/400 program product. If you are not familiar with BEST/1 Capacity Planning, it is highly recommended that you review the following manual:

AS/400 BEST/1 Capacity Planning Tool, SC41-3341

#### 4.1.1 When to Use BEST/1 for Communications Performance Analysis

Use BEST/1 modeling when the communications performance does not meet the predefined objectives or when you know that there are major changes coming to either the workload or the system configuration. For example, you can predict the impact to the system performance of adding 100 new users to the existing configuration. You can also see how replacing a 2626 IOP with a 6506 IOP affects either response times or the number of transactions getting done.

The first step in analyzing the communications performance data collected by using the Start Performance Monitor (STRPFRMON) CL command usually is to use the Advisor tool. See Chapter 3, "Using Performance Tools/400" on page 27 for information about using the advisor tool for communications performance analysis. By using BEST/1 with the real communications performance data, you can simulate **beforehand** what happens if you change, for example:

- · The line speed of a communication line
- A communication IOP
- The CPU model

- · The size of main storage
- DASD configuration

#### 4.2 Creating a Model for Communications Analysis

The purpose of this section is to show you the steps of building a model using performance measurement data.

When building a model, choose a performance data member that represents a **normal workload** on the system. If you choose a member with only a few active jobs, the results you obtain may not help you in your search of the performance bottleneck. The heavier the workload in the performance data file member you choose to build the model from, the more usable the model is that you create.

If the created model can handle a workload significantly heavier than the one you have in real life, the system performance after the configuration changes should be acceptable in real life also. Usually, the results acquired by using the BEST/1 tool are accurate within five percent.

The following sections describe some of the displays associated with these steps. For a complete step-by-step demonstration, see the *AS/400 BEST/1 Capacity Planning Tool Guide*.

Enter the STRBEST command to start the BEST/1 modeling tool and from the *BEST/1 for the AS/400* menu, choose option 1 to work with models. The *Work with BEST/1 Models* menu is displayed. Enter option 1 to create a new model from performance data. Either use the default jobs classification or create your own job classifications as shown on the following pages.

#### 4.2.1 Assigning Jobs to Workloads by Communications Line

BEST/1 enables you to assign jobs to workloads based on communications line or control unit options.

This enables models to be created that allow for workload changes according to remote locations. For example, you can use these options to predict what happens if:

- The amount of remote work station users increase or decrease.
- The business volumes on the remote end changes such as when:
  - A new branch is opened.
  - A competitive company is bought.

#### 4.2.1.1 Specify Job Classification by Communication Line

Figure 21 on page 55 shows an example of the Specify Job Classification Category display. In this example, option 9 is used to group the jobs according to the communication line they are attached to.

Specify Job C	lassification Category
Type choice, press Enter.	
Category	9 1=User ID 2=Job type 3=Job name 4=Account code 5=Job number 6=Subsystem 7=Pool 18=Control unit 9=Comm line 10=Functional area
F3=Exit F12=Cancel	

Figure 21. Specify Job Classification Category Display

Notes:

When a control unit option is selected, all of the work that can be associated with a local station controller, a display station pass-through virtual controller, or a WAN controller is identified. All of the other work is assigned to a single workload.

When a communications line option is selected, all of the work that was not associated by the Performance Monitor with a communication line is assigned to only one workload.

## 4.2.1.2 Edit Job Classification

Figure 22 shows workloads and communications line pairs manually typed in. Only the communications lines that were active during performance data collection are shown. Press the PF9 key to get a list of communications lines from the previously gathered performance data.

press En	load names and ter. Jobs wit			•	-
1 Workload	2 Comm Line	Workload	Comm Line	Workload	Comm Line
SDLC101	SC101				
DLC102	SC102				
SDLC103	SC103				
RNLAN	LINTRN				
(25A	LINX25A				
(25B	LINX25B				
DEFAULT 3					
				<u> </u>	
				<u> </u>	
					More

Figure 22. Edit Job Classifications Display

Notes:

**1** and **2** show the workload assignments with activity from lines SC101, SC102, SC103, LINTRN, LINX25A, and LINX25B.

3 The remaining activity is assigned to workload QDEFAULT.

For easier assignment of workloads, press the PF9 (Display values from data) key to have BEST/1 query the QAPMJOBS file and show you a list of communications line names instead of trying to remember the names of communications lines.

#### 4.2.1.3 Assign Jobs to Workloads

Figure 23 shows an example of the selection display after pressing the PF9 key in the Edit Job Classification display.

			Assign Jobs to W	orkloads		
Work	load				1	
			Unassigned jobs ad 2=Unassign	become par	t of workload	QDEFAULT.
_	·		3 Number of	3 CPU	<b>3</b> I/0	
0pt	Workload 4	Comm Line	Transactions 38199	Seconds 13501.999	Count 1917862	
_	SDLC101	SC101	1515	295.622	48664	
-	SDLC102 SDLC103	SC102 SC103	1740 523	258.110 63.922	37562 8156	
_	TRNLAN	LINTRN	0	26.908	8428	
-	X25A X25B	LINX25A LINX25B	0 88	8.383 36.165	2464 6255	
F3=E	vit 512-0	ancal	5	load F	16-Sout by co	Bottom
	xit F12=C Sort by tra		F15=Sort by work F18=Sort by CPU		16=Sort by co 19=Sort by I/	

Figure 23. Assign Jobs to Workloads

#### Notes:

**1** Type a workload name and use option 1 or 2 beside the communications line to group work into workloads.

**2** Use options 1 and 2 to assign or unassign the activity associated with the communications lines.

**3** The Number of Transactions, CPU Seconds, and I/O Counts statistics provide you information about the activity on the line.

The first line shown under communications line names shows no communications line. This line represents all of the work that was not assigned to any of the communications lines. This *other* work can be assigned to only one workload, but it is preferable to let BEST/1 assign this work to the QDEFAULT workload to handle the \*LIC (Licensed Internal Code) tasks properly. Leave this line unassigned.

**5** You can have the workloads sorted after different factors by using the function keys shown on the bottom of the display.

# 4.2.2 Creating a Model

The actual creation of the model is submitted after the job classification scheme has been created. The create process accesses the performance data collected by the Performance Monitor and builds a model according to the specified job classifications.

# 4.3 Using a Model for Communications Analysis

Once the batch job creating the model has completed, you can work with the model to examine the results that can be viewed either as reports or graphs. Have the model analyzed and the calibration report viewed prior to any *What if...*? analysis.

The Analyzing of the model is done by selecting either option 5 (Analyze current model) or option 6 (Analyze current model and give recommendations) on the *Work with BEST/1 Models* menu.

# 4.3.1 Displaying Model Reports

Figure 24 shows an example of the Display Comm Resources Report display that shows the communications IOP utilization and the following information for each communications line resource:

- Utilization
- Response time per transaction
- · Number of lines it represents
- · Line speed of all the lines

Display Comm Resources Report								
Period: Analys		4	5	6	7			
2	3	Overhead	Rsp Time per	Nbr of	Line Speed			
Resource	Util	Util	Trans (Sec)	Lines	(Kbit/sec)			
CC01	1.5							
LINTRN	0.4	0.0	0.01	1	4000.0			
CC02	65.2							
AE101	20.4	2.6	2.79	1	9.6			
JAIRO	3.6	0.1	2.05	1	9.6			
LINSI	14.0	4.7	3.39	1	9.6			
LITECP1	26.7	4.7	3.21	1	9.6			
SC101	15.3	6.7	8.17	1	4.8			
SC102	16.8	6.2	7.36	1	4.8			
CC03	93.2			_				
FILIAL CTR	0.0	0.0	0.00	1	19.2			
ITSC	0.0	0.0	3.71	1	9.6			
0M104	2.3	0.0	2.03	1	9.6			
SC103	1.2	0.0	0.82	1	4.8			
LINX25A	19.0	0.6	1.18	1	9.6			
LINALUA	15.0	0.0	1.10	Ŧ	More			
F3=Exit F10=Re	-analyze	F12=Cancel	F15=Configura	tion monu	1010			
F17=Analyze mult			y objectives F					

Figure 24. Communications Resources Report

Notes:

**1** The descriptive name of the analysis period (for example, a date).

**2** The system-assigned or user-assigned name of the communications resource.

The predicted utilization of this line resource. For a communications IOP (such as the CC01 in this example), this is calculated from the number of frames processed and the service time per frame. For a line resource, this is calculated from the number of characters transferred and the line speed.

The line utilization that is due to overhead. For example, let's assume that the line resource has a line overhead value of 10%. This means that for every 10 information bytes transferred, there is an extra overhead byte transferred. If the predicted line utilization (total) is 55%, the utilization due to overhead is 5%.

**I** This represents the average predicted response time in seconds of the interactive transactions that contribute to the line traffic. The BEST/1 workload definitions indicate what portion of LAN or WAN transactions flow across each communications line. See Section 4.5.3, "Distribution of Characters Transferred Across Line Resources" on page 68 for more details. The workload report shows average WAN and LAN response times for an entire workload.

**6** This field indicates the number of lines that the line resource represents. Adding or removing line resources is done by using the Work with Communications IOP Features display.

The line speeds for lines that are represented by the line resource. If this is an input field, type the line speed of your choice, or press PF4 to select from a list of line speeds. This line speed must be the actual speed of the connection. If the modems are communicating at 9.6Kbps, use 9.6Kbps as the AS/400 line speed (ignore what the AS/400 line description parameters show since they may not match the current situation).

### 4.3.2 Understanding Recommendations

If you choose option 6 to analyze the model and give recommendations, you may get suggestions for configuration changes. These changes are based on the internal tables containing values for resource utilization limits, so reading the recommendations is helpful when analyzing communications performance. Some of the recommended changes may be creating, changing, or deleting communications IOPs.

#### 4.3.2.1 Display Recommendations

Figure 25 on page 60 shows an example of the Display Recommendations display that indicates both the components that were not meeting the desired objectives and the changes proposed to the current configuration to meet those objectives. This report contains two sections of information: exceptions and recommendations.

Display Recommendations \*\*\*\*\* Analysis Exceptions \*\*\*\*\* Utilization of 65.22 for communications IOP CC02 exceeds objectives of 45.00 Utilization of 93.20 for communications IOP CC03 exceeds objectives of 45.00 \*\*\*\*\* Analysis Recommendations \*\*\*\*\* Move 3 Communication lines from IOP CC02 to CIOP1 Move 4 Communication lines from IOP CC03 to CIOP2 Create 1 communication lines from IOP CC02 to CC04 Move 1 communication lines from IOP CC03 to CC05 Move 1 communication lines from IOP CC03 to CC05 Bottom Performance estimates -- Press help to see disclaimer. F3=Exit F12=Cancel F15=Configuration menu F17=Analyze multiple points F18=Specify objectives F19=Work with workloads

Figure 25. Display Recommendations

#### Notes:

**1** Exceptions are conditions that BEST/1 has identified as indicators of poor performance according to the objectives or guidelines.

**2** Recommendations may suggest configuration changes to achieve the desired performance.

### 4.3.2.2 Exceptions

There are two basic types of exceptions related with communications performance:

• Utilization of ... exceeds objectives ...

The predicted utilization of the identified hardware component has exceeded the guideline for that type of component.

• ... is saturated

The predicted utilization of the identified hardware component has exceeded 100%. This usually indicates a severe over-commitment of the hardware resource, which means that system was not capable of managing the workload.

### 4.3.2.3 Recommendations

If one or more exceptions have occurred, BEST/1 makes specific reconfiguration suggestions. These suggestions have one of two possible origins:

Primary

The reconfiguration is specifically indicated to remove one or more performance exception.

Secondary

Additional reconfiguration is required by AS/400 configuration requirements. For example, if the communications IOP utilization guideline is exceeded, BEST/1 probably recommended installation of a new communications IOP. For communication lines, BEST/1 suggests increasing line speeds first. Then it suggests adding more lines to the configuration.

BEST/1 only recommends hardware reconfigurations that are both:

- · Adequately or completely defined in the hardware table.
- Marked as currently available (Y).

### **4.3.2.4 How Communication Resources Utilizations are Predicted** BEST/1 uses the amount of:

- The total number of characters transferred
- Characters per transaction
- Transactions per function
- Functions per user

to calculate the utilization of communications resources for each workload.

Characters per transaction is the total of all characters transferred in and out. When communications lines are present, the number of characters is kept separately for each line. These are added across all workloads.

When building the workloads, BEST/1 assigns relative communication line activity to each workload based on the job's CPU usage that has been assigned to each workload. Most interactive jobs indicate the communications line they are associated with, so this assignment is thought to be valid. Results in your environment may vary if you are using Client Access workstations attached to 5294 or 5394 remote workstation controllers.

**WAN Controllers and LAN Controllers:** Utilization of LAN and WAN controllers is determined by using the number of active jobs connected to LAN or WAN.

This method is based on the assumption that an average service time is representative and that the traffic is evenly spread among all the controllers of a particular type.

*LAN and WAN IOPs:* Use of LAN IOPs is determined by the attached communications lines. Each line's contribution depends on the total LAN characters (determined previously for each workload), frame size, and IOP service time per frame. All the attached lines are added together to calculate the total percentage of the IOP utilization.

LAN IOP service time per frame is specific to each IOP. Line frame size is specific to each communications line.

Utilization for WAN IOPs is determined similarly by using the total WAN characters and number of WAN IOPs for WAN utilizations.

**Communications Lines:** Utilization of a LAN communications line is calculated by using the total LAN characters (determined previously to each workload), the line overhead, and the line speed.

Line overhead and line speed in kilobits per second is specific to each communications line. Utilization of WAN lines is determined similarly by using the total WAN characters per line.

*Multifunction IOPs:* The utilization of a multifunction IOP is determined by adding together the utilization for each type of activity. For example, the disk IOP utilization plus communications IOP utilization equals total MFIOP utilization.

## 4.4 Changing Communications Resources

This section shows some of the changes you can make to your model to meet your performance definitions. By changing some of the communications resources, you can ask *what-if...?* questions that help you with communications performance prediction.

*Work with Communications Resources:* Figure 26 shows an example of the Work with Communication Resources display. This display shows you all the communications IOPs and line resources in the current configuration for both LANs and WANs. Use this display to change the properties of communications resources.

For a communications IOP, you can change:

- Communications IOP feature
- Average service time

For a communications line, you can change:

- · Number of lines the line represents
- · Line speeds of all the lines

	options, pre Change 3=Co		ete 7=	Rename 8=Create	e line resourc	es
	2	3	4 Nbr of	5	6 Line Speed	7 Pct line
Dpt	Resource	Feature	Lines	Text	(Kbit/sec)	
	CC01	2626		LAN IOP	(	
-	LINTRN		1	Comm line(s)	4000.0	2.0
- - - - - -	CC02	2623		WAN IOP		
_	AE101		1	Comm line(s)	9.6	14.5
_	JAIRO		1	Comm line(s)	9.6	2.0
_	LINSI		1	Comm line(s)	9.6	50.4
_	LITECP1		1	Comm line(s)	9.6	21.3
_	SC101		1	Comm line(s)	9.6	78.5
_	SC102		1	Comm line(s)	4.8	57.7
_	CC03	2623		WAN IOP		
_	FILIAL_CTR		1	Comm line(s)	19.2	2.0
_	ITSC -		1	Comm line(s)	9.6	2.0
_	LINX25A		1	Comm line(s)	9.6	3.0
_	OM104		1	Comm line(s)	9.6	2.0

Figure 26. Changing Communications Resources

#### Notes:

**1** The create line resources option allows you to create one or more line resources to attach to the current communications IOP.

**2** This shows you the unique system-assigned or user-assigned name of the communications resource.

3 The communications IOP feature is shown on this column.

This field indicates the number of lines that the line resource represents. Adding or removing of the line resources is done through the Work with Communications IOP Features display.

**5** A description of the communications resource. This can be a LAN IOP, a WAN IOP, or a communication line.

**6** The line speed parameter for the lines that are represented by the line resource. If this is an input field, you can type the line speed of your choice, or press the PF4 key to select from a list of line speeds.

The amount of non-information bytes sent over a line resource is expressed as a percentage of the information bytes. For example, if 800 information bytes and 200 non-information bytes are transferred, the overhead is 25%. Depending on the type of line, non-information bytes can represent items such as protocol overhead or error retransmission. A high percentage of line overhead may indicate error conditions. By default, this value is set to 2% if the line utilization is 10% or less.

8 The create communications IOP function allows you to add a communication IOP into your configuration.

Multiple function IOPs are shown in this display as well as the Work with Disk Resources display because a multiple function IOP serves both as a disk IOP and as a communications IOP.

BEST/1 uses a LAN IOP called the 613L to represent a 6130 with LAN communications lines. The 6130 can support either WAN or LAN communications lines, but BEST/1 requires any communications IOP in the hardware table to be exclusively WAN or LAN. The hardware table includes a 6130 that supports WAN line speeds and a 613L that supports LAN line speeds.

When you create a model from performance data, the line speeds of the lines attached to a 6130 determine whether the IOP is listed as a 6130 or 613L.

— LAN or WAN? -

BEST/1 determines the communications IOP type by whether the minimum line speed supported by an IOP is less than 4MB.

- An IOP with a minimum line speed of 4MB or greater is considered LAN.
- An IOP with a minimum line speed of less than 4MB is considered WAN.

# 4.4.1 Example - Changing the IOP Type

The characteristics of the communications IOP usually affect the performance of the lines attached to the IOP. The higher capacity 2623 IOP provides better line performance than the lower capacity IOPs if any of these conditions are true:

- There is high throughput.
- The line has a high line speed.
- · The IOP has many lines attached to it.
- · Other lines on the IOP are highly utilized.
- There is high polling activity across the lines.

**Change Communications IOP:** Figure 27 shows an example of the Change Communications IOP display that allows you to change characteristics of the communications IOP. To change the communications IOP feature, select option 2 next to the element you want to change on the Work with Communications Resources display shown in Figure 26 on page 62.

		Change	Communica	ations IOP	
IOP name Text <b>2</b>	<b>1</b>	: C	<b>CO2</b> N IOP		
Type chan	ges, press l	Inter.			
<b>3</b> Feature <b>4</b> Service	 Time	· · · · · ·	<b>2623</b> 7.2	F4 for list Msecs per frame	
F2 F 11		510.0			
F3=EXIT	F4=Prompt	F12=Cancel			

Figure 27. Changing IOP Type

Notes:

**1** The name of the communications IOP resource

- **2** A description of the communications IOP resource. This can be:
- · LAN (Local Area Network) IOP
- WAN (Wide Area Network) IOP



The communications IOP average service time expressed in milliseconds per frame

### 4.5 BEST/1 Communications Support for Performance Analysis

BEST/1 communications support refers to modeling the way the users are connected to the system. For a communications performance analysis, look for users that are connected to the AS/400 system through:

- Local Area network (LAN)
- Wide Area Network (WAN)

A high utilization percentage of the communications line (LAN or WAN) surely affects response time. The purpose of this section is to describe the configuration displays that provide the communications support. These include the following displays:

- Create communications IOP feature.
- Create communications line resource.
- Specify Chars to communication line resources.

These three displays may be helpful if you have communications performance problems such as:

- There are IOPs with high utilization percentages.
- There are lines with high utilization percentages.
- You need to spread the workload evenly between IOP and line resources.

## 4.5.1 Creating a Communications IOP Feature

This section shows you an example of creating a communications IOP that you can add to your model to improve the performance. For example, if the analysis shows that there are IOPs with a high utilization percentage, you can see the estimated effect of adding a new IOP.

*Create Communications IOP:* Figure 28 on page 66 shows an example of the Create Communications IOP display that enables you to create a new communications IOP for your configuration. At the same time, you can also create communications lines and attach them to the new IOP.

You can add one or more communications lines to the current communications IOP with the average line speed specified in kilobits per second.

Fill in the necessary parameters for the communications IOP such as the feature number, service time, and the frame size. You also need to fill in information for the first line resource displayed such as the number of lines the line resource represents and whether the data is sent half or full duplex.

To create a communications IOP, press the PF6 key (Create Communications IOP) on the Work with Communications Resources display shown in Figure 26 on page 62.

You can also use the copy function on the Work with Communications Resources display shown in Figure 26 on page 62 to create an IOP.

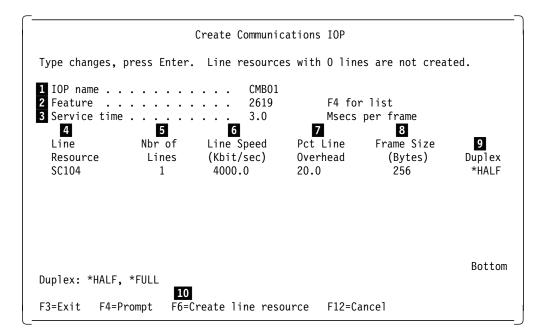


Figure 28. Create Communications IOP

Notes:

**1** The name of the communications IOP resource



\_\_\_\_\_

3 The communications IOP average service time expressed in milliseconds per frame

The name of the line resource. In the case of a model created from performance data, this name is system-defined. When you create (add) a communications IOP to a configuration, you provide the name.

**5** This field indicates the number of lines that the line resource represents. Adding or removing line resources is done in the Work with Communications IOP Features display.

**6** The line speed for lines that are represented by the line resource. If this is an input field, you can type the line speed of your choice, or press the PF4 key to select from a list of line speeds.

The amount of non-information bytes sent over a line resource given as a percentage of the information bytes. For example, if 800 information bytes and 200 non-information bytes are transferred, the overhead is 25%. Depending on the type of line, non-information bytes represent items such as protocol overhead or error retransmission. A high value for line overhead may indicate error conditions.

- For lines with less than 10% utilization, the default value of Pct Line Overhead is 2%.
- As the traffic on the line increases, the percentage value of Pct Line Overhead remains the same. Therefore, whether 800 or 8000 information bytes are transferred, if the value for Pct Line Overhead is set to 5%, it remains at 5%.

**8** The size of the frame being processed by the communications line resource. For measured models, the frame size is determined by the average size of the information frame transferred across the line during the measurement interval.

**9** This shows whether the line resource represents half duplex lines or full duplex lines. Half duplex lines can only send or receive data at any one time. Full duplex lines can both send and receive at the same time.

**10** Press the PF6 key (Create line resource) to add line resources to this new communications IOP.

### 4.5.2 Creating a Communications Line Resource

This section is an example of creating a communications line. This helps you to remove a performance bottleneck if the line utilization percentage exceeds the guidelines.

*Create Communications Lines:* Figure 29 shows an example of the Create Communications Lines display that you can use to create a line resource and to specify its parameters. These include:

- Number of lines the line resource represents.
- Line speeds of all the lines. This is not a total speed, but a speed for each line.

**Note:** The fields shown in this display have already been described in Figure 28 on page 66.

To add lines to an **existing** communications IOP, select option 8 (Create line resources) on the Work with Communications Resources display shown in Figure 26 on page 62.

	Create Communications Lines							
IOP name		.: CMB01						
Type changes,	press Enter.	Line resource	es with O line	es are not crea	ted.			
Line Resource SC104	Nbr of Lines 1	Line Speed (Kbit/sec) 4000.0	Overhead		Duplex *HALF			
Duplex: *HALF	, *FULL				Bottom			
F3=Exit F4=	Prompt F6=C	reate line reso	ource F12=Ca	ancel				

Figure 29. Create Communications Line Display

# 4.5.3 Distribution of Characters Transferred Across Line Resources

You may examine the distribution of transaction characters in a specific workload being transferred over the communications line resources to find out:

- · The utilization of the line resource
- · Whether you need to consider redistributing a part of the workload

**Distribution is expressed as a relative count**, not as a percentage. For example, if the relative count for line resource SC103 is 4.5 and for SC104 is 18, four times as many characters are being transferred across SC104. Note that line resource SC107 has a relative count of 67.5 that represents 15 times more characters being transferred than SC103.

Also notice that relative counts for LAN are not related to relative counts for WAN. The division of work between WAN and LAN is specified by the number of active jobs on the Objectives display.

**Specify Chars to Comm Line Resources:** Figure 30 shows an example of the Specify Chars to Comm Line Resources display that allows you to specify the relative counts and characters transferred for this workload across communications line resources.

You can access the Specify Chars to Communication Line Resources display by pressing the PF9 key on the Change or Create Workload display.

-		51	<b>4</b>	5	2
2 Line Resour	re (	3 Connect	Nbr of Lines	Line Speed (Kbit/sec)	6 Relative Count
SC103		*WAN	1	4.8	4.5
SC104		*WAN	1	4.8	18.5
SC107		*WAN	1	4.8	65.0
LINTRN		*LAN	1	4000.0	100.0
LINX25A		*WAN	1	9.6	2.5
LINX25B		*WAN	1	4.8	9.5

Figure 30. Specify Chars to Comm Line Resources

Notes:

1 The name of the workload

2 The line resource that the workload is transferring characters across

The type of the line resource. The values are \*LAN (Local Area Network) and \*WAN (Wide Area Network). This value is determined by the minimum line speed supported by the communications IOP feature. LAN communications IOP features have a minimum line speed of 4MB. WAN communications IOP features have a maximum line speed of 4MB.

This field indicates the number of lines that the line resource represents. Adding or removing line resources is done from the Work with Communications IOP Features display.

**5** This indicates the line speeds for lines that are represented by the line resource. If this is an input field, you can type the line speed of your choice. You may also press the PF4 key to select from a list of line speeds.

**6** The relative number of characters transferred across this communications line resource. These are relative to each other; **they are not percentages**. Relative counts for WAN are calculated separate from the relative counts for LAN. For example, Figure 30 on page 68 shows all LAN traffic going across LINTRN and sixty five-hundreds of the WAN traffic going across SC107.

### 4.5.3.1 Communications Workload

BEST/1 creates two types of communications workloads to represent communications activity:

- For communications lines that have traffic but have no jobs associated, BEST/1 creates a workload named QCMN that represents traffic on those lines. QCMN workload contains no I/O activity and no CPU utilization.
- BEST/1 creates a communications workload for workloads that show non-interactive activity in a group but with no corresponding interactive activity in the same group. The name of the workload is your workload name plus the letters QLAN or QWAN (QL or QW if the name is too long). This workload contains only non-interactive activity. BEST/1 creates this workload because it cannot show non-interactive activity for that group in your original workload without showing corresponding interactive activity, which misrepresents the activity of your workload.

### 4.6 Comparing the Model Against the Measured Performance

After completing the changes to the model created, press the PF12 key until the Work with BEST/1 Model menu is displayed and re-analyze the model. On the Display Analysis Summary display, press the PF11 key to compare the results against the measured values.

Repeat the entire process described in this chapter until your performance objectives are met.

# 4.7 Considerations When Analyzing Communications Data with BEST/1

The following list contains communications related assumptions under which BEST/1 creates the model for analysis:

- All controllers are equally distributed across all communications lines for LAN and WAN.
- · All LAN controllers have the same service time.
- All WAN workstation controllers have the same service time.

Please remember the following things when analyzing the model:

- Many times, communications activity caused by batch jobs is put in the special QCMN workload described in Section 4.5.3.1, "Communications Workload" on page 69. Use the copy function or the combine workloads function to properly associate communications activity with CPU and DASD activity.
- Client/Access users connected through 5294 or 5394 controllers are incorrectly assigned as local Client/Access jobs. Client/Access users attached through 5494, however, are correctly assigned.
- Total MFIOP utilization can only be determined by adding the predicted utilizations from the disk IOPs and Arms report with the predicted utilization on the Communications report.
- Assignment of relative counts of communications line activity to workloads is done based on job assignments to workloads and their relative CPU usage.
- LAN utilizations can only be calculated for workload that is actually being done with the AS/400 system. Other traffic on the LAN causes utilizations to be different from the predicted.
- Response times can only take into account the effect of the communications line that is attached to the AS/400 system. Any other connections beyond that line add additional response time.

# Chapter 5. Using System Service Tools

The System Service Tools (SST) provides a relatively easy access to numerous logs that OS/400 constantly maintains. This chapter gives you some examples of how to use the system service tools but please remember that **incorrect use of this service tool can cause damage to data in the system**. Contact your service representative for assistance if you have even a slightest doubt about how to proceed.

## 5.1 Checking the Communications Hardware

The following displays give you an example of how to find information concerning communications error log data. Choose the option that is displayed on the input field. Sign on to the system with a user profile having the \*SERVICE special authorities and enter the STRSST command on any command line. The following display is shown:

System Service Tools (SST)								
Select one of	Select one of the following:							
<ol> <li>Start a service tool</li> <li>Work with active service tools</li> <li>Work with disk units</li> <li>Work with diskette data recovery</li> </ol>								
Selection								
$\frac{1}{2}$								
F3=Exit	F10=Command entry	F12=Cancel						

Figure 31. The System Service Tools (SST) Display

System Service Tools (SST) lets you start service tools, work with active tools, and work with disk unit data. **Be aware:** Service tools should only be used under the direction of your service representative. The options you can select from this display are:

- 1. Start a service tool. The service tools are:
  - Product activity log
  - Trace Licensed Internal Code
  - · Work with communications trace
  - Display/Alter/Dump
  - Work with LIC log
  - · Main storage dump manager

- Hardware service manager
- 2. Select this option to:
  - Start a service tool.
  - · Re-enter a service tool you left active.
  - End an active service tool.

The status of a service tool is shown if the service tool is either active or ending.

- 3. Select this option to use tools that can be run for disk units. You can:
  - Display disk unit configuration.
  - · Calculate disk configuration.
  - Work with the storage threshold of an Auxiliary Storage Pool (ASP).
  - Work with disk unit information.
  - Work with disk unit recovery.
- 4. This option is used to recover the data from a diskette containing read errors. Select this option to:
  - Read the contents of a diskette into the system.
  - Print reports about the data on the diskette.
  - · Review the data on the diskette.
  - · Change the data that has been read from the diskette.
  - Write the changed data back to another diskette.

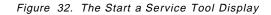
Use this option only when directed by your service representative.

#### – Important! –

Service Tools should only be used under direction of a service representative. Some of the tools allow changes in the data and LIC. These can cause unpredictable results.

The following example shows Start a Service Tool display:

```
Start a Service Tool
Warning: Incorrect use of this service tool can cause damage
to data in this system. Contact your service representative
for assistance.
Select one of the following:
     1. Product activity log
    2. Trace Licensed Internal Code
    3. Work with communications trace
    4. Display/Alter/Dump
     5. Licensed Internal Code log
     6. Main storage dump manager
    7. Hardware service manager
Selection
    1
F3=Exit
                F12=Cancel
                                   F16=SST menu
```



The Start a Service Tool display lets you select a service tool to diagnose problems, for example, with the system Licensed Internal Code (LIC).

The options you can select from this display are:

- 1. This option displays or prints errors that have occurred (such as in disk and tape units, communications, and workstations). This option also lets you work with tape and diskette statistics.
- 2. This option shows a menu that lets you start or stop a trace of Licensed Internal Code (LIC). You can also display, dump, allocate, or clear the trace tables where the LIC is recorded.
- 3. This option lets you start or stop a trace of data on a communications line or network. Any traced data can be formatted and printed.
- 4. This option lets you display or change virtual storage data. You can dump the data to tape, diskette, or printer. You can also print data that was previously dumped to a tape or diskette. USE THIS OPTION ONLY WHEN DIRECTED BY SERVICE REPRESENTATIVE!!
- 5. This option lets you display LIC log information. You can dump the Licensed Internal Code log information to tape or diskette, or to a printer.
- 6. This option lets you display a main storage dump or copy the dump to tape or diskette, or to a printer.
- 7. This option lets you display, work with, and print the stored hardware resource information. Both logical and packaging hardware resources are displayed. This option also allows you to display, alter, trace, or dump input/output (I/O) processor Licensed Internal Code. I/O processors control the storage devices, workstations, and communication data links on the system.

Selecting option 1 provides you with the Product Activity Log display:

	Product Activity Log
Select one	of the following:
2. Dis 3. Cha 4. Won 5. Dis	alyze log splay or print by log ID ange log sizes rk with removable media lifetime statistics splay or print removable media session statistics ference code description
Selection <u>1</u>	
F3=Exit	F12=Cancel

Figure 33. The Product Activity Log Display

This display allows you to display or print product activity log entries, removable media statistic log entries, or to change the size of logs. The options you can select from this display are:

- Select analyze log to display or print a summary of product activity entries. This summary is useful for analyzing intermittent and multiple error conditions.
- 2. Select this option to display or print data from the product activity log by log identifier. The log ID is a unique identifier that ties together all data related to a single error condition.
- 3. Select this option to verify or change the amount of storage on a disk unit used for product activity log data.
- 4. Select this option to display, print, or delete the statistical data logged for the lifetime use of a removable media.

Lifetime is the total length of time one of these media allows information to be read from or written to it. When a removable media is deleted, please delete the entry from the log.

5. Select this option to display or print the statistical data logged for a session of a removable media.

Session is the length of time one of these media is in position to be read from or written to (read/write heads are loaded).

6. Select this option to display or print the description of a reference code.

Select Option 1 on the Product Activity Log display. The Select Subsystem Data display is shown.

	Select S	ubsystem Data	
Type choices, press Enter.			
Log	<u>5</u>	1=All logs 2=Processor 3=Magnetic media 4=Local work station 5=Communications 6=Power 7=Licensed program 8=Licensed Internal Code	
From: Date Time	<u>10/24/96</u> 11:51:44		
To: Date	<u>10/25/96</u> 11:51:44	MM/DD/YY HH:MM:SS	
F3=Exit F5=Re	fresh	F12=Cancel	

Figure 34. The Select Subsystem Data Display

This display allows you to select a subsystem log to work with and the time period you want to work in.

The options you can select from this display are:

- 1. Display or print all data in the product activity log.
- 2. Display or print processor log data.
- 3. Display or print magnetic media error log data, including data for disk and removable media devices.
- 4. Display or print local workstation log data. Local workstations are connected to the system by a method other than a local area network or a communications device.
- 5. Display or print communications log data including:
  - Communications I/O processors
  - · I/O adapters
  - Ports
  - Lines
  - · Controllers including devices connected with following protocols:
    - SDLC
    - ASYNC
    - BSC
    - X.25
    - IDLC
    - ISDN
    - Local Area Network
- 6. Display or print log data associated with the system power control network.
- 7. Display or print licensed program log data.

- 8. Display or print Licensed Internal Code (LIC) log data. LIC is the layered architecture below the machine interface (MI) and above the machine. LIC is a proprietary system design that carries out many functions such as:
  - Storage management
  - · Pointers and addressing
  - · Program management functions
  - · Exception and event management
  - · Data functions
  - I/O managers
  - · Security

All of the selections lead you to the following display:

Select Analys	sis Report Options
Type choices, press Enter.	
Report type <b>1</b> <u>1</u>	1=Display analysis, 2=Display summary 3=Print options
Optional entries to include: Informational 2 Y Statistic <u>N</u>	Y=Yes, N=No Y=Yes, N=No
Reference code selection: Option 3 <u>1</u> Reference codes <b>*ALL</b>	1=Include, 2=Omit *ALL
Device selection: Option	1=Types, 2=Resource names *ALL
F3=Exit F5=Refresh F9=Sor	rt by F12=Cancel

Figure 35. The Select Report Type for Subsystem Display

This display allows you to choose the type of report, the detail report format you want, and the type of entries you want in the report.

**1** The three different report options are:

- 1. This option provides you with a list of entries that match the selected search values. The fields displayed include:
  - System reference code that identifies a unique logging condition. The system reference code is made up of the first four digits of the translate table ID followed by the four digits of the reference code.
  - · Date and time when the entry was logged
  - Error class
  - · Resource name and resource type
  - Logical address that is the direct select address and unit address for the resource most closely related to the entry
  - Frame ID (the identifier assigned to the frame enclosure)
  - · Card and device position

- Device name
- Component (the component ID of the program logging the entry)
- Code (the product library code for the program logging the entry)
- Description
- This option provides you with a summary of log entries sorted by the option specified using the PF9=Sort by...function. The default is to sort by date. The number of entries that match the search values is displayed with each summary line.
- 3. This option prints a report based on the selected search values and sort value.

2 The optional entries to include are:

- Informational entries that are logged to provide information about the system (for example, vary ons and vary offs).
- Statistic entries are logged to record the volume statistics information for removable media. Usually the statistic entries contain no information about communications.

3 The reference code selection enables you to:

- 1. Include entries with certain reference codes only.
- 2. Omit entries with certain reference codes.

Type up to 10 reference codes separated by blanks or commas. Reference codes must be four hexadecimal numbers or you may use a wildcard (\*). The wildcard represents all reference codes that match the hexadecimal numbers in front of the wildcard. For example, AA\* represents all reference codes that begin with AA. There can be only one wildcard in each value and the wildcard must be the last character, although multiple values with wildcards may be used.

The default is to include all entries for all reference codes.

4 The device selection field enables you to:

- 1. Include entries for selected device types.
- 2. Include entries for devices with specific resource names.

Type up to 10 device types or resource names separated by blanks or commas. Device types must be four characters while the resource names are up to 10 characters. You may use wildcards (\*) on both types and names. As with reference codes, only one wildcard per entry is allowed and the wildcard must be in the last position of the value (for example, 93\*).

The default is to include all entries for all device types.

The combination of selections provides you with the Log Analysis Report display:

options, pr Display repo	ress Enter. ort <mark>3</mark> 6=Prin				
isplay repo	ort <mark>3</mark> 6=Prin				
		it report			
System				Resource	Resource
Ref Code	Date	Time	Class	Name	Туре
B008170C	10/25/96	11:15:04	Perm	CHN01	2605
B600FDC0	10/25/96	11:59:42	Temp	CMN02	2619
B00156ED	10/25/96	17:42:58	Perm	CMN01	2612
B00156ED	10/25/96	17:43:33	Perm	CMN01	2612
B00156ED	10/25/96	17:43:49	Perm	CMN01	2612
B600FDC0			Temp		
				CHN05	2605
					2605
					2605
					2605
20001 200	10, 20, 90	00.10.04	, cinh	011107	More
xit					nor c
	Ref Code           B008170C           B600FDC0           B00156ED           B00156ED           B00156ED           B600FDC0           B600FDC0           B600FDC0           B0081701           B0085002           B600FDC0           B600FDC0	Ref CodeDateB008170C10/25/96B600FDC010/25/96B00156ED10/25/96B00156ED10/25/96B600FDC010/28/96B600FDC010/28/96B008170110/28/96B008500210/28/96B600FDC010/28/96B008500210/28/96B600FDC010/28/96B600FDC010/28/96B600FDC010/28/96B600FDC010/28/96	Ref CodeDateTimeB008170C10/25/9611:15:04B600FDC010/25/9611:59:42B00156ED10/25/9617:42:58B00156ED10/25/9617:43:33B00156ED10/25/9617:43:49B600FDC010/28/9609:06:05B600FDC010/28/9609:06:05B008170110/28/9609:06:05B008500210/28/9609:06:05B600FDC010/28/9609:10:203B600FDC010/28/9609:12:03B600FDC010/28/9609:12:04	Ref CodeDateTimeClassB008170C10/25/9611:15:04PermB600FDC010/25/9611:59:42TempB00156ED10/25/9617:42:58PermB00156ED10/25/9617:43:33PermB00156ED10/25/9617:43:49PermB00156ED10/25/9617:43:49PermB000FDC010/28/9609:06:05TempB008170110/28/9609:06:05TempB008500210/28/9609:06:05PermB600FDC010/28/9609:12:03TempB600FDC010/28/9609:12:04Temp	Ref CodeDateTimeClassNameB008170C10/25/9611:15:04PermCHN01B600FDC010/25/9611:59:42TempCMN02B00156ED10/25/9617:42:58PermCMN01B00156ED10/25/9617:43:33PermCMN01B00156ED10/25/9617:43:49PermCMN01B00156ED10/25/9617:43:49PermCMN01B005FDC010/28/9609:06:05TempB600FDC010/28/9609:06:05TempB008170110/28/9609:06:05PermCHN05B008500210/28/9609:12:03TempCMN06B600FDC010/28/9609:12:04TempCMN07

Figure 36. The Log Analysis Report Display

This display allows you to display or print error log entries for each resource listed. If you select to display reports of more than one resource entry, you cannot return to this display until all selected resource entries have been displayed. The PF12 key can only cancel the entry you are working on.

**1** From and To (date and time). The information displayed is gathered between these times. The format is the same as the system date and time.

2 Use the display option to display the Detail Report for the selected entry.

**3** Use the print option to print the Detail Report for the selected entry.

**4** Using the PF11 key provides additional information about all of the entries in the log.

The following display is the Detailed Report for the previously selected entry. If you have selected to display more than one entry, PF12 does not return you to the Log Analysis Report display until all of the selected reference code entries have been displayed.

	Displa	ay Detail Rep	oort for Resource	
Name ITSOX2506	Туре 2605	Model 002	Serial Number 10-***0C	Resource Name CHN01
Date Reference code Table ID	· · · · · ·	: 4 B008F080 : 6 X.25		: 11:15:04 : <b>3</b> 00000000
Press Enter to co	ontinue.			
F3=Exit F9=Address Infor	nation	F10=Pr	F6=H revious detail report	exadecimal report F12=Cancel

Figure 37. The Display Detail Report for Resource Display

The fields have the following meanings:

The Sequence field shows you the numbers (assigned to the entries in the error log) that indicate the sequence in which the errors occurred. The highest number is the most recent.

**2** The Reference code. This is the code that your service representative asks you for because this shows you the hardware error code for the failing condition.

The Secondary code may show the failing condition (for example, IOP return code, processor step code, program return code, or major/minor code).

4 The Table ID. Your service representative may also ask the contents of this field because this identifies a group of reference codes.

**5** This identifies the source of the IPL code being used at the time the entry was added and the state of the machine when the entry was added.

**6** The protocol field shows you the protocol used for sending and receiving data between the resource and the system.

**7** The Error class that identifies the type of the entry is one of the following:

- Permanent
- Statistics
- Temporary
- Threshold
- Buffered
- Recoverable

- Informational
- · Vary on or vary off
- Machine check
- Qualified

8 The description is provided by the reference code translate table.

# 5.2 Working with Communications Traces

Communications Trace is a service function that allows data to be traced on a communications line, a network interface, or a network server. Once the data has been traced, it may be formatted and placed in a spooled file to be displayed or printed.

Communications Trace should be used when:

- Your problem analysis procedures do not give sufficient information about the problem.
- You suspect that a protocol violation is the problem.
- · You suspect that line noise is the problem.
- The error messages indicate that there is an SNA BIND problem.

Interpreting the communications trace output requires detailed knowledge of the line protocols being used to correctly interpret the data generated. The information needed to interpret the trace is in the *SNA Formats*, GA27-3136. Whenever possible, start the communications trace before varying on the line to be traced. This gives you the most accurate sample of the line coming up.

# 5.2.1 Starting and Stopping the Trace

There are two ways to start a trace:

- Enter the Start Communications Trace (STRCMNTRC) CL command.
- Press PF6 on the Work with Communications Traces display accessed by using SST.

A communication trace continues until:

- The End Communications Trace (ENDCMNTRC) command is run.
- TRCFULL(\*STOPTRC) is specified when starting the Trace and the buffer becomes full.
- The Communications Trace function of the SST is used to end the trace.
- A physical line problem causes the trace to end.

In this presentation, we are using the SST functions to trace a token-ring line called AN EXAMPLE. The Work with Communications Traces display is accessed by choosing option 3 on the Start a Service Tool menu displayed in Figure 32 on page 73. The following display is shown:

Work with Communications Traces					
Type options, press Enter. 2=Stop trace 4=Delete trace 6=Format and print trace 7=Display message 8=Restart trace					
0pt	Configuration Object	Туре	Trace Descript	ion Protocol	Trace Status
(No	active traces)				
	it F5=Refres Hisplay buffer s			F10=Change size	

Figure 38. The Work with Communications Trace Display with No Trace Active

Start the trace:

**1** Press PF6; the Start Trace display is shown:

Start	Trace	
Type choices, press Enter.		
Configuration object	<u>an exam</u>	<u>PLE</u>
Туре	<u>1</u>	1=Line, 2=Network interface 3=Network server
Trace description	YOUR DE	SCRIPTION
Buffer size	<u>6</u> 1	1=128K, 2=256K, 3=2048K 4=4096K, 5=6144K, 6=8192K
Stop on buffer full	<u>N</u> 2	Y=Yes, N=No
Data direction	<u>3</u> 3	1=Sent, 2=Received, 3=Both
Number of bytes to trace: Beginning bytes Ending bytes	<u>*CALC</u> *CALC	Value, *CALC Value, *CALC

Figure 39. The Start Trace Display

The descriptions of the fields are:

**1** Buffer Size(K); this shows the size of the buffer allocated to capture data for this trace. The maximum value that can be specified is 8192K bytes.

**Note:** For network server description traces, the buffer size indicates the size of the buffer allocated for the formatted trace output.

2 Stop on buffer full (referred to later as Stop/Wrap) specifies whether the data captured by the trace should be overwritten after the specified buffer size is filled. "Yes" indicates that trace data is written to the buffer only until the buffer is filled. Later data is not traced. "No" indicates that later data is written over earlier data once the buffer is full. Data collected in the beginning of the trace is lost if the buffer wraps over.

**3** Trace Direction determines whether to trace transmitted data, received data, or both.

After starting the trace, the Work with Communications Traces display is shown again as follows:

Work with Communications Traces							
Type options, press E 2=Stop trace 7=Display message	4=Delete trace 6=Format and print trace						
Configuration Opt Object 2 1 AN EXAMPLE 2	TypeTrace DescriptionProtocolTrace Status2LINE3YOUR DESCRIPTION4TRN5ACTIVE						

Figure 40. The Work with Communications Trace Display with Active Trace

The options or the function keys available on this display are:

Option 2 = Stop trace

Select this option to stop a trace that is currently active or waiting for the line, network interface, or network server to be varied on.

- Option 4 = Delete trace
- Select this option to delete a trace that is currently stopped or has an error. • Option 6 = Format trace data

Select this option to show trace data formatting options.

**Note:** The trace status must be STOPPED or ERROR **before** using this option. Use PF5 to update the display and view the current trace status. When

formatting is complete, the trace data is placed in a spooled file named QPCSMPRT in the default output queue.

• Option 7 = Display message

Select this option to show a message associated with a trace that has an error status.

• Option 8 = Restart trace

Select this option to restart a trace. Selecting this option is equivalent to selecting option 4 (Delete trace) and pressing PF6 to start trace in succession. Restarting a trace starts the trace again using the options selected for the original trace.

Note: The trace status must be STOPPED or ERROR to use this option.

- PF10 is used to change the maximum storage size for all traces.
- PF11 is used to view more information about a trace.

#### The fields shown on this display are:

**1** Configuration object shows the name of the configuration object being traced.

2 Type shows the type of configuration object being traced.

**3** Trace Description shows you the text description specified for this trace.

Protocol shows you the protocol used for sending and receiving data on the communications line, network interface, or network server. The protocol types are:

- Async (Asynchronous Communications)
- BSC (Binary Synchronous Communications)
- TRLAN (Token-Ring Network)
- X.25
- SDLC (Synchronous Data Link Control)
- Ethernet (CSMA/CD or DIX V2)
- IDLC (ISDN Data Link Control)
- ISDN (Integrated Services Digital Network)
- DDI (Distributed Data Interface)
- Frame Relay
- Wireless LAN
- NetBIOS (Network Basic Input Output System)

5 The status of the trace is one of the following statuses:

Active	Trace data is being gathered.
Error	An error occurred while the trace was gathering data (some data may have been gathered) or while the trace was being formatted.
Formatting	The trace is being formatted.
Starting	Trace is being started by another user. You cannot stop or delete this trace. Use the PF5 key to update the trace status.
Stopped	The trace has stopped (it is not gathering data).
Stopping	The trace is stopping.

**Waiting** The trace is waiting for the line, network interface, or network server to be varied on and is not gathering data.

If the status of the trace is WAITING and the line, network interface, or network server has not been varied on or the job has not been started, do the following steps:

- 1. Return to the SST Main Menu.
- 2. From the SST Main Menu, press PF10 to receive the Command Entry display.
- 3. Vary on the line, network interface, or network server and start the job.
- 4. Return to the SST Main Menu and choose the option to start a service function.
- 5. Select the Communications Traces service function.
- The trace status should be shown as ACTIVE on the Work with Communications Traces display. Use PF5 to update the trace status.

If you chose the option to stop the trace when the buffer is full, use PF5 to update the trace status. When the trace buffer is full, the trace status changes to STOPPED.

# 5.2.2 Formatting the Trace Data

After the trace has been stopped, you must format the trace. Formatting is done by entering Option 6 on the Work with Communications Traces display and the following display is shown:

Format Trace Data	
Configuration object : AN EXAMPLE Type LINE	
Type choices, press Enter.	
Controller	*ALL, name
Data representation 2 <u>3</u>	1=ASCII, 2=EBCDIC, 3=*CALC
Format SNA data only 3 <u>N</u>	Y=Yes, N=No
Format RR, RNR commands 4 <u>N</u>	Y=Yes, N=No
Format TCP/IP data only <mark>5</mark> <u>N</u>	Y=Yes, N=No
Format UI data only 6 <u>N</u>	Y=Yes, N=No
Format MAC or SMT data only . 7 <u>N</u>	Y=Yes, N=No
Format Broadcast data8Y F3=Exit F5=Refresh F12=Cancel	Y=Yes, N=No



The display-only fields on this display are:

- The configuration object that shows the name of the configuration object traced.
- The type that shows the type of configuration object traced.

The input fields on this display are:

Controller. This option is only valid for Async, X.25, SDLC, IDLC, and local area networks. You can select to format the data for a specific controller or for all controllers attached to the communications line at the time of the trace.

- To format the data for all controllers, type \*ALL.
- To format the data for a specific controller, type the name of the controller.

**2** Data representation. This option is not valid for BSC networks. This option determines whether the hexadecimal data is converted to ASCII or EBCDIC characters.

- Select \*CALC (default) to have the system calculate how to format the displayable characters in the trace.
- Select ASCII to convert the hexadecimal data to displayable characters using ASCII conversion rules.
- Select EBCDIC to convert the hexadecimal data to displayable characters using EBCDIC conversion rules.

For example, hexadecimal 61 is a slash ('/') in EBCDIC but hexadecimal 61 is an "a" using ASCII conversion.

**3** Format SNA data only. This option is only valid for local area networks, SDLC, X.25, and IDLC.

- Select Yes to format and spool SNA data only.
- Select No to format and spool line protocol data (SDLC, X.25, Ethernet, token-ring, DDI, and wireless). SNA data is spooled (shown in hexadecimal form) but is not formatted.

Format RR and RNR commands. This option is only valid for local area networks, SDLC, X.25, IDLC, and ISDN.

- Select Yes to format RR (Receiver Ready) and RNR (Receiver Not Ready) commands in addition to other data.
- Select No if you do not want RR and RNR commands formatted with other data.

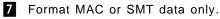
**5** Format TCP/IP data only. This option is only valid for local area networks and X.25.

- Select Yes to format and spool frames that contain Transmission Control Protocol/Internet Protocol (TCP/IP) data only.
- Select No to format and spool line protocol data (token-ring, Ethernet, X.25, or wireless) only.

**6** Format UI data only. This option is only valid for local area networks. "Yes" can be specified for this option only if "No" was specified for the "Format SNA data only" option.

• Select Yes to format and spool Unnumbered Information (UI) data only.

• Select No to format and spool line protocol data (token-ring, Ethernet, DDI, or wireless) only.



**Note:** Traces of token-ring lines attached to a network server description do not contain any MAC data; therefore, this option must be set to No.

This option is only valid for local area networks.

- Select Yes to format and spool only Medium Access Control (MAC) or Station Management (SMT) data.
- Select No to format and spool line protocol data (token-ring, Ethernet, DDI, or wireless) only.

8 Format broadcast data. This option is only valid for local area networks.

- Select Yes to include the broadcast data (frames received with destination MAC addresses of FFFFFFFFFFFF) in the formatted trace data.
- Select No to exclude the broadcast data from the trace.

Usually, the next step after having the trace data both collected and formatted is to send the data to somewhere else to be analyzed. You normally have three alternatives:

- Print out the spooled file and send the printout.
- Save the spooled trace data on tape or diskette and send them.
- · Send the spooled file through communications lines.

To save the spooled trace data to tape or diskette:

- 1. Use the Create Physical File (CRTPF) command to create a file with a record length of 133 and a file type of \*DATA.
- Use the Copy Spooled File (CPYSPLF) command to copy the spooled file QPCSMPRT to the physical file created previously. Set the CTLCHAR parameter to \*FCFC on the CPYSPLF command, or the person receiving the file is unable to print the file.
- 3. To copy to diskette, use the Copy To Diskette (CPYTODKT) command to copy from the physical file to file QDKT. To copy to tape, use the Copy To Tape (CPYTOTAP) command to copy from the physical file to file QTAPE.

To send the spooled trace data to another system:

Use the Send Network Spooled File (SNDNETSPLF) command to send the spooled file to another user on the SNADS network.

If the target system supports DDM:

- 1. Use the Create DDM File (CRTDDMF) command to create a DDM file.
- Use the Copy Spooled File (CPYSPLF) command to copy the spooled file QPCSMPRT to the DDM file created in step 1 in the preceding list. Remember to specify CTLCHAR(\*FCFC) on the Copy Spooled File command.

# Chapter 6. Communications I/O Processor (IOP)

The communications I/O processor (IOP) is the major component within a communications subsystem. When configuring an AS/400 system with communications lines, it is important not to overload an IOP to avoid a possible system performance bottleneck.

This chapter handles the most important values that the performance manager collects for IOPs. It describes how you can use these values to identify IOP bottlenecks, where you can find these values, how they are related to each other, and what you can do to remove the bottlenecks. From a performance point of view, there are two types of IOPs for communications:

- Communications IOPs
- Multi-function IOPs

Performance data for communications IOPs is collected in the file *QAPMCIOP*. Performance data for multi-function IOPs is collected in the file *QAPMMIOP*. The field names described in this chapter start with *xx*. You should replace *xx* by *CI* to retrieve the field name used in the QAPMCIOP file. You should replace *xx* by *MI* to retrieve the field name used in the QAPMMIOP file.

In this chapter, references are made to performance reports and performance displays. Read Chapter 3, "Using Performance Tools/400" on page 27 to see how you can print these reports or reach these displays.

## 6.1 Important Fields in the IOP Performance Manager File

The important performance fields in the QAPMCIOP file are all related to IOP utilization.

# 6.1.1 IOP Utilization

IOP utilization is the percentage of elapsed time during which the IOP was utilized. IOP utilization is an important performance indicator. Exceeding the utilization threshold value may lead to unacceptable response times.

### 6.1.1.1 Using Performance Tools/400 to Display IOP Utilization

To view the IOP utilization, you can print:

- · The component report
- · The resource report

The component report has an IOP utilizations section that shows you the IOP utilization over the total report period (see Figure 42 on page 90). You can print the component report by using the PRTCPTRPT command.

					onent Repor Utilization				11/15/	96 16:01:5 Page 1
		Model/Seria MTA System name				÷				
Communicatio	ns		OPS1	ART Msg -	КВ	ytes Trar	nsmitted	Restart	BNA	Availabl
IOP's		Utilization	Reverse	Norm	al IOP		System	Queues	Received	Storage
 CCO1	(2619)	4.6	0	1,0	81	465	429	0	0	1,895,53
CC03	(2617)	4.4	0	-	72	4,922	350	0	0	2,130,64
CC04	(2623)	.2	0	1	95	14	7	0	0	43,74
DASD IOP's		Utilization	Ops Pe	er Sec						
SI03	(6512)	.0		4						
Multi-functi IOP's	on	Utilization								
СМВО1	(9162)	1.1								
Local Work Station IOP'			OPSTART Msg verse Norma	-	Transmitted System		BNA Received		ue Average Suspend Active	
wS01 (916A	) .1		0	,	0	0	0	.0	.0 .0	.0

Figure 42. Component Report - Communications IOP Utilization

The resource report has an IOP utilizations section that shows you the IOP utilization per interval. Figure 43 shows the component report for the communications IOP. Figure 44 on page 91 shows the component report for the multi-function IOP. You can print the resource report by using the PRTRSCRPT command.

						rval Report IP Utilizations			11/15,	96 16:42:0 Page
Member . Library			odel/Serial . : 5 ystem name :			Main storage Version/Release .				
IOP Name/		Itv		OPSTAR	T Msg	KBytes Tran	smitted	Restart	BNA	Avail Loc
(Model)		End	Utilization	Reverse	Normal	IOP	System	Queues	Received	Storage (
CC01	(2619)	14:29	4.5	0	169	65	58	0	0	1,8
		14:34	4.6	0	152	69	67	0	0	1,8
		14:39	5.0	0	367	111	174	0	0	1,8
		14:44	4.4	0	146	63	69	0	0	1,8
		14:49	4.3	0	75	51	19	0	0	1,8
		14:54	4.5	0	89	51	25	0	0	1,8
		14:59	4.6	0	83	55	17	0	0	1,8
CC03 (2	(2617)	14:29	6.7	0	3,735	4,916	350	0	0	2,0
		14:34	4.0	0	7	1	0	0	0	2,0
		14:39	4.1	0	6	1	0	0	0	2,0
		14:44	3.8	0	6	1	0	0	0	2,0
		14:49	3.8	0	6	1	0	0	0	2,0
		14:54	4.0	0	6	1	0	0	0	2,0
	<i></i>	14:59	4.1	0	6	1	0	0	0	2,0
CC04	(2623)	14:29	.1	0	28	2	1	0	0	
		14:34	.2	0	28	2	1	0	0	
		14:39	.4	0	28	2	1	0	0	
		14:44	.1	0	27	2	1	0	0	
		14:49 14:54	.1	0	28 28	2	1	0	0	
		14:54 14:59	.3	0	28	2	1	0	0	

Figure 43. Resource Report - Communications IOP Utilization

					erval Report OP Utilizations		11/15/96	16:42:0 Page 1
					Main storage : 3 Version/Release . :			
OP Name/		Itv						
(Model)		End	Utilization	1				
MB01	(9162)	) 14:29						
	(,	14:34						
		14:39						
		14:44	.4					
		14:49	1.9					
		14:54	2.4					
		14:59	.7					

Figure 44. Resource Report - Multifunction IOP Utilization

To relate the IOP information provided by the Component and Resource reports to particular communication line descriptions, you can use the System Report -Communication Summary. By selecting the line description you want, the System Report provides the IOP Resource Name, IOP Type and line name. Otherwise, it is not obvious which lines are associated with which IOPs from the component and resource reports alone.

Alternatively, you can enter the WRKHDWRSC (\*CMN) command and use PF11 to display the addresses of the IOPs.

### 6.1.1.2 Performance Monitor Database Fields

The following fields in the performance monitor database file are related to the IOP utilization:

- **xxIDLC** The idle loop count. The number of times the communication IOP ran an idle loop. This is done when the IOP has no work to perform.
- **xxIDLT** The idle loop time. The time in hundredths of micro seconds to run the idle loop once.
- **xxKBYO** Number of bytes transmitted from the IOP to the system. For communications, this includes inbound data from all lines on this IOP.
- **xxKBYI** Number of bytes transmitted from the system to the IOP. For communications, this includes outbound data to all lines on this IOP.
- **xxRSTQ** The number of times that the IOP sent a work request (OPSTART) to the system and the system queues to process the request were full.
- xxBNAR The number of times that a system hardware buffer overrun occurred.

A non-zero value in the field xxRSTQ indicates that the IOP is sending requests and data to the system faster than the system can handle them. This value should be 0 or low.

A non-zero value in the field xxBNAR indicates that IOP work requests are being sent to the system faster than the hardware buffers are unloaded. This value should be 0 or low.

The IOP utilization is derived from the following equation:

IOP utilization = (INTSEC - (xxIDLC \* xxIDLT) / 10 \*\* 8) / INTSEC

INTSEC is the elapsed interval seconds.

### 6.1.1.3 Where to Find the Performance Values

- **xxIDLC** This is a field in the QAPMCIOP/QAPMMIOP file. To determine the value of this field, you can:
  - Query the QAPMCIOP/QAPMMIOP file.
- **xxIDLT** This is a field in the QAPMCIOP/QAPMMIOP file. To determine the value of this field, you can:
  - Query the QAPMCIOP/QAPMMIOP file.
- **xxKBYO** This is a field in the QAPMCIOP/QAPMMIOP file. To determine the value of this field, you can:
  - Query the QAPMCIOP/QAPMMIOP file.
  - Print the resource report (Communications IOP only).
  - Print the component report (Communications IOP only).
- **xxKBYI** This is a field in the QAPMCIOP/QAPMMIOP file. To determine the value of this field, you can:
  - Query the QAPMCIOP/QAPMMIOP file.
  - Print the resource report (Communications IOP only).
  - Print the component report (Communications IOP only).
- **xxRSTQ** This is a field in the QAPMCIOP/QAPMMIOP file. To determine the value of this field, you can:
  - Query the QAPMCIOP/QAPMMIOP file.
  - Print the resource report (Communications IOP only).
  - Print the component report (Communications IOP only).
- **xxBNAR** This is a field in the QAPMCIOP file. To determine the value of this field, you can:
  - Query the QAPMCIOP/QAPMMIOP file.
  - Print the resource report (Communications IOP only).
  - Print the component report (Communications IOP only).

#### **IOP** utilization

This is a derived field. To determine the value of this field, you can:

- · Print the resource report.
- · Print the component report.

The component report shows you the IOP utilization over the total report period. The resource report shows you the IOP utilization per interval.

### 6.2 Communication IOP Recommendations

One of the most important factors affecting the overall communication performance on an AS/400 network is the performance of the communication Input/Output Processor (IOP). The communications workload should be distributed as evenly as possible across all available resources such as communication lines, IOP subsystems, and system buses.

We shall examine the following factors affecting IOP performance:

- Configuring communication lines
- Frame size
- IOP type
- IOP assist
- · IOP utilization

# 6.2.1 Configuring Communication Lines

Care should be taken when configuring wide-area network communication lines because each IOP subsystem has a limit to the number of lines it can support based on factors such as line speed, protocol, frame size, and the number of X.25 virtual circuits. This limitation is mainly determined by the amount of storage on the IOP and is more important for the older IOPs that had less storage available. In addition to the storage used to hold operational microcode and protocol specific code, the following line configuration parameters require additional storage.

**MAXFRAME** Maximum frame size.

**MAXOUT** Maximum number of outstanding or unacknowledged frames.

#### MAXBUFFER

Maximum size of inbound and outbound data buffers or message size (used for BSC or ASYNC protocols).

MAXCTL Maximum number of controllers.

For detailed guidelines on configuring lines and communication subsystems, refer to the *Communications: Management Guide*, SC41-3406. Pay special attention to the section describing aggregate line speed and subsystem storage considerations.

These theoretical maximum configurations for each communications IOP may not provide the expected performance if there is some other bottleneck such as the CPU's ability to support the communications workload, or if there are excessive errors on a particular line. Communications applications consume CPU resources to process data and support disk I/O as well as to process the communications software itself. Instead of thinking how many communication lines a given system can support, determine how many lines are required to support the expected workload, and find out which AS/400 model is capable of accommodating this load.

The configuration guidelines should be adhered to because seemingly minor configuration changes may lead to problems if the IOP is overloaded. Future changes to certain line description parameters such as MAXFRAME, MAXCTL, or MODULUS may result in insufficient IOP storage if they are increased beyond the default values.

The guidelines are more accurate for a large transfer environment because the utilization of the IOP is affected by the size of the frames being handled. In an interactive environment where many small frames are being transmitted to a large number of workstations per line, the IOP has to work considerably harder than for a large file transfer environment. This is particularly true for frames smaller than 256 bytes and can reduce the number of lines supported.

### 6.2.2 Frame Size

In general, the use of larger frames results in improved IOP performance and lower response times. This is because the time it takes the IOP to process a large frame is only slightly longer than that for a small frame. As the total number of frames is reduced by using large frames, so too is the total overhead associated with the processing of the frames. The IOP processing time is shorter, allowing it to handle other transactions and provide improved throughput. This is of particular significance in a LAN environment where the high media speed reduces the possibility of the line being a bottleneck. This is in contrast to a wide-area network communication line, where line speed is often the main cause of throughput and response time problems. The frames on a LAN arrive at the IOP at a much higher rate and if the frame size is not maximized, throughput may be dramatically reduced. The relatively error free transmission environment of a LAN aids the use of large frames as few re-transmissions are required. This is the main concern when using large frames on a noisy wide-area communication line, as re-transmissions reduces overall performance.

To correctly configure your lines for maximum frame sizes, you must change the MAXFRAME parameter on both the line and controller descriptions. This holds for TRLAN, ELAN, FDDI, Frame Relay, SDLC, and ISDN. For X.25, both the DFTPKTSIZE and MAXFRAME parameters must be increased.

# 6.2.3 IOP Type

The choice of a communication IOP is also of importance because the new high performance IOPs such as the 2623, 2619 (token-ring), 2617 (Ethernet) and 2666 offer superior performance compared to the older IOPs. These high performance IOPs have faster microprocessors and more memory. If the throughput of the IOP is unsatisfactory and it is not possible to offload some of the workload to other IOPs, it may be necessary to upgrade to one of these processors. It is especially important to use the higher performing IOPs for file serving and database serving and in environments where there are many communication I/Os per transaction.

The 2623 six-line communication IOP provides better performance than the older style processors in any of the following situations:

- There is a requirement for high X.25 throughput.
- The IOP has several lines attached to it.
- High speed lines are required.
- The lines are heavily utilized.
- There is a high amount of polling on the lines.

The 2666 high speed communications IOP supports high speed lines such as T1(1.544Mbps)/E1(2.048Mbps) and supports communication protocols such as SDLC, frame relay, and X.25.

Refer to Section 9.2.1, "IOP Utilization" on page 159, Section 8.4.1, "IOP Utilization" on page 143, and Section 7.10, "LAN IOPs" on page 122 for a more detailed comparison of IOP performance measurements.

### 6.2.4 IOP Assist

The new LAN IOPs (2617, 2619, 2618, 2665, 2668, and 2666) also support a function called IOP assist that allows APPC applications to send RUs and TCP/IP applications to send buffers to the IOP for processing, which reduces the CPU utilization for these tasks. When using WAN IOPs or the older types of LAN IOP, the time spent by the CPU processing frames decreased significantly as the frame size was increased. The IOP assist feature makes the CPU time far less dependent on frame size because much of the processing is offloaded to the IOP.

```
- Note -
```

Changing the RU size (MAXLENRU) in the APPN mode descriptions to a value other than \*CALC may negate the IOP assist performance feature.

## 6.2.5 IOP Utilization

An essential step to obtaining good system level performance is to ensure that you do not exceed the recommended utilization limit of any system resource. Guidelines for IOP utilization figures are given in Appendix I, "Guidelines for Interpreting Performance Data" on page 379 for the following communication IOPs:

- Multifunction IOP
- Communication IOP (WAN)
- · LAN IOP
- Integrated PC Server (Formerly referred to as FSIOP)

It is not possible to give a fixed percentage IOP utilization as a maximum recommended value as this depends on the nature of the communication workload at the time the utilization is measured. In the case of an SDLC line with several controllers attached and workstations in an "active" or "varied on" state, the IOP utilization may be as high as 80% without any real "work" being done by the remote workstations. This is due to the constant transmission of Receive Ready (RR) frames that are necessary to maintain the active links. This is referred to as "polling" and means that an IOP can appear busy even when no real work is being performed. For this reason, the IOP utilization value provided by AS/400 Performance Tools is only of value if you know that productive work was being done during a particular monitor interval. If you know that only RR activity was present during the interval, you need not be concerned by seeing a high utilization.

For interactive environments, you may still have acceptable performance with a utilization of up to 60%. This figure may be even higher if there is only a small number of concurrent users.

Similarly, when using multipoint lines, you should vary off any controllers that are turned off as the IOP wastes time polling them if they are left "vary on pending". This unnecessary polling increases IOP utilization and slows response time for other users. See Section 9.1.5, "Connect Poll Retries" on page 155 for a discussion of polling and the importance of line description polling parameters such as POLLPAUSE, which can be adjusted to limit the frequency of polling inactive stations. The IOP utilization is also affected by error recovery and retries. If you are experiencing high utilization, check the System Service Tools (SST) error logs for the lines controlled by that IOP for errors. You can also change the error logging threshold level (THRESHOLD) to \*MAX temporarily to have error messages posted to the QSYSOPR message queue.

# Chapter 7. Local Area Network Performance Analysis

Local Area Network (LAN) support on the AS/400 system offers a flexible means of connection for token-ring and Ethernet network users at much higher transmission rates than are possible with conventional wide-area network communication lines. Yet in spite of the high bandwidth available, LANs also suffer from bottlenecks and poor performance. This chapter discusses some of the common reasons for poor performance on token-ring and Ethernet LANs and describes the key indicators of performance that are found in the OS/400 Performance Monitor database. This data can be analyzed using Performance Tools/400 or by running your own queries over these database files.

LAN performance is also dependent upon the applications and protocols being used, the hardware and software configurations of the LAN workstations, and the LANs physical topology. This chapter focuses on tuning the AS/400 system for optimum performance and does not cover these other variables.

## 7.1 LAN Performance Indicators in Performance Monitor Database

The following are the main LAN performance indicators that are analyzed using the information available in the OS/400 Performance Monitor database files.

- · Line utilization
- LAN congestion
- Medium access control (MAC) errors
- Retransmissions
- Timeouts
- LAN overheads

## 7.2 Line Utilization

Line utilization measures the percentage of elapsed time during which the LAN was busy transferring data.

Operating the LAN at too high a line utilization results in poor response time and throughput due to excessive queuing time.

### 7.2.1 Using Performance Tools/400 to Display Line Utilization

Line utilization can be displayed using the DSPPFRDTA command after having collected performance data with OS/400 Performance Monitor.

The DSPPFRDTA command provides a combination of system, component, and resource report information. Press PF21 on the Display Performance Data display to view the Communication Line Detail display as shown in Figure 45 on page 98.

The line utilization for the sample interval selected is the value listed under the % Busy column heading.

Member . Libran	 ^у	•	290843 FRDATA	Elapsed †	time	: 09:5	7:23
Type opt	tions, press	Enter.					
5=Disp	olay remote	jobs 7=D	isplay comm	unications	s interval d	ata	
	Line	Line	Line	Tns	Average	Job	%
Option	ID	Туре	Speed	Count	Response	Count	Busy
•	0M102	SDLC	9.6	412	3.19	9	7.3
	OM105	SDLC	9.6	2145	1.84	22	8.6
	SI102	SDLC	9.6	219	3.22	7	6.2
	OM106	SDLC	9.6	1949	2.19	17	10.7
	ITSC	SDLC	9.6	0	.00	0	1.1
	0M104	SDLC	9.6	1300	1.99	13	9.2
	SC103	SDLC	4.8	2176	2.42	18	23.4
	LINTRN	TRLAN	4000.0	142	.00	44	.3
							Botto
					Sort by tran		0000

Figure 45. DSPPFRDTA - Communications Line Detail

Performance Tools/400 also provides the following reports that can be printed using PRTSYSRPT (Print System Report) and PRTRSCRPT (Print Resource Interval Report):

• System Report - Communication Summary shows average and peak line utilization over the total report period as in Figure 46.

				Communi	tem Report cations Su	mmary		9/	06/93 16:39:0 Page 000
ember : Q95229 Library : QPFRD/		'Serial . 1 name				port orage: 64 /Release : 3/			
Bus/IOP/ Line	Protocol	Line Speed	Avg Util	Max Util	Active Devices	Number Transactions	Average Response	Bytes P Received	er Second Transmitte
JS 0 IOP 03 (2626)	TRLAN	4000.0	0	1	23	0	.0	1315.8	499.2

Figure 46. System Report - Communication Summary

• Resource Interval Report - Communications Line Detail shows the utilization calculated per sample interval as shown in Figure 47 on page 99.

						ce Inte cations lesource	Line [	etail	ort			09,		15:09:1 Page 10
Libra	: Q9 ary : QP OL = TRLAN (	FRDATA	System	Serial name					.:64 .:3			••••••••••••••••••••••••••••••••••••••		
								stion -						
	Bus/			I Frames	I Frames			Rem			Rsp	Remote		
Itv	IOP/	Line	Line	Trnsmitd	Recd	Not	Seq	Not	Seq	Frame	Timer	Fram		MAC
End	Line	Speed	Util	Per Sec	Per Sec	Ready	Error	Ready	Error	Retry	Ended	Trnsmitd	Recd	Error
	BUS 0 IOP 3 (2626)													
	LINTRN	4000.0	0	1	1	0	1	-	0	0	8	0	0	8
		4000.0	0	2	2	-	2		0	0	16	0	0	12
9:14	LINTRN				2	0	3	0	0	0	20	0	0	15
9:14 9:29	LINTRN LINTRN LINTRN	4000.0	0	1	3	0	1	0	0	0	16	0	0	11

Figure 47. Resource Interval Report Showing Communication Line Details

Performance Tools also provides graphic support for line utilization and can show up to 16 lines on a single graph.

— Note –

If you are using TCP/IP in a LAN environment, the line utilization in the PT/400 output may not be correct because frames for TCP/IP traffic are not counted in the PT/400 report. If this is the case, you need to create your own query to measure the line utilization. For an example, please see Appendix B, "Local Area Network Queries" on page 239.

### 7.2.2 Performance Monitor Database Fields

ELICT

The following fields can be found in the performance monitor database files QAPMECL and QAPMETH that contain token-ring network and Ethernet fields respectively.

Total number of characters transmitted in all I-frames

### **QAPMECL** - Token-Ring Network File:

ELICR	Total number of characters received in all I-frames
ELLSP	Line speed expressed in bits per second
INTSEC	The number of seconds since the last sample interval
ELLND	Line description
QAPMSAF	P - SAP data File:
SCBXMT	Total number of characters transmitted in UI-frames for this SAP
SCBRCV	Total number of characters received in UI-frames for this SAP
SCLND	Line description
SCSSAP	The source SAP (SSAP) ID (for TCP/IP, it is AA.)
LINE UTL	(%) = ((ELICT+ELICR+SCBXMT+SCBRCV)*8*100) / (ELLSP * INTSEC)

The factor of 8 in this equation is used to convert the number of characters (bytes) into the number of bits.

This line utilization may not represent a value that is quite accurate. First of all, LAN is a shared media and many stations may be using the same ring. AS/400 PT/400 collects bytes counts only from the AS/400 system or to the AS/400 system so that data between other stations are not collected. Second, only I-frames are counted for SNA traffic and we have no idea for other frames. If you observe poor performance in a LAN environment but the line utilization shows a low number (such as 10%), the IOP utilization may show a high figure.

#### **QAPMETH - Ethernet Network File:**

ETLICT Total number of characters transmitted in all I-frames
ETLICR Total number of characters received in all I-frames
ETLLSP Line speed expressed in bits per second
INTSEC The number of seconds since the last sample interval
ETLLND Line description

((ETLICT + ETLICR + SCBXMT + SCBRCV) \* 8 \* 100)
LINE UTILIZATION (%) = -----(ETLLSP \* INTSEC)

This line utilization may not represent a value that is quite accurate. First of all, LAN is a shared media and many stations may be using the same bus. AS/400 PT/400 collects bytes counts only from the AS/400 system or to the AS/400 system so that data between other stations are not collected. Second, only I-frames are counted for SNA traffic and we have no idea for other frames. If you observe poor performance in a LAN environment but the line utilization shows a low number (such as 10%), the IOP utilization may show a high figure.

### 7.2.3 Recommendations

In order to achieve good performance in a token-ring environment, it is recommended that the line utilization should not exceed 50%. The figure is lower for the Ethernet environment. Studies have shown that the CSMA/CD protocol used on Ethernet networks optimizes throughput and response time under conditions of relatively low (less than 40%) bandwidth utilization.

In a large data transfer environment where there are a small number of interactive users contending for the line, a higher line utilization can still offer acceptable performance.

The relatively high transmission rates of LAN networks reduce the likelihood of the line utilization being a performance bottleneck. It is more common for the application code, the system communication code, or the performance of the CPU and LAN IOP to be the limiting factors on response time and throughput.

### 7.3 LAN Congestion

LAN adapter congestion is often a cause of performance degradation on token-rings and Ethernets. This section discusses some common performance indicators that identify LAN congestion.

### 7.3.1 Not Ready and Sequence Errors

When a link station is experiencing congestion due to overflow of the receive buffers, it signals the host using a Receive Not Ready frame. This usually indicates a slow-down or a temporary inability to receive additional information frames.

If a receiving station finds an error in frames, it signals the sending station using a Reject frame for retransmission. This is an indication that the information frames are being received out of sequence.

### 7.3.2 Using Performance Tools/400 to Display Congestion

LAN congestion errors can be analyzed using the DSPPFRDTA command as follows:

- Type DSPPFRDTA.
- · Select performance member.
- Select time interval.
- Press PF21 for Display Communication Line Detail.
- Select the line you want to view with a "7" for Display Communication Interval Data.

The results are shown in Figure 48.

Line ty Line sp Bus num	pe eed ber ress	· · · · ·	LINTRN TRLAN 4000.0 0 3	L	ibrary		:	Q952290843 QPFRDATA 09:57:23
• • •	tions, pres play remote		er.			Cona	estion	
			I Frames	I Frames	Local	Local		
	Itv	Line	Trnsmitd	Recd	Not	Seq	Not	Seq
Option	Itv End	Line Util		Recd Per Sec				
Option	End 16:28:38	Util .2	Per Sec 1					
Option	End	Util .2	Per Sec 1 7	Per Sec 1 4	Ready	Error	Ready	Error
Option	End 16:28:38	Util .2 .2	Per Sec 1 7 2	Per Sec 1 4 2	Ready 0	Error 1	Ready 0	Error O
Option	End 16:28:38 16:43:37	Util .2 .2 .3	Per Sec 1 7 2	Per Sec 1 4 2 2	<b>Ready</b> 0 0	Error 1 3	Ready 0 0	Error 0 0
Option	End 16:28:38 16:43:37 16:58:35	Util .2 .2 .3	Per Sec 1 7 2	Per Sec 1 4 2	<b>Ready</b> 0 0 0	Error 1 3 0	<b>Ready</b> 0 0 0	<b>Error</b> 0 0 0
Option	End 16:28:38 16:43:37 16:58:35 17:13:33	Util .2 .3 .3	Per Sec 1 7 2 2	Per Sec 1 4 2 2	<b>Ready</b> 0 0 0 0	Error 1 3 0 1	<b>Ready</b> 0 0 0 0	Error 0 0 0 0

Figure 48. DSPPFRDTA - Display Communications Interval Data

This display shows the congestion error counters for each sample interval.

#### Local Not Ready

These are the Receiver Not Ready frames transmitted by the host as a percentage of the Information Frames received by the host.

### Local Sequence Error

These are the Reject frames transmitted by the LAN IOP as a percentage of the Information Frames received by the AS/400 system.

#### **Remote not Ready**

These are the Receiver Not Ready frames received by the AS/400 system as a percentage of the Information Frames transmitted by the LAN IOP.

### **Remote Sequence Error**

These are the Reject frames received by the host as a percentage of the Information Frames transmitted by the host.

These same congestion error counters can be displayed using PRTRSCRPT (Print Resource Interval Report) as shown in Figure 47 on page 99.

### 7.3.3 Performance Monitor Database Fields

The following fields from the performance database files QAPMECL and QAPMETH are the most important indicators of LAN adapter congestion.

#### **QAPMECL** - Token-Ring Network File:

ELRFT	Total number of Receiver-Not-Ready frames transmitted
ELRFR	Total number of Receiver-Not-Ready frames received
ELRJFT	Total number of Reject frames transmitted
ELRJFR	Total number of Reject frames received
ELIFT	Total number of I-frames transmitted
ELIFR	Total number of I-frames received
EMRXC	Receive Congestion. Frame was not received due to insufficient receive buffer.
EMIOA	I/O adapter overrun. Adapter interrupt status queue overrun.
QAPMETH -	Ethernet File:
ETLRFT	Total number of Receiver-Not-Ready frames transmitted
ETLRFR	Total number of Receiver-Not-Ready frames received
ETLRJFT	Total number of Reject frames transmitted
ETLRJFR	Total number of Reject frames received
ETLIFT	Total number of I-frames transmitted
ETLIFR	Total number of I-frames received
ETMROV	Receiver overruns due to buffer shortage
ETLLBC	Counts of the number of times the station entered a local busy substate
-	on errors reported by Performance Tools/400 are derived from the lds using the following equations:

Local Not Ready (%) = ( ELRFT\*100 )/ ELIFT

### Local Sequence Error (%) = ( ELRJFT\*100 )/ ELIFT

Remote Not Ready (%) = ( ELRFR\*100 )/ ELIFT

Remote Sequence Error (%) = ( ELRJFR\*100 )/ ELIFT

If the local congestion values are high, it is an indication that the AS/400 IOP or system data buffers are not being emptied fast enough to cope with the received traffic.

If the remote congestion values are high, further investigation should be undertaken to determine which remote stations are experiencing the congestion. This is because these figures are gross values for the entire network that can mask individual station problems.

In this case, more detailed information for each workstation is found in the performance database files QAPMSTNL and QAPMSTNE that contain token-ring station and Ethernet station file entries respectively. The following fields are useful:

#### **QAPMSTNL** - Token-Ring Station File:

SLLND	Token-ring line description
SLTYPE	Resource type of the token-ring IOP
SLSTNN	Name of reporting workstation
DTETIM	Interval date (yy/mm/dd) and time (hh:mm:ss)
SLRNRX	Number of Receiver-Not-Ready frames transmitted
SLRNRR	Number of Receiver-Not-Ready frames received
SLREJT	Number of Reject frames transmitted
SLREJR	Number of Reject frames received
SLIXMT	Total number of I-frames transmitted
SLIRCV	Total number of I-frames received
SLLBCT	Number of times station entered local busy substate
QAPMSTNE	- Ethernet Station File:
STLND	Ethernet line description
STLND STTYPE	Ethernet line description Resource type of Ethernet IOP
	·
STTYPE	Resource type of Ethernet IOP
STTYPE	Resource type of Ethernet IOP Name of reporting workstation
STTYPE STSTNN DTETIM	Resource type of Ethernet IOP Name of reporting workstation Interval date (yy/mm/dd) and time (hh:mm:ss)
STTYPE STSTNN DTETIM STRNRX	Resource type of Ethernet IOP Name of reporting workstation Interval date (yy/mm/dd) and time (hh:mm:ss) Number of Receiver-Not-Ready frames transmitted
STTYPE STSTNN DTETIM STRNRX STRNRR	Resource type of Ethernet IOP Name of reporting workstation Interval date (yy/mm/dd) and time (hh:mm:ss) Number of Receiver-Not-Ready frames transmitted Number of Receiver-Not-Ready frames received
STTYPE STSTNN DTETIM STRNRX STRNRR STREJT	Resource type of Ethernet IOP Name of reporting workstation Interval date (yy/mm/dd) and time (hh:mm:ss) Number of Receiver-Not-Ready frames transmitted Number of Receiver-Not-Ready frames received Number of Reject frames transmitted
STTYPE STSTNN DTETIM STRNRX STRNRR STREJT STREJR	Resource type of Ethernet IOP Name of reporting workstation Interval date (yy/mm/dd) and time (hh:mm:ss) Number of Receiver-Not-Ready frames transmitted Number of Receiver-Not-Ready frames received Number of Reject frames transmitted Number of Reject frames received
STTYPE STSTNN DTETIM STRNRX STRNRR STREJT STREJR STIXMT	Resource type of Ethernet IOP Name of reporting workstation Interval date (yy/mm/dd) and time (hh:mm:ss) Number of Receiver-Not-Ready frames transmitted Number of Receiver-Not-Ready frames received Number of Reject frames transmitted Number of Reject frames transmitted Total number of I-frames transmitted

## 7.3.4 Receive Congestion Errors on Token-Rings

Another useful indicator of LAN adapter congestion is the Receive Congestion error which is a Medium Access Control (MAC) error reported by token-ring devices only.

Receive congestion is one of the standard MAC errors reported to the functional address of Ring Error Monitor every two seconds and is a function of the token-ring architecture. There are many devices that can perform the function of a ring error monitor (for example, a LAN Network Manager station or a 3174).

Performance Tools/400 only displays the total number of MAC errors occurring on the network. This is discussed in Section 7.4, "Medium Access Control (MAC) Errors" on page 106. However, the following field in database file QAPMECL can be used as an indicator of congestion on the AS/400 token-ring I/O adapter.

**EMRXC** Receive congestion: The frame was not copied because no buffer was available.

There are no individual station counters for receive congestion errors in the database files. This makes it difficult to isolate the offending adapter. Often it is the case that a PC simply needs to be re-booted to clear a congestion problem as there can be a problem between the token-ring adapter drivers and the PC application. Even though there may be no application currently using the token-ring connectivity, as long as the PC is still powered on and connected to the LAN, the adapter still tries to process frames containing its MAC address or a broadcast frame.

## 7.3.5 Ethernet Collision Counters

Ethernet networks implement a Carrier Sense Multiple Access with Collision Detection (CSMA/CD) protocol. When a station has data to send, it first listens to the media to determine if data is currently being transmitted by another station. If not, the station begins to transmit while continuing to listen to detect whether the frames collide with other transmissions. If a collision does occur, the stations must "back-off" and cease transmitting for a random period of time. As this time period is different for each station, eventually one of them should be able to successfully transmit without further collisions. If a station encounters 16 unsuccessful transmission attempts, the frames are discarded and it is left to the higher level protocols to deal with the retransmission of that frame.

Clearly the more stations on any given Ethernet segment, the greater the number of collisions, and more retransmissions are needed. This leads to congestion of the available bandwidth and poor response times.

Performance Tools/400 does not display information regarding Ethernet collision statistics. However, the following database files do contain collision counters. There are no equivalent fields in the Ethernet station counter file QAPMSTNE so it is not possible to look at individual station statistics.

### **QAPMETH - Ethernet Statistics File:**

- **ETMEXR** Number of frames unsuccessfully transmitted more than 16 times and hence discarded due to excessive retries
- **ETMM1R** Number of frames requiring more than one retry for successful transmission

- **ETM1R** Number of frames requiring exactly one retry to transmit
- **ETMDCN** This counts the number of times that transmission was deferred due to the media being busy

A high value for ETM1R does not necessarily correspond to a high collision rate on the Ethernet bus. This field is useful if you analyze the information together with the other fields and make a comparison on the success rate of transmission on the network.

### 7.3.6 Recommendations to Control Congestion

Invariably LAN congestion causes degraded network performance. However, there is no definitive approach to take to produce immediate results because of the many different components that affect congestion on a LAN. Some of these factors are:

- · The characteristics of the application
- The amount of data sent
- The rate that the application can present and accept data
- The data blocking characteristics
- · The LAN adapter type
- The processing unit model..
- The utilization of the line, adapter, and the CPU..
- The internal buffering capabilities..

Some improvements that can be taken to resolve congestion are:

- Install a higher performance LAN adapter.
- · Use larger frame sizes to increase the throughput of the LAN.
- Use pacing for SNA sessions to limit the transmission rate to congested adapters. Pacing specifies the number of request units (RUs) that can be sent before an acknowledgement is required from the receiving device. Pacing is specified in the mode description and may be different for each session. This is discussed in further detail in Chapter 10, "SNA" on page 163.
- Increase the value of the LANRSPTMR parameter in the controller description. See Section 7.9.3, "LANRSPTMR and LANFRMRTY" on page 117. This reduces the number of times that a station solicits a response and lets it wait for the receiver's LANACKTMR to expire causing it to send the needed response if the frame has arrived. LANRSPTMR should not exceed two seconds.
- Consider lowering the value of LANMAXOUT, which controls the rate of transmission of the transmitting station if you have the following situation. The transmitting station is using a faster adapter than the receiving station over a fast media and the transmitting station is receiving a high number of Receiver Not Ready frames or Reject frames.
- Consider changing the topology of your network by breaking it up into smaller segments using bridges or switched hubs. Careful network design is required to prevent creating bottlenecks with these new network components.
- Some of the congestion may be caused by bottlenecks in the CPU or the disks. In this case, refer to the *AS/400 Performance Management Version 3 Release 6*, GG24-4735, for tips on managing your system performance.

## 7.4 Medium Access Control (MAC) Errors

The number of Medium Access Control (MAC) errors is an important indication of frame transmission and reception errors and frame format recognition problems as well as frame validity-related errors.

MAC errors are those reported by each workstation to the functional address of the Ring Error Monitor (REM) that may or may not exist. Often a LAN has a dedicated station acting as a LAN Manager that performs the REM function. If not, the MAC errors may be interrogated by any device that uses this functional address including the AS/400 system.

MAC errors consist of "soft errors" that indicate an underlying problem with some component of the network but that are not severe enough to totally disrupt the LAN and "hard errors" such as Beacon frames that do indicate a major failure of the LAN.

These errors can also be described as either isolating or non-isolating, depending on whether the problem can be pinpointed to a particular station or pair of stations (called a fault domain).

The IBM Performance Tools/400 provides some tools that can help you retrieve the gross MAC error count, but this does not help in isolating the fault domain. In order to do so, you must use the data in the performance database files described later in this chapter. You can use the queries provided in Appendix B, "Local Area Network Queries" on page 239 to examine the appropriate fields.

### 7.4.1 Using Performance Tools/400 to Display MAC Errors

The total number of MAC errors per performance monitor time interval can be displayed using the following command.

Type DSPPFRDTA:

- Select performance member.
- Select time interval.
- Press the PF21 key for Display Communication Line Detail.
- Select the line you want to view with a "7" for Display Communication Interval Data.
- Press PF11 to view the MAC errors on the display. An example is shown in Figure 49 on page 107.

Line ty Line sp Bus num IOP add	pe eed ber ress	· · · · ·	4000.0 0 3		Member Library . Elapsed time	:	QPFRDATA
iype up							
• • •	play remote	e jobs	F	Response	Remote	LAN	
• • •		-	Frame	Response Timer		LAN Frames	МАС
5=Dis	play remote	Line	Frame	Timer	Frames	Frames	-
• • •	play remote	Line Util	Frame Retry	Timer Ended		Frames	-
5=Dis	play remote Itv End	Line Util .1	Frame Retry O	Timer Ended 8	Frames Transmitted	Frames Received	Errors
5=Dis	Itv End 08:59:29	Line Util .1 .2	Frame Retry O 0	Timer Ended 8 16	Frames Transmitted O	Frames Received O	Errors 86
5=Dis	ltv End 08:59:29 09:14:25	Line Util .1 .2	Frame Retry O O O	Timer Ended 8 16	Frames Transmitted O O	Frames Received O O	Errors 86 124

Figure 49. DSPPFRDTA - Displaying MAC Errors

The total number of MAC errors for each time interval can also be printed using PRTSCRPT (Print Resource Interval Report) to generate the Communication Line Interval Report as shown in Figure 50.

					Resour Communi Sample R	cations		etail	rt			09,	/06/95	15:09:1 Page 10
Libr	: Q! ary : Qf DL = TRLAN	FRDATA	System	Serial name					.:64 .:3			: 08, : 08,		
							- Conge	stion -						
	Bus/			I Frames	I Frames	Loc	al	Rem	ote		Rsp	Remote	LAN	
Itv	IOP/	Line	Line	Trnsmitd	Recd	Not	Seq	Not	Seq	Frame	Timer	Frame	es	MAC
End	Line	Speed	Util	Per Sec	Per Sec	Ready	Error	Ready	Error	Retry	Ended	Trnsmitd	Recd	Erro
	BUS 0 IOP 3 (2626)													
8:59	LINTRN	4000.0	0	1	1	0	1	0	0	0	8	0	0	1
9:14	LINTRN	4000.0	0	2	2	0		0	0	0	16	0	0	1
9:29	LINTRN	4000.0	0	1	2	0	3	0	0	0	20	0	0	1
9:44	LINTRN	4000.0	0	2	3	0	1	0	0	0	16	0	0	1

Figure 50. Resource Interval Report Showing MAC Errors

## 7.4.2 Performance Monitor Database Fields

The following Performance Monitor database fields can be used to analyze MAC errors on both token-rings and Ethernets.

The query definition in Appendix B, "Local Area Network Queries" on page 239 shows you which fields constitute the total MAC error counts displayed by Performance Tools/400.

**QAPMECL** - Token-ring Network File:

- **EMFTR** Total frames transmitted: This includes all LLC and MAC frames.
- **EMFRV** Total frames received: This includes also all LLC and MAC frames.
- **EMLNE** Line Error: Code violation of frame-check sequence error.
- **EMINE** Internal Error: Adapter internal error.
- **EMBRE** Burst Error: Burst of same polarity is detected by the physical unit after the starting delimiter of a frame or token.
- **EMAFE** Address Recognized indicator or Frame Copied indicator Error: Physical control field-extension field error.
- **EMABT** Abnormal Ending Delimiter: Abnormal ending delimiter transmitted because of internal error.
- **EMLST** Lost Frame: Physical trailer timer ended while IOA is in transmit stripping state.
- **EMRXC** Receive Congestion: Frame not copied because no buffer was available.
- **EMFCE** Frame Copied Error: The frame with a specific destination address was copied by another adapter.
- **EMFQE** Frequency Error: Adapter detected wrong frequency or data has been corrupted enough to prevent adapter from synchronizing on incoming data.
- **EMTKE** Token Error: The adapter any token timer ended without detecting any frame or token.
- **EMANR** Total number of frames with address not recognized error.
- **EMFNC** Total number of frames with frame not copied error.
- **EMTSE** Total number of adapter frame transmit or frame strip process errors.
- **EMSFT** Soft Error: Total number of soft errors as reported by the adapter.
- **EMTBC** Total number of Beacon frames transmitted.

### **QAPMETH - Ethernet Counter File:**

- **ETLTFT** Total number of SNA related frames transmitted.
- **ETLTFR** Total number of SNA related frames received.
- **ETMIFM** Inbound Frames Missed: A receive buffer error or a missed frame was detected by the IOA.
- **ETMCRE** CRC Error: Checksum errors detected by the receiver.
- **ETMEXR** More than 16 retries: Frame unsuccessfully transmitted due to excessive retries.
- **ETMOWC** Out of Window Collisions: Collisions occurred after slot time of channel elapsed.
- **ETMALE** Alignment Error: Inbound frame contained non-integer number of bytes and a CRC error.
- **ETMCRL** Carrier Loss: Carrier input to the chipset on the IOA is false during Transmission.

- **ETMTDR** Time-domain reflectometry: Counter used to approximate distance to a cable fault. This value is associated with the last occurrence of more than 16 retries.
- **ETMRBE** Receive Buffer Errors: A silo overflow occurred upon receiving a frame.
- **ETMSPI** Spurious Interrupts: An interrupt was received but could not be decoded into a recognizable interrupt.
- **ETMDIF** Discarded Inbound Frames: Receiver discarded frame due to lack of AIF entries.
- **ETMROV** Receive Overruns: Receiver has lost all or part of a incoming frame due to buffer shortage.
- **ETMMEE** Memory Error: The chipset on the IOA is the bus master and did not receive a ready signal within 25.6 usecs of asserting the address on the DAL lines.
- **ETMIOV** Interrupt Overrun: Interrupt not processed due to lack of status queue entries.
- **ETMTUN** Transmit Underflow: Transmitter has truncated a message due to data late from memory.
- **ETMBBE** Babble Errors: Also called Jabber errors. Transmitter exceeded maximum allowable time on Ethernet bus.
- **ETMSQE** Signal Quality Error: Signal indicating the transmit is successfully complete did not arrive within two seconds of a successful transmission.

### 7.4.3 Recommendations

To analyze the number of MAC errors your LAN is experiencing, you should consider studying the percentage of LAN traffic due to MAC errors. An acceptable range is 0.1% to 1% for token-ring networks. Ethernets function with higher MAC error rates due to the amount of collisions. A MAC error percentage higher than 1% or 2% on a token-ring may require further investigation.

MAC error percentage can be calculated as follows:

 Number of MAC errors
 \* 100

 Number of MAC errors + total frames transmitted and received

The total number of MAC errors can be obtained from either the Display Performance Data display or the printed Resource Interval Report as shown previously. The total number of frames transmitted and received is calculated from the following performance database fields:

**QAPMECL** - Token-ring Network File:

- **EMFTR** Total frames transmitted: This includes all LLC and MAC frames.
- **EMFRV** Total frames received: This includes also all LLC and MAC frames.

### **QAPMETH - Ethernet Counter File:**

- ETLTFT Total number of SNA related frames transmitted
- **ETLTFR** Total number of SNA related frames received

The threshold figure of 0.1% to 1% for MAC errors is only a rough guide. If your LAN performance is satisfactory and you are not losing sessions, you may choose to ignore these errors. Otherwise, you may want to investigate whether a hardware problem exists.

For more information on the nature and frequency of MAC errors occurring on your token-ring network, you can increase the value of the error logging level (TRNLOGLVL) in the line description to one of the following values:

- \*MIN Reports only conditions indicating degraded performance.
- \***MED** Reports conditions indicating existing or potential degraded performance.
- \*MAX Reports all errors.

Messages appear in the QSYSOPR message queue. The second level text explains the cause and possible actions you may take.

### 7.4.4 Token-Ring Network Errors

The token-ring network manager support is provided in OS/400 to assist you in monitoring a token-ring network and determining the source of problems on the ring. All ring error problems reported by the token-ring network manager are logged as messages to the history log (QHST), and some are also logged in the system operator message queue (QSYSOPR).

Sometimes a serious error can occur such as when an adapter is not receiving a normal signal due to a cable break. In such a situation, the network manager posts repeated messages to QSYSOPR and the QHST log. This is typically beaconing. Beaconing can affect performance on the LAN significantly. When this happens, you need to look into the QHST log and investigate the source of the problem.

### 7.5 Retransmissions

When receive congestion errors occur on any station adapter and information frames are not able to be processed, retransmission of those frames is necessary. Similarly, if high numbers of MAC errors are occurring, frames are being corrupted or lost and must be retransmitted. This leads to greater overall LAN utilization and longer queuing times for the other stations.

Performance monitor files provide statistics that you can use to calculate the retransmission rate:

QAPMSTNL	- Token-ring Station File:
SLIREX	Number of I-frames retransmitted
SLBREX	Number of bytes retransmitted in I-frames
QAPMETH -	Ethernet Counter File:
ETLFTR	Number of times I-frame retransmission occurred
ETLBRT	Number of bytes retransmitted in I-frames
QAPMSTNE	- Ethernet Station File:
STIREX	Number of I-frames retransmitted

### **STBREX** Number of bytes retransmitted in I-frames

When significant numbers of frames are being retransmitted, it is recommended that you determine the rate of transmission from:

#### Total number of I-frames retransmitted / Total Elapsed Time

Total Elapsed Time is the total sampling period over which performance data is collected. A high rate of retransmissions warrants further investigation into the congestion counters discussed earlier.

### 7.6 Timeouts

Frequent timeouts experienced on the network are an indication that the timers controlling transmission and acknowledgements may not be properly set. For instance, if the remote station's acknowledgement timer is set longer than the response timer of the local station, and the remote system does not have as much data to send to the remote station, the local response timer expires and may need to retransmit the frame again. This retransmission creates unnecessary traffic which may add to the congestion of a LAN.

The response timer (LANRSPTMR, also known as the T1 timer) begins when a frame is sent with the poll/final bit on. If the timer expires and an acknowledgement has not been received from the other system, a receiver ready (RR) is sent to solicit an acknowledgement. This timer is used to recover lost frames, and should not expire often. An acceptable level is for less than 3% of the frames transmitted to result in this timer expiring. Some amount of T1 expirations always occur. Powering off or disconnecting a PC may cause the T1 timer to end, which is no cause for concern. Other causes may need to be investigated. For example, transmission of frames across a bridge may cause the T1 timer to time out when the bridge becomes a bottleneck. This timer should not be set higher than two seconds.

The retry count (LANFRMRTY) is related to the response timer. The response timer sets the wait time before the sending system needs to solicit a response for a frame that was sent. LANFRMRTY, which is also known as the N2 counter, sets the number of times the system attempts to send a frame before it declares that a problem exists with the remote station.

### 7.6.1 Using Performance Tools/400 to Display Timeouts and Retries

The IBM Performance Tools/400 provides some tools that can help you retrieve the response timeouts and the retry count information.

The number of times the response timer T1 expired and the number of frame retries N2 can both be displayed using the following steps:

- Type DSPPFRDTA:
- Press PF21 for the Display Communication Line Detail display.
- Select the line you want to view with a "7" for Display Communication Interval Data.
- Press PF11 for View 2. This is shown in Figure 51 on page 112.

Ling ID					Member		0952290843
	pe						QPFRDATA
	eed				Elapsed time		
	ber				Liapseu time	• • • • •	09.37.23
	ress						
			•				
5=Dis	play remote		er.				
5=Dis	play remote	e jobs	I	Response			MAG
	play remote	e jobs Line	I Frame	Timer	Frames	Frames	-
	play remote Itv End	e jobs Line Util	I Frame Retry	Timer Ended	Frames Transmitted	Frames Received	Errors
	play remote Itv End 08:59:29	e jobs Line Util .1	l Frame Retry O	Timer Ended 8	Frames	Frames	Errors 86
	play remote Itv End 08:59:29 09:14:25	e jobs Line Util .1 .2	I Frame Retry 0 0	Timer Ended 8 16	Frames Transmitted O O	Frames Received O O	Errors
	play remote Itv End 08:59:29	e jobs Line Util .1 .2	I Frame Retry 0 0	Timer Ended 8	Frames Transmitted O	Frames Received O	Errors 86
	play remote Itv End 08:59:29 09:14:25	Line Util .1 .2 .2	Frame Retry 0 0 0	Timer Ended 8 16	Frames Transmitted O O	Frames Received O O	Errors 86 124
5=Dis	play remote Itv End 08:59:29 09:14:25 09:29:24	Line Util .1 .2 .4	Frame Retry 0 0 0 0	Timer Ended 8 16 20	Frames Transmitted 0 0 0	Frames Received 0 0 0	Errors 86 124 151

Figure 51. DSPPFRDTA - Displaying T1 and N2 Counters

The total number of T1 and N2 counts for each time interval can also be printed using PRTSCRPT (Print Resource Interval Report) to generate the Communication Line Interval Report as shown in Figure 52.

						ce Inte						09.	/06/95	15:09:13
					Communi	cations	Line D	etail)						Page 108
					Sample R	lesource	Interv	al Repo	ort					
Member	· : Q9	52290843	Model/	Serial	: E50/12-345	67 M	ain sto	rage .	. : 64	.0 M	Started	: 08	/17/95	08:44:29
Libr	ary : QP	FRDATA	System	name	: CPD	01 V	ersion/	Release	. : 3	/1.0	Stopped	: 08	/17/95	18:43:2
	Bus/			I Frames	I Frames	Loc	al	Ren	note		Rsp	Remote	LAN	
							- Conge							
Itv	IOP/	Line	1.4.4.4	I Frames Trnsmitd						F				MAG
			Line	Irnsmita	Recd	Not	Seq	Not	Seq	Frame	Timer	Fram	es	MAC
							-		-		- · ·	- · · · ·		
End	Line	Speed	Util	Per Sec	Per Sec	Ready	Error	Ready	Error	Retry	Ended	Trnsmitd	Recd	Error
	Line		Util 	Per Sec	Per Sec	Ready	Error	Ready	Error	Retry	Ended	Trnsmitd	Recd	Error
	Line BUS 0		Util 	Per Sec	Per Sec	Ready	Error	Ready	Error	Retry	Ended	Trnsmitd	Recd	Error
	Line BUS O IOP 3		Util 	Per Sec	Per Sec	Ready 	Error	Ready	Error	Retry	Ended	Trnsmitd	Recd	Error
End	Line BUS 0				Per Sec					Retry		Trnsmitd 0	Recd 	
	Line BUS 0 IOP 3 (2626)	Speed	Uti1  0 0	Per Sec		0	Error  1 2				Ended  8 16			Error  8 12
End 	Line BUS O IOP 3 (2626) LINTRN	Speed	0			0		0	 0 0	0		0	0	

Figure 52. Resource Interval Report Showing T1 and N2 Counters

## 7.6.2 Performance Monitor Database Fields

The performance monitor database file contains some statistics on T1 (LANRSPTMR) expiration and N2 (LANFRMRTY) retry counts that can be used to assess whether T1 and N2 have been appropriately set. These are shown in the following list:

#### **QAPMECL** - Token-ring Network File:

**ELT1T** The number of times the response timer T1 (LANRSPTMR) expired on the AS/400 system

ELN2R The number of times the AS/400 system has retried N2 (LANFRMRTY) times to contact a remote station without success

#### **QAPMETH - Ethernet Network File:**

- **ETLT1T** The number of times the response timer T1 (LANRSPTMR) expired on the AS/400 system
- ETLN2R The number of times the AS/400 system has retried N2 (LANFRMRTY) times to contact a remote station without success

If these counters indicate a high value, further investigation should be made by querying the station file to examine the values set for the response timer and retry count. The relevant station files are:

#### **QAPMSTNL** - Token-ring Station File:

**SLT1TE** T1 timer end count

SLN2RE N2 retries end count

**QAPMSTNE - Ethernet Station File:** 

**STT1TE** T1 timer end count

STN2RE N2 retries end count

A high value in these fields may indicate a mismatch in values of the timers set for the local stations and the remote stations. Section 7.9.3, "LANRSPTMR and LANFRMRTY" on page 117 discusses these parameters in greater depth.

### 7.7 LAN Overheads

Generally LAN overhead tends to be less noticeable than for conventional communication lines because of the higher media speed. However, you should still expect to see some overhead on your LAN arising from the following conditions:

- MAC frames resulting from activities such as ring purging, neighbor notification, error detection, and reporting that occur only on token-rings.
- Disconnect frames that are sent by a link station to terminate a connection with a remote link station.
- Disconnect mode frames that are sent by the remote link station in response to the disconnect frames.
- Set Asynchronous Balanced Mode Extended (SABME) frames that are used by a link station to initiate data transfer with a remote link station.
- Frame Reject frames that are generated when there is an invalid or unsupported command in the control field, invalid information, length of the information field, or received sequence error in the control field.

If these overheads form a large percentage of the line traffic, especially on a station basis, you should investigating the cause as you may be experiencing unnecessary session drop-outs or corruption of information frames due to some physical problem with the LAN. An example has been provided in Appendix B, "Local Area Network Queries" on page 239 to show you how to analyze the overhead on a token-ring using a query called TRNUSAGE. This query uses the

statistics in the Performance Monitor database files to provide the percentages of overhead frames to the total number of frames transmitted and received.

# 7.7.1 Performance Monitor Database Fields

The following database fields may be of use in analyzing session control overhead due to rejects, disconnects, and SABMEs.

### **QAPMECL** - Token-Ring Network File:

-	
ELFFT	Number of Frame-Reject frames transmitted
ELFFR	Number of Frame-Reject frames received
ELSFT	Number of SABMEs transmitted
ELSFR	Number of SABMEs received
ELDFT	Number of Disconnect frames transmitted
ELDFR	Number of Disconnect frames received
ELDMT	Number of Disconnect Mode frames transmitted
ELDMR	Number of Disconnect Mode frames received
QAPMSTNL	- Token-Ring Station File:
SLFRMX	Number of Frame-Reject frames transmitted
SLFRMR	Number of Frame-Reject frames received
SLSABX	Number of SABMEs transmitted
SLSABR	Number of SABMEs received
SLDISX	Number of Disconnect frames transmitted
SLDISR	Number of Disconnect frames received
SLDMFX	Number of Disconnect Mode frames transmitted
SLDMFR	Number of Disconnect Mode frames received
QAPMETH -	Ethernet Network File:
ETLFFT	Number of Frame-Reject frames transmitted
ETLFFR	Number of Frame-Reject frames received
ETLSFT	Number of SABMEs transmitted
ETLSFR	Number of SABMEs received
ETLDFT	Number of Disconnect frames transmitted
ETLDFR	Number of Disconnect frames received
ETLDMT	Number of Disconnect Mode frames transmitted
ETLDMR	Number of Disconnect Mode frames received
QAPMSTNE	- Ethernet Station File:
STFRMX	Number of Frame-Reject frames transmitted
STFRMR	Number of Frame-Reject frames received
STSABX	Number of SABMEs transmitted

- **STDISR** Number of Disconnect frames received
- **STDMFX** Number of Disconnect Mode frames transmitted
- **STDMFR** Number of Disconnect Mode frames received

### 7.8 LAN Queries

Some examples have been provided in Appendix B, "Local Area Network Queries" on page 239 to show you how you can write your own queries to generate reports that show some of the performance indicators discussed in this chapter as well as demonstrate how you can interrogate the data collected by the OS/400 Performance Monitor for further performance analysis. To write these queries, you need the product, Query/400. Examples have been provided for both token-ring LANs and Ethernet LANs. These queries cover the following areas:

- 1. Token-ring LAN Performance Indicators
- 2. Token-ring LAN MAC Error Counters
- 3. Token-ring LAN Overhead
- 4. Ethernet LAN Performance Indicators
- 5. Ethernet LAN MAC Error Counters

These queries generate reports that can help you assess your LAN performance and identify bottlenecks. Having determined what your bottlenecks are, you can make use of the recommendations discussed in the next section to tune your LAN performance.

### 7.9 LAN Performance Tuning Recommendations

In this section, we discuss in more detail recommendations for SNA environment to improve performance and address bottlenecks in your LAN network. We shall investigate the relationships between the LAN controller description tuning parameters and look at the performance characteristics of the different LAN IOPs and the effects of varying frame sizes.

### 7.9.1 LAN Controller Performance Parameters

All SNA controller descriptions used on local area networks have LANxxxxx parameters that affect their performance. These are summarized in Table 12. In this section, we examine their relationships and look at recommended values to optimize LAN performance.

Table 12 (Page 1	Table 12 (Page 1 of 2).       Summary of LAN Controller Performance Parameters							
Parameter	Short Term	Function						
LANCNNTMR	CT1	Sets wait time for polling remote station during connection establishment.						
LANCNNRTY	CN2	Sets number of poll retries sent to remote station during connection establishment.						
LANRSPTMR	T1	Sets wait time for frame retransmission.						

Table 12 (Page 2	of 2). Summary of	LAN Controller Performance Parameters
Parameter	Short Term	Function
LANFRMRTY	N2	Sets number of frame retransmission attempts.
LANACKTMR	T2	Sets wait time for acknowledgement to remote station.
LANACKFRQ	N3	Sets number of frames received before sending acknowledgement.
LANINACTMR	Ti	Sets wait time for requesting response from remote station.
LANMAXOUT	TW	Sets number of outstanding frames allowed before requesting acknowledgement from remote station.
LANWDWSTP	NW	Provides an alternative value equivalent to the LANMAXOUT parameter for use during periods of network congestion. The system provides an algorithm for returning the effective maximum outstanding frames value to that specified by the LANMAXOUT parameter as congestion subsides.
LANACCPTY		Sets priority of the station. Stations with higher priority have greater access to the token (used on token-ring only).

Notes:

TW may be referred to as MAXOUT because TW is perceived as the MAXimum OUTstanding frames transmitted. Similarly, N3 may be referred to as MAXIN because it is perceived as the MAXimum INbound frames received before sending an acknowledgement to the originator of the frames.

## 7.9.2 LANCNNTMR and LANCNNRTY

Both these values work together to define the frequency and persistence of polling the remote system or controller for the purpose of establishing a connection.

LANCNNTMR, which is in tenths of seconds, specifies how long to wait before sending an exchange identifier (XID) command or the Set Asynchronous Balanced Mode-Extended (SABME) command again.

LANCNNRTY specifies how often this polling occurs when the LANCNNTMR has ended. When the retry limit LANCNNRTY is reached and no response is received from the remote station, the following actions occur:

- The user is notified that contact with the remote station was unsuccessful.
- The system places the controller description in answer mode.
- If retry is the answer to the inquiry, the AS/400 system re-attempts the connection again.

The defaults of these parameters are usually sufficient for a non-bridged local area network. When the amount of network traffic is excessive, or the AS/400 LAN adapter becomes over-utilized, the connections may time out. In this case, the connection timer (LANCNNTMR) can be increased to allow the remote adapter to respond. LANCNNRTY may also be raised but we suggest that you raise the value of LANCNNTMR first and observe the results.

LANCNNRTY should not be raised unless LANCNNTMR is near its maximum value, or the adapter may generate unnecessary network traffic that only contributes to the original problem of not being able to connect. LANCNNRTY can be raised if the network is unreliable in the sense that frames have a reasonable chance of being dropped or if the remote adapter is dropping frames because of over-utilization.

In a bridged environment, the default connection parameters may not be sufficient to allow a normal connection because bridges generally introduce a delay in frame delivery, and if a bridge is congested, the frames are dropped. Therefore, both connection parameters can be incremented in a similar fashion as for a non-bridged environment. If there are a number of bridge hops between the local and remote stations, first increase the LANCNNTMR to give the frames and the acknowledgments time to cross the network. Observe the results. If frames are being dropped due to congestion of one or more bridges, the LANCNNRTY can be increased. Remember that by increasing LANCNNRTY, there is ultimately more traffic crossing the bridges, which may lead to further congestion.

## 7.9.3 LANRSPTMR and LANFRMRTY

The LAN response timer (LANRSPTMR) and the LAN frame retry (LANFRMRTY) parameters work together to determine how soon and how often a frame of data is transmitted again. Frames of data need to be transmitted again when one of the following conditions occur:

- A previous frame of data was lost or damaged.
- The remote station is too busy to receive and respond to the frame in time.
- The remote station is waiting to acknowledge the frame with an information frame of its own. This is affected by the LAN acknowledgement timer (LANACKTMR) parameter that is discussed later.

The LANRSPTMR parameter defines the time interval in tenths of seconds that the system waits before requesting a response for a frame that was sent.

The LANFRMRTY value specifies how many times the frame is transmitted again before the system notifies the user that an error occurred and the logical link to the remote station is disconnected.

The defaults for these parameters are intended for use on a single local area network. If a bridge is being used to communicate with a remote station on another local area network, you may want to consider increasing the values on both the local and remote systems because the bridge may slow down the line traffic enough to cause the timer to expire before the remote station is able to respond.

The value for each parameter should be chosen carefully. If LANRSPTMR is too small, the system solicits a response before the remote system has time to receive the frame and send the acknowledgement. If LANFRMRTY is too small, frames may be lost. A good value for LANFRMRTY is 10 or less.

### 7.9.4 LANACKTMR and LANACKFRQ

The LAN acknowledgement timer (LANACKTMR) and the LAN acknowledgement frequency (LANACKFRQ) parameters work together to determine how often an acknowledgement is sent to the remote station.

The LANACKTMR parameter specifies how long the system waits before sending an acknowledgement to a received frame. This allows the system, if it has any data to send to the remote controller, to use that frame to acknowledge the received frame.

Similarly, the LANACKFRQ parameter specifies the maximum number of frames the system can receive before acknowledgement is sent to the remote station independent of timers or any data to send. The system has a greater chance of sending a frame of data that includes an acknowledgement of the received frame if the LANACKFRQ value is large.

The LANACKTMR also serves a purpose if the LANMAXOUT at the sending system and LANACKFRQ on the receiving system are not set correctly. If the LANACKFRQ is set to three frames, for example, and LANMAXOUT is set to two frames, the LANACKTMR should expire in a reasonable time to cause a response to be sent. Since LANMAXOUT is less than the remote system's LANACKFRQ, this count does not cause a response to be sent. Only two frames have been received so the LANACKFRQ value of three frames has not been reached. Therefore, a response is not sent until the LANACKTMR expires. The timer on the sending system, LANRSPTMR, should be greater than the LANACKTMR on the receiving system to give the receiver time to respond before being solicited for the response.

Small values for LANACKTMR may cause unnecessary acknowledgements to be sent, contributing to heavier LAN traffic. If your network has relatively high traffic, you may want to increase either or both values.

In most cases, where network traffic is not a problem and data tends to flow one way (as in a file transfer), large values may introduce unnecessary delay in sending acknowledgements and slow response times. If this is the case, a LANACKFRQ value of one is recommended.

The LAN acknowledgement values should also be carefully balanced with the response timer and maximum outstanding frame count of the remote station. The wrong values can result in timeouts and retransmissions, contributing to higher LAN traffic.

## 7.9.5 LANACKTMR and LANRSPTMR Relationship

Between two stations, LANRSPTMR sets the wait time before a response is solicited. LANACKTMR on the receiving station sets the wait time before a response is sent for the transmission. However, if acknowledgement frequency (LANACKFRQ of the remote station) is already set to 1, the response timer (LANRSPTMR) and the acknowledgement timer (LANACKTMR) should not expire unless a frame has been lost, in which case the Receive Ready (RR) response indicates by sequence number the last frame that was successfully received.

To determine which values to set for LANRSPTMR (T1) and LANACKTMR (T2), we need to consider a hypothetical case of a LAN with the two stations shown in Figure 53.

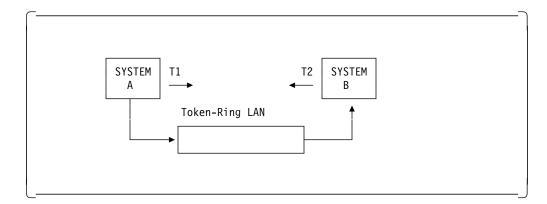


Figure 53. LANACKTMR and LANRSPTMR Relationship

The response timer of the transmitting station and the acknowledgement timer of the receiving station can be determined by:

#### LANRSPTMR > LANACKTMR + (2 \* propagation delay)

The value, (2 \* propagation delay) represents the time for two frames to travel the entire ring path as:

- The first path through the network is taken by the local station's transmitted frame.
- The second is taken by the remote station's acknowledgement frame as a response to the first frame.

The relatively high speed of a token-ring LAN makes this propagation delay negligible for a non-bridged environment resulting in the following guideline:

#### LANACKTMR <= LANRSPTMR /2

In a non-bridged environment, the AS/400 default settings of (\*CALC) are sufficient to ensure that there are few T1 expirations.

These values may still hold for bridged LANs with up to a maximum of two bridges. However, in a bridged environment where the bridge becomes so congested that it becomes a bottleneck, the increase in propagation delay across the bridge may cause the T1 timer to expire. If this happens, you may start to lose connections. To counter this, the response timers and acknowledgement timers should be retuned.

To do this, you must first determine the propagation delay across the bridge. The communication trace tool can assist you in this process. This value can be used to determine the values of the timers based on the relationship we discussed earlier.

You probably need to increase the value of the response timer and the frame retry limit so that the retransmission period is extended. In addition, you may also need to adjust some parameters on the remote system. For example, you may want to decrease the value of the acknowledgement timer and reduce the acknowledgement frequency (LANACKFRQ) of the remote station. This ensures that the remote station sends its acknowledgement earlier after receiving a smaller amount of frames.

It is important that since both stations are transmitting and receiving frames, timers should be tuned on both stations.

## 7.9.6 LANACKFRQ and LANMAXOUT Relationship

LANMAXOUT on the local station specifies the number of frames that the local station sends to the remote station before waiting for an acknowledgement. LANACKFRQ on the remote station specifies how many frames the remote station receives before sending this acknowledgement.

If the remote station's LANACKFRQ is set larger than the local station's LANMAXOUT, the local station continuously waits for acknowledgement of the frames it has outstanding with the remote station before sending more frames. On the other hand, the remote station keeps waiting for more frames until its LANACKTMR expires. This certainly leads to poor performance.

For optimal performance, it is essential to specify appropriate values for LANMAXOUT and LAN acknowledgement frequency (LANACKFRQ) parameters on both the sending and receiving stations. If the wrong values are chosen, the LAN throughput may be reduced by up to 50% or worse if timeouts start to occur.

The LANACKFRQ parameter should be set to a value less than the remote station's LANMAXOUT value. In practice, the following guideline is good:

#### LANACKFRQ (remote) = LANMAXOUT (local) /2

*NEVER* allow LANACKFRQ on one station to be greater than LANMAXOUT on the other station.

In general, leaving these parameters at the \*CALC settings (LANACKFRQ=1 and LANMAXOUT=2) gives adequate performance for interactive environments. However, significant performance improvements can be made in large file transfer environments by increasing the LANMAXOUT value. This parameter is sensitive to the remote stations buffering and processing capabilities and can be made larger when transmitting to faster stations.

You may need to experiment with the LANMAXOUT parameter to get the best performance. If there is no significant improvement, the value should be changed back to \*CALC. Consider the following guidelines:

- When using the new LAN IOPs (2626, 2636, 2619, 2617, and 6506), try using LANMAXOUT=6. If there is no improvement, reduce to LANMAXOUT=4 and test again. If there is still no improvement, return the value to \*CALC(2).
- When using the older LAN IOPs (6130, 6034, 6134, and 2625), \*CALC(2) probably gives the best performance. However, you may still try experimenting with a higher value.
- It is unlikely for performance to be improved by using values for LANMAXOUT greater than 7, and tests suggest that throughput can dramatically decrease if you use a value greater than 10.
- When communicating with a PS/2 smaller than a model 50 or equivalent, use \*CALC(2) to avoid buffer overruns.
- When communicating with a PS/2 model 50 or above, you can experiment with LANMAXOUT=6 or 4; however, LANACKFRQ should be kept at \*CALC(1).
- LANMAXOUT and LANACKFRQ should have the same value on the sending station as on the receiving station.

Note that in a mixed batch and interactive environment, a value of LANACKFRQ=\*CALC(1) tends to favor the interactive traffic. If this value is increased, batch transfers may improve but at the expense of the interactive traffic.

### 7.9.7 LANINACTMR

The LAN inactivity timer (LANINACTMR) parameter is used to determine how long the system should wait before requesting a response from the remote station. This request is made to determine if the remote station is still on the ring or if the logical link is disconnected.

If the LANINACTMR value is set too small, unnecessary traffic is created. If it is set too large, the system may not determine that the logical link is inoperable as quickly as necessary. This timer is sensitive to whether the remote station is on the same local LAN segment or not. In a bridged environment, this value may need to be increased. If the value is set to 0 (that is, no timeout), you may not be informed if the logical link is inoperable until a data transfer attempt occurs.

Between two active communicating stations, the shortest time it takes for either station to detect that the remote station is not responding is equal to the following example:

#### LANINACTMR + ((LANFRMTRY + 1) \* LANRSPTMR)

This value is important when both stations are communicating over a bridge. Bridges occasionally go into a temporary offline state before coming online again. If this is happening in your installation, it is recommended that you raise the LANINACTMR value to ensure a higher tolerance for your network. The LANINACTMR should be five to 10 times the value of LANRSPTMR.

### 7.9.8 LANWDWSTP

The LAN window step (LANWDWSTP) parameter provides a mechanism to aid in the reduction of network congestion. It does this by effectively reducing LANMAXOUT to one and slowly returning this value to the original LANMAXOUT value defined in the controller description. This allows the network congestion to subside faster than if the LANMAXOUT value was continually maintained.

If we call the temporary maximum outstanding frames value MAXOUTFRM, we can examine how this mechanism works.

When congestion occurs, the value of MAXOUTFRM is reduced from LANMAXOUT to one. This helps to reduce acknowledgement timeouts and retransmissions even though each frame must now be acknowledged. MAXOUTFRM is slowly raised in increments of one until it returns to the original value of LANMAXOUT set in the controller description. This incremental increase is controlled by the value set for LANWDWSTP. This parameter can be any value from one to 127. If, for example, LANWDWSTP=10, the remote station must successfully receive 10 frames before MAXOUTFRM can be incremented by one. This process continues until MAXOUTFRM is equal to LANMAXOUT.

If LANWDWSTP is set to \*NONE, the number of outstanding frames is not reduced during network congestion.

## 7.9.9 LANACCPTY (Token-Ring Networks Only)

For a station on a token-ring to transmit a frame, it must first capture a free token to which it appends its data, converting the token into an information frame.

The free tokens on a ring contain three bits in their Access Control byte, which determines the priority of the token. A token with a high priority can only be used by a station authorized for equal or higher priority. In this way on heavily utilized rings, critical applications or workstations can be guaranteed greater access to the LAN. Of course, the token-ring architecture also ensures that enough low priority tokens circulate to service the other stations.

The priorities available are zero to three, with zero being the lowest priority. This is also the default value for LANACCPTY when creating controller descriptions. You should not change this value unless you are sure you need greater priority for a particular station. Changing priorities without caution can lead to serious performance degradation for the majority of users.

The LANACCPTY parameter is ignored for controllers attached to Ethernet LANs.

## 7.10 LAN IOPs

The relatively high bandwidth of local area networks reduces the likelihood that line utilization is a performance bottleneck. Response times are much more dependent upon the speed of the CPU and the IOP microprocessor.

Today there are several types of LAN IOP available, all with different performance characteristics. We shall examine their relative merits in this section. For a discussion of how to analyze the utilization of your IOP using Performance Monitor data, see Chapter 6, "Communications I/O Processor (IOP)" on page 89.

Upgrading to a higher performance LAN IOP provides significant increases in throughput and improved response times. However, it should also be noted that equal distribution of workload across the available IOPs is important, as is the distribution of those IOPs across the available busses on your system.

Generally, the different IOPs provide the same functions. The higher performing IOPs incorporate faster microprocessors and more memory to accommodate larger buffers and frame sizes. However, with higher performing IOPs, there exists a potential for overrun of slower performing IOPs. Symptoms include retransmissions and timeouts. This can be minimized or avoided by limiting the LANACKFRQ and LANMAXOUT parameters to one and two, respectively.

The following list shows LAN IOPs currently available in order of best performance.

### Token-Ring IOPs:

1. 6506 IOP

- Integrated PC Server, also known as File Serving Input Output Processor and FSIOP (TRLAN or ELAN)
- The performance characteristics of this IOP when used for token-ring connectivity are similar to the 2619 IOP.

- Laboratory tests have measured throughput rates in excess of 14 Mbps for a single file transfer without database accesses. Actual LAN throughput realized by customers is less than the adapter capability as it is affected by many factors including system model and workload characteristics.
- This IOP also provides high performance file serving when using LAN Server/400 software.
- 2. 2619 IOP
  - 16/4 Mbps Token-Ring Network Adapter/HP
  - This adapter has similar performance to the 6506 Integrated PC Server and provides increased performance over the 2626 IOP (2626 is a CISC only IOP; it cannot be used with RISC machines).

### Ethernet IOPs:

- 1. 6506 IOP
  - Integrated PC Server (TRLAN or ELAN)
  - The performance characteristics of this IOP when used for Ethernet connectivity are similar to the 2617 IOP.
  - This IOP also provides high performance file serving when using LAN Server/400 software.
- 2. 2617 IOP
  - 10 Mbps Ethernet/IEEE 802.3 Adapter/HP
  - This adapter is capable of six times the throughput possible of its predecessor. Laboratory measured throughput maximums are about 10 Mbps. This performance is seldom achievable in a production environment.
- 3. 2625 IOP and 6130 IOP with 2635 adapter
  - 10 Mbps Ethernet subsystem
  - Performance of both IOPs are equivalent.

Both the 2625 and 2635 Ethernet adapters discard inbound frames when they arrive at a rate in excess of 100 frames/sec (assuming a frame size of 1500 bytes). The 2617 adapter has been designed with more storage, which avoids this problem.

This possible discarding of frames should be kept in mind if you are using User Datagram Protocol (UDP) applications that use an unacknowledged delivery service.

If you are using TCP/IP or SNA applications, the higher level protocols should provide notification of discarded frames. However, if SNA sessions are dropping out because of discarded frames, you should attempt to reduce the amount of traffic flowing to the overloaded adapters or increase the maximum number of allowable retries using the LANFRMRTY parameter.

## 7.11 Frame Size

LAN throughput increases significantly as the frame size increases. For the LAN IOP, this translates into lower utilization as there are fewer frames to process. CPU utilization, however, is higher because the CPU has more data to process in each frame.

Generally, local area networks provide a relatively error-free environment. Data transmission is, therefore, more efficient if data is sent in the largest frames possible. This, coupled with the faster media speeds, results in significant improvement to the performance of the LAN.

## 7.11.1 Token-Ring Frame Sizes

When configuring token-ring lines on an AS/400 system, there are three places where you can define the maximum frame size (MAXFRAME) to be used. The effective MAXFRAME size is the smaller of the three.

- · MAXFRAME in the line description
- · MAXFRAME in the controller descriptions
- MAXFRAME parameter specified for each source service access point (SSAP) associated with the line

The largest value allowed for MAXFRAME varies depending on the type of token-ring IOP installed. You should select the largest value possible. This is usually *not* the default value for the line and controller descriptions. Table 13 lists these maximum frame sizes.

	Largest MAXFRAME Value				
Resource Type	Line Speed 16 Mbps	Line Speed 4 Mbps			
6506, 2619, 2626	16 393	4060			
6134, 2636	8156	4060			
6034, 6160	N/A	1994 (default)			

Note: Type WRKHDWRSC \*CMN to view the LAN Adapter type.

The largest value for MAXFRAME may not always be used in practice because the receiving IOP or intervening bridge/router or station may not be able to support this frame size. This does not cause any problem as the frame size is negotiated between the two stations at the time of session establishment. The smaller of the two frame sizes is selected. It is, therefore, important to remember to configure both the AS/400 system and the other stations when you increase the maximum frame size.

## 7.11.2 Ethernet Frame Sizes

In an Ethernet environment, the probability of collisions occurring is proportional to the following conditions:

- · The number of stations
- Rate of transmission
- The length of the LAN
- The LAN utilization
- The IOP utilization

• The size and number of "collision windows"

A collision window is the time during which a collision may occur. Its maximum value is the time required by a frame to travel between the two outermost stations on the Ethernet. On a 10 Mbps Ethernet, the collision window equals the one-way propagation delay (sum of all transmission delays) between the two contending stations.

While the size of the collision windows may be reduced by decreasing the frame size used by the adapters, this is not recommended since it increases the number of collision windows and also the overhead due to frame headers and trailers. Therefore, in an Ethernet environment, you should still use the maximum frame size for transmission.

Ethernet standards allow a maximum frame size of 1502 bytes. This size is only possible if you are using user-defined communications. Ordinarily, if you create an Ethernet line with the ETHSTD specified as \*ALL or \*IEEE8023, the maximum frame size is 1496 bytes. If you create an Ethernet line description with the ETHSTD specified as \*ETHV2, the maximum frame size is 1493 bytes. The minimum frame size is 265 bytes. This is summarized in Table 14.

Table 14. Maximum	Table 14. Maximum Frame Size Based on ETHSTD Parameter							
ETHSTD Parameter Value	Frame Type	Maximum Frame Size						
*ALL	IEEE 802.3	1496						
	Ethernet Version 2	1500						
*IEEE8023	IEEE 802.3	1496						
*ETHV2	Ethernet Version 2, SNA data	1493						
	Ethernet Version 2, non-SNA data	1500						

## 7.11.3 Bridge Frame Size Considerations

If a frame is being transmitted to a station that resides on a different LAN, the frame must be copied and transmitted again by a bridge. If the bridge is not configured to support a frame size as large as that configured on the token-ring or Ethernet line description, the frame is discarded. For SNA in the token-ring environment, the system originating the connection is informed of the frame size supported by the bridge if the bridge and frame are using source routing.

In the Ethernet environment, no indication of the unsupported frame size is received. This condition is only detected when a connection is being established with the remote system and a CPA57A1 message is sent to the QSYSOPR message queue.

If it is not possible to configure the bridge to support a larger frame size, the following parameters need to be changed to accommodate the frame size acceptable to the bridge:

- MAXFRAME parameter on the controller description
- SSAP MAXFRAME parameter on the line description
- MAXFRAME parameter on the line description (Token-ring networks only as Ethernets use the value specified for the ETHSTD parameter.)

Generally it is preferred that the MAXFRAME parameter on the controller description be changed first to minimize the impact on the rest of the network.

## 7.11.4 ETHSTD Parameter

The AS/400 system supports two Ethernet standards:

- Ethernet Version 2
- IEEE 802.3

If you choose to configure your Ethernet line with the ETHSTD specified as \*ALL, the AS/400 system operates on both frame types simultaneously. You should configure your Ethernet line for the best performance based on your specific needs. For example, if your job requires a TCP/IP configuration that uses only the IEEE 802.3 Ethernet standard, but the line is configured to operate on both standards, all incoming Ethernet Version 2 frames are also processed. This unnecessary processing can cause performance problems.

## 7.11.5 Other Considerations

What we have discussed in this section covers recommendations for optimizing performance at the protocol level. Since you may want to run some form of application on your LAN network, there are other additional considerations for these environments.

For example, if you have application programs using SNA support and SNA parameters such as Request/Response Unit size (MAXLENRU), PACING and program output operations can have the same impact as the configuration parameters at the protocol level. You are advised to refer to Chapter 10, "SNA" on page 163 for a more detailed discussion of SNA parameters. If you are running CA/400 on your LAN, a useful guide for performance monitoring on your LAN is the redbook, *AS/400 Client/Server Performance using Windows 3.1 Client*, SG24-4526.

# Chapter 8. X.25

X.25 is an alternative protocol to SDLC and is compatible with SNA. Some of the functions performed by SDLC for SNA are not supported by X.25. A layer called the logical link control exists between the SNA layers and the X.25 packet layer on a given virtual circuit. X.25 is capable of sending and receiving data simultaneously, which provides a significant performance advantage for those environments that are running multiple conversations over the same link (for example, pass-through between two AS/400 systems in both directions).

This chapter handles the most important values that the performance monitor collects for the X.25 protocol. It describes how you can use these values to identify bottlenecks in an X.25 environment, where you can find these values, how they are related to each other, and what you can do to solve the bottlenecks. Most of these values come from the *QAPMX25* performance tools database file that is generated when you run the Performance Monitor (see Chapter 1, "Tools Used for Finding Performance Problems" on page 1).

The performance values are related to the following three layers:

- High level data link control (HDLC)
- Packet level control (PLC)
- Logical link control (LLC)

The data link control layer defines the procedures for the connection, error free transfer of information, and disconnection between the DTE and the network DCE.

The packet layer defines the procedures necessary for establishing connections (virtual circuits) between DTEs, transferring information (in packets), and clearing connections.

Logical link control is the layer between the SNA layers and the X.25 packet layer on a given virtual circuit. It provides additional function required for SNA connections that is not available in X.25.

The following sections discuss the performance values related to these layers.

### 8.1 High Level Data Link Control (HDLC)

The data link control layer defines the procedures for the connection, error free transfer of information, and disconnection between the DTE and the network DCE. At the data link control layer, the information is transmitted between the two stations in data units called high-level data link control (HDLC) frames. Both the DTE and the network DCE are considered peer stations.

The following list contains the main HDLC communications performance indicators:

- Line utilization
- · Line errors
- Congestion
- · Data link resets

Some performance problems may be caused by errors at the HDLC layer. Errors related to the HDLC layer do not produce any cause or diagnostic codes. These errors must be isolated by using information provided in the QSYSOPR message queue.

### 8.1.1 Line Utilization

Line utilization is the percentage of elapsed time during which the line was utilized. Because X.25 is full duplex, line utilization should be determined for both directions. Line utilization is an important performance indicator. Exceeding the utilization threshold value may lead to unacceptable response times. For line speeds of 19200 bits per second or less, most application programs can fully use the bandwidth of the line. The performance in this environment depends largely on the ability of the line to transfer data. For line speeds of greater than 19200 bits per second, some application programs cannot fully use the bandwidth of the line. The performance in this environment depends much more on the performance of the application itself.

## 8.1.1.1 Using Performance Tools/400 to Display Line Utilization

Line utilization can be observed by using the DSPPFRDTA command after having collected performance data with OS/400 Performance Monitor (see Chapter 1, "Tools Used for Finding Performance Problems" on page 1). You can also print the System or Resource report to view the line utilization.

Use the DSPPFRDTA command to access the Display Communications Interval Data display shown in Figure 54 on page 129. The display shows you the line speed, the transmit, receive, and average line utilization. This display can be accessed from the Display Performance Data display by pressing F21=Display Communications Detail. Choose the line to be analyzed and use option 7=Display Communications Interval Data. The transmit, receive, and average line utilization for the sample interval selected are the values listed in the Transmit/Receive/Average Line Util column heading.

Line ty Line sp Bus num	pe peed ber ress	· · : 9.6	5	Member : Q953171314 Library : QPFRDATA Elapsed time : 09:58:09				
	tions, pre play remot			Pct		Pct		
		Receive/		I Frames		Frames		
	Itv	Average	I Frames	Trnsmitd	Frames	Recd		
Option	End	Line Util	Trnsmitd	in Error	Recd	in Error		
_	08:54:25	31/16/24	2274	0	4424	0		
	09:09:23	42/61/52	4331	0	7841	0		
	09:24:22	41/23/32	2817	0	5454	0		
_	09:39:19	40/21/31	2728	0	5239	0		
-		61/20/46	4022	0	7639	0		
- - -	09:54:17	01/30/40					More	
- - -		01/30/40					1101 6	

Figure 54. Communications Interval Data (View 1) - X.25 Sample

Use the PRTSYSRPT command to print the System Report. The Communications Summary shows average and peak line utilization over the total report period shown in Figure 55.

System Report Communications Summary Performance Data for X.25 Communications Analysis								11/31/95 11:50:53 Page 0004			
Member : Q953171 Library : QPFRDAT		/Serial . n name		)/10-15181 SYSTEM1		•		: 11/30 : 11/30			
Bus/IOP/ Line	Protocol	Line Speed	Avg Util	Max Util	Active Devices	Number Transactions	Average Response	Bytes Per Received	Second Transmitted		
BUS 0 IOP 10 (6130) LINX25	X25	9.6	13	96	10	88	4.2	141.4	179.5		
Bus/IOP/Line Protocol .ine Speed	Line s	rotocol (SD beed (1000	LC, ASYM bits per	(C, BSC, ) r second)	25, TRLAN,	ELAN, IDLC)					
lvg Util Max Util	Average Maximur	(For IDLC this is the maximum over the measurement) Average line utilization Maximum line utilization in all measurement intervals Average number of active devices on the line									
Active Devices Number Transactions Average Response	Number Average	of transac system re	tions sponse	(service)	time (seco	nds)					
Bytes /Sec Received Bytes /Sec Transmitted	Average		-								

Figure 55. Communications Summary - X.25 Sample

Use the PRTRSCRPT command to print the Resource Interval Report. The Communications Line Detail shows the utilization calculated per sample interval shown in Figure 56 on page 130.

						terval Report NS Line Detail					
Libr	• : Q9 •ary : QF •OL = X.25 (S	FRDATA	Model/Serial System name		10-15181 SYSTEM1	Main storage Version/Relea					
T NOTOC	OL X.25 (3	JOINT DI INI	Transmit/			Percent			Percent		
	Bus/		Receive/	Bytes	Total	I Frames	Bytes	Total	Frames	Rese	t
Itv	IOP/	Line	Average	Trnsmitd	I Frames	Trnsmitd	Recd	Frames	Recd	Pack	ets
End	Line	Speed	Line Util	Per Sec	Trnsmitd	In Error	Per Sec	Recd	In Err	Trnsmitd	Recd
	BUS 0 IOP 10										
13:20	(6130) X25LINE	9.6	13/01/07	160	210	5 0	0	14	0	42,800	
13:25	X25LINE	9.6	11/00/05	132	150	5 0	0	8	0	31,100	
	X25LINE	9.6	16/02/09	196	250	D O	0	28	0	49,500	

Figure 56. Resource Interval Report - Communications Line Detail

### 8.1.1.2 Performance Monitor Database Fields

The following fields in the performance monitor database file QAPMX25 are related to the line utilization:

- **XHBRCV** The number of bytes received including all bytes in frames that had any kind of error
- XHBTRN The number of bytes transmitted including bytes transmitted again
- **XLLSP** The speed of the line in bits per second (bps)
- **INTSEC** Number of seconds since the last elapsed interval

The transmit line utilization is derived from the following equation:

Transmit line utilization = XHBTRN \* 800 / (INTSEC \* XLLSP)

The receive line utilization is derived from the following equation:

Receive line utilization = XHBRCV \* 800 / (INTSEC \* XLLSP)

The 800 is really (100 \* 8) where 100 represents the result as a percentage, and 8 is the number of bits per byte (since line speed is bits per second).

Line utilization is calculated per interval, that is, the time you have specified on the INTERVAL parameter of the STRPFRMON command.

Appendix C, "X.25 Queries" on page 275 lists the sample queries (X25\_ALL, X25\_HDLC, and X25\_JOB) to show the values previously mentioned.

#### 8.1.1.3 Recommendations

- For interactive environments, keeping line utilization below 30% is recommended to maintain predictable and consistent response time.
- If you have batch jobs, such as file transfers running on that line, it is normal to have the line utilization above 50%. However, for interactive jobs, performance begins to degrade around 40% line utilization.
- If the percentage of errors is also high, the line utilization can be driven by lots of retransmission of data. Take the appropriate action to reduce line errors, (see Section 8.1.2, "Line Errors" on page 131).
- Line utilization can also be driven by running large file transfer type work (for example, running a query over large files). Besides affecting all genuine interactive users, it increases the response time for all interactive users on the same communications line.

• If you cannot isolate the large file transfer traffic such as rescheduling the jobs or applications, you need to use pacing to throttle the large file transfer work (low pacing value) and consider increasing the line speed to minimize the impact (see Chapter 10, "SNA" on page 163).

## 8.1.2 Line Errors

Line errors often result in frames being retransmitted. If the retransmission still results in bad frames, the application is notified and has to resend the entire record or multiple records. This may result in one RU (request unit) or a chain of RUs being transmitted again.

## 8.1.2.1 Using Performance Tools/400 to Display Line Error Information

Line error information can be displayed by using the DSPPFRDTA command after having collected performance data with OS/400 Performance Monitor (see Chapter 1, "Tools Used for Finding Performance Problems" on page 1). You can also print the Resource Report to view the line error information.

Use the DSPPFRDTA command to access the Display Communications Interval Data display shown in Figure 54 on page 129. The display shows you the number of information frames transmitted, the percent of information frames transmitted in error, the number of frames received, and the percent of frames received in error. This display can be accessed from the Display Performance Data display by pressing F21=Display Communications Detail. Choose the line to be analyzed and use option 7=Display Communications Interval Data.

Use the PRTRSCRPT command to print the Resource Interval Report. The Communications Line Detail shows you the number of Information frames transmitted, the Percent of Information frames transmitted in error, the number of frames received, and the percent of frames received in error per sample interval shown in Figure 56 on page 130.

## 8.1.2.2 Performance Monitor Database Fields

The performance monitor collects data about the number of:

- Frame retransmission
- · Frames received in error
- Invalid frames received

A frame can be an information supervisory of unnumbered frames:

#### Information frames

I-frames are used to transfer user data. If there are no I-frames transmitted, you can conclude that the remote stations on that line are inactive. *Inactive* means that the stations connected to the controller are not doing any work even though the controller has been successfully varied on.

#### Supervisory frames

S-frames are used to perform link supervisory control functions such as acknowledge I-frames, request retransmission of I-frames, or request a temporary suspension of transmission of I-frames.

#### **Unnumbered frames**

U-frames are used to provide additional link control functions and contain no sequence numbers.

Frame retransmission is normally caused due to frames received in error and by link resets. To avoid communications performance problems, this number should be 0 or low. The following fields from the performance monitor can be used to determine the retransmission error rates:

- **XHFTRN** Number of frames transmitted (I-frame, supervisory, and frames not numbered) excluding frames transmitted again
- **XHIFTR** Number of I-frames transmitted excluding I-frames transmitted again
- **XHIFRT** Number of I-frames transmitted again
- **XHFRT** Number of I-frame, supervisory, and frames not numbered transmitted again

The percent of frames transmitted with errors is derived from the following equation:

Percent of frames transmitted with errors
= (XHFRT \* 100) / (XHFRT + XHFTRN)

The percent of I-frames transmitted with errors is derived from the following equation:

Percent of I-frames transmitted with errors
= (XHIFRT \* 100) / (XHIFRT + XHIFTR)

The following fields from the performance monitor can be used to determine the number or percent of frames received in error or that are not valid:

- **XHEFFR** Error free frames received (I, S, and U)
- **XHFRIE** The number of I-frames, S-frames, and U-frames received in error. There are three error possibilities:
  - An S-frame or I-frame was received with an number count that is requesting retransmission of a frame.
  - An I-frame was received with a number count that indicates that frames were missed.
  - A frame was received with one of the following errors:
    - A frame check sequence error
    - An abnormal end
    - A receive overrun
    - A frame truncated error
- **XHIFR** Frames received that are not valid: The number of not valid frames received. These are frames received with either:
  - · Short frame error: Frame is less than 32 bits.
  - · Residue error: Frame is not on a byte boundary.

The percent of frames received in error is derived from the following equation:

Percent of frames received in error

= ((XHIFR + XHFRIE) \* 100) / (XHEFFR + XHIFR + XHFRIE)

Appendix C, "X.25 Queries" on page 275 lists the sample queries, X25\_ALL and X25\_HDLC, to show the values previously mentioned.

## 8.1.2.3 Recommendations

Receive and transmit errors can occur when the host system or remote device has an error or cannot process received data fast enough, see also Section 8.1.3, "Congestion" for congestion. Factors that can influence the performance because of retransmission are:

- Line quality
- Packet size
- Window size

Line quality: If the percentage of errors on a line is about 5% for a few intervals that had I-frames transmitted, check the local and remote connections. Ensure that all cables are properly shielded, that they are the correct cable type, and that all plug connections are secure. There should be no ribbon cables (flat, unshielded cables) anywhere between the system and the modem. Sometimes the errors can be caused by electrical "noise" or interference. If problems still occur, contact your line supplier to have the line tested. You might consider changing to a better quality line or modem. Normally, it is true that a non-switched line is a better quality line than a switched line.

Packet size: The AS/400 support for X.25 allows a range of packet sizes up to 4096 bytes. The packet size is specified using the DFTPKTSIZE parameter on the line and controller descriptions and the MAXPKTSIZE parameter on the line description. Larger packet sizes provide better performance. However, in case of an error-prone line, large packet sizes may not work well. The large packets have a higher probability for errors in this environment and take longer to transmit again.

Window size: The X.25 window size is similar to the maximum number of outstanding frames parameter used by SDLC and the token-ring networks. The maximum that this parameter can be set to depends on the MODULUS and DFTWDWSIZE parameters that are part of the line description. If MODULUS is set to 8, the largest size that DFTWDWSIZE can be set to is 7. If MODULUS is set to 128, the largest size that DFTWDWSIZE can be set to is 15. Usually, making this number as large as possible results in the best performance.

As with large packet sizes, a large window size may not work well for error-prone lines or networks.

## 8.1.3 Congestion

Local or remote congestion occurs when data is not processed fast enough either while sending or while receiving. Congestion results in transmitting receive-not-ready frames by the system that is congested, either the host or remote device.

# 8.1.3.1 Using Performance Tools/400 to Display Information About Congestion

Information about congestion can be displayed using the DSPPFRDTA command after having collected performance data with OS/400 Performance Monitor (see Chapter 1, "Tools Used for Finding Performance Problems" on page 1). You can also print the Resource Report to view the information about congestion.

Use the DSPPFRDTA command to access the Display Communications Interval Data display shown in Figure 57 on page 134. The display shows you the percentage of Receive Not Ready frames transmitted and received. This display can be accessed from the Display Performance Data display by pressing F21=Display Communications Detail. Choose the line to be analyzed and use option 7=Display Communications Interval Data. Press F11=View 2 to see the second display. The percentage of Receive Not Ready frames transmitted and received for the sample interval selected are the values listed in the Local Not Rdy and Remote Not Rdy column headings respectively.

Line ty Line sp Bus num IOP add	pe eed ber ress tions, pre	: X.2 : 9.6 : 0 : 10			Library .	· · · · · : · · · · · :	
	play remot		-Conge	stion			
		Receive/	Local	Remote	Reset	Reset	
	Itv	Average	Not	Not	Packets	Packets	
Option	End	Line Util			Trnsmitd	Recd	
Option _	End		Rdy O		Trnsmitd O	Recd O	
Option _ _	End 08:54:25	Line Util	Rdy	Rdy	-		
Option _ _ _	End 08:54:25 09:09:23	Line Util 31/16/24	Rdy O	Rdy 0	0	0	
Option _ _ _ _	End 08:54:25 09:09:23 09:24:22	Line Util 31/16/24 42/61/52	Rdy 0 0	Rdy 0 0	0 0	0 0	
Option _ _ _ _ _	End 08:54:25 09:09:23 09:24:22 09:39:19	Line Util 31/16/24 42/61/52 41/23/32	Rdy 0 0 0	Rdy 0 0 0	0 0 0	0 0 0	
Option _ _ _ _ _ _	End 08:54:25 09:09:23 09:24:22 09:39:19	Line Util 31/16/24 42/61/52 41/23/32 40/21/31	Rdy 0 0 0 0	Rdy 0 0 0 0	0 0 0 0	0 0 0 0	More

Figure 57. Communications Interval Data (View 2) - X.25 Sample

### 8.1.3.2 Performance Monitor Database Fields

The following fields in the performance monitor database file gives an indication of the congestion at the local or remote side:

- **XHRNRT** Number of receive not ready supervisory frames transmitted (local congestion)
- **XHRNRR** Number of receive not ready supervisory frames received (remote congestion)

Both values should be close to 0 in a well performing system. High congestion increases both CPU and IOP utilization and directly affects remote response time.

Important values that can be derived from these fields are:

#### Local Not Ready

Receive Not Ready frames transmitted by the AS/400 system as a percentage of all frames received by the host. A large number means the AS/400 data buffers are not emptied fast enough. The Local Not Ready value can be derived from the following equation:

Local Not Ready = XHRNRT / (XHEFFR + XHFRIE + XHIFR + XHRRFR + XHRNRR)

#### **Remote Not Ready**

Receive Not Ready frames received by the host as a percentage of the Information Frames transmitted by the host. A large number

usually means X.25 network or the remote device data buffers are not emptied fast enough. The Remote Not Ready value can be derived from the following equation:

Remote Not Ready = XHRNRR / (XHIFTR + XHIFRT + XHRRFT + XHRNRT)

Appendix C, "X.25 Queries" on page 275 lists the sample queries (X25\_ALL, X25\_IOP, and X25\_HDLC) to show the values previously mentioned.

#### 8.1.3.3 Recommendations

**Local Congestion:** A remote system is sending data too fast for your AS/400 system to process. This is probably caused by some sort of bottleneck such as high CPU, disk, or IOP utilization. Another cause might be a low machine pool size. You can find more information about IOP in Section 8.4.1, "IOP Utilization" on page 143. For CPU, disk, and pool utilization, refer to *AS/400 Performance Management*, GG24-4735, or Appendix I, "Guidelines for Interpreting Performance Data" on page 379.

**Remote Congestion:** Another system or X.25 network receiving data from your AS/400 system cannot process the data fast enough and has sent out "NOT READY" messages. Check for possible bottlenecks on system or X.25 network receiving data from your AS/400 system. If the receiving system is an AS/400 system, the problem may also be a low machine pool size on that system.

## 8.1.4 Data Link Resets

Data link resets represents the number of times a Set Asynchronous Balance Mode (SABM) was received when the station was already in asynchronous balance mode during a measured period. This is caused due to a procedure error.

## 8.1.4.1 Using Performance Tools/400 to Display Data Link Resets

Performance tools do not create reports that show Data Link Reset values, nor can you use performance tools to display Data Link Reset values.

#### 8.1.4.2 Performance Monitor Database Fields

Data link resets are indicated by the following field:

**XHLNKR** The number of times a set asynchronous balance mode (SABM) was received when the station was already in asynchronous balance mode

The performance monitor collects this number for each interval.

Appendix C, "X.25 Queries" on page 275 lists the sample queries, X25\_ALL and X25\_HDLC to show the values previously mentioned.

#### 8.1.4.3 Recommendations

To avoid communications performance problems, this number should be zero or low. As this indication is caused by a procedure error, the line should be debugged. The link resets may be contributing to high line utilization. If the throughput or response time is unacceptable in your X.25 line, you may need to have the line or modem serviced; however, the amount of errors normally occurring changes depending on a number of variables such as the location and the quality and type of line. Before servicing the lines, ensure that all cables are properly shielded, are IBM-supplied cables, and that all plug connections are secure. There should be no ribbon cables anywhere between the system and the modem.

## 8.2 Packet level Control (PLC)

The packet layer defines the procedures necessary for establishing connections (virtual circuits) between DTEs, transferring information (in packets), and clearing connections. The packet level protocol provides the multiplexing support for multiple virtual circuits for a given X.25 line. It should be noted that each virtual circuit competes for the total bandwidth available on the line to the network. As the number of active virtual circuits is increased, it is possible that the throughput on the individual virtual circuits will decrease.

The following list contains the main PLC communications performance indicators:

- Number of packets transmitted
- Congestion

Some performance problems may be caused by errors at the packet layer. The CCITT and SNA cause and diagnostic codes should help you understand why and where X.25 packet layer errors are occurring. SNA and CCITT codes are described in *X.25 Network Support*, SC41-3405. Cause and diagnostic codes can be retrieved by:

• Looking at the message help in the QSYSOPR message queue.

When you use the DSPMSG QSYSOPR command, the first-level text of the message queue QSYSOPR is displayed. Move the cursor to a specified message and press the Help key to display the second-level text of the message. Also shown with the second-level text is the message ID, the error log ID, and other vital data. The X.25 cause and diagnostic codes are contained in the X.25-related error messages or in the error log.

• Taking a communications trace during an X.25 communications error. Cause and diagnostic codes are included in the data field of all CLEAR, RESET, RESTART REQUEST, or INDICATION, and DIAGNOSTIC packets are two bytes of data. The first byte of data is the cause code field, and the second byte of data is the diagnostic code field. It is also important to notice whether the AS/400 system has sent or received a packet containing cause or diagnostic codes. The meaning of the codes can be determined. How to take a communications trace is described in Chapter 5, "Using System Service Tools" on page 71.

## 8.2.1 Number of Packets Transmitted

This indicator represents the number of X.25 packets transmitted during a measured period.

# 8.2.1.1 Using Performance Tools/400 to Display Packets Transmitted

Performance tools do not create reports that show the number of packets transmitted, nor can you use performance tools to display the number of packets transmitted.

### 8.2.1.2 Performance Monitor Database Fields

The following fields in the performance monitor database file reflect the total number of packets transmitted:

**XPTPT** Total packets transmitted. Packets are created (disassembled) from the protocol data units (PDUs) that were created in the logical link control level.

Appendix C, "X.25 Queries" on page 275 lists the sample queries (X25\_ALL and X25\_PLC) to show the values previously mentioned.

#### 8.2.1.3 Recommendations

The packet protocol creates an overhead in the transmission of user data. Because this overhead is constant, increasing the packet size to the limit allowed by the network improves performance without increasing the packet overhead.

#### 8.2.2 Congestion

This indicator represents the number of X.25 receive-not-ready packets received during a measured period.

## **8.2.2.1 Using Performance Tools/400 to Display Information About Congestion**

Performance tools do not create reports about congestion, nor can you use performance tools to display information about congestion.

#### 8.2.2.2 Performance Monitor Database Fields

The following field in the performance monitor database file indicates PLC congestion:

**XPRNR** Receive-not-ready packets received

Receive-not-ready packets are sent due to a high network utilization.

Appendix C, "X.25 Queries" on page 275 lists the sample query (X25\_ALL) to show the values previously mentioned.

#### 8.2.2.3 Recommendations

The number of receive-not-ready packets received should be low. Look for network utilization (line, remote jobs, and IOP).

## 8.3 Logical Link Control (LLC)

Logical link control is the layer between the SNA layers and the X.25 packet layer on a given virtual circuit. It provides additional function required for SNA connections that is not available in X.25. The AS/400 system supports three LLC protocols:

- The qualified logical link control (QLLC)
- The enhanced logical link control (ELLC)
- The Logical Link Control-2 (LLC2)

The qualified logical link control (QLLC) protocol provides additional function required for SNA connections that is not available in X.25. QLLC has low protocol overhead; however, it provides no end-to-end (DTE-to-DTE) acknowledgment of logical link control protocol data units (LLC PDUs) carrying

user data. QLLC provides an efficient logical link control when used in a reliable network.

The enhanced logical link control (ELLC) protocol performs the same base function as QLLC. In addition, it includes enhanced logical link error recovery procedures (using transparent recovery for recoverable failures), additional checksum protection, and sequencing (to guard against lost or duplicate data). The intent is to compensate for an unreliable network. This, however, is not without additional effects on *performance* that are caused by protocol overhead and by longer delays before failures are reported.

The logical link control-2 is used for Client Access/400 to give full SNA session support using X.3 network packet assembler/disassembler. The LLC2 needs longer protocol header bytes than QLLC and ELLC. In this document, we do not discuss LLC2.

The following list contains the main LLC communications performance indicators:

- · Data units retransmitted and data units received in error
- · LLC rejects
- · LLC protocol data units discarded
- · Number of time outs
- Checksum errors detected
- · Number of reset indications from packet link control
- LLC congestion

Some performance problems may be caused by errors at the LLC layer. The CCITT and SNA cause and diagnostic code should help you understand why and where LLC layer errors are occurring. Cause and diagnostic codes can be retrieved by:

• Looking at the message help in the QSYSOPR message queue.

When you use the DSPMSG QSYSOPR command, the first-level text of the message queue QSYSOPR is displayed. Move the cursor to a specified message and press the Help key to display the second-level text of the message. Also shown with the second-level text is the message ID, the error log ID, and other vital data. The X.25 cause and diagnostic codes are contained in the X.25-related error messages or in the error log.

 Taking a communications trace during an X.25 communications error. Cause and diagnostic codes are included in the data field of all CLEAR, RESET, RESTART REQUEST, or INDICATION, and DIAGNOSTIC packets are two bytes of data. The first byte of data is the cause code field, and the second byte of data is the diagnostic code field. It is also important to notice whether the AS/400 system has sent or received a packet containing cause or diagnostic codes. The meaning of the codes can be determined. How to take a communications trace is described in Chapter 5, "Using System Service Tools" on page 71.

## 8.3.1 Data Units Retransmitted and Data Units Received in Error

This indicator represents the number of data units retransmitted and data units received in error on the LLC level. Data unit retransmission occurs due to data units received in error.

# 8.3.1.1 Using Performance Tools/400 to Display Data Units Retransmitted or Received in Error

Performance tools do not create reports about the number of data units retransmitted or received in error, nor can you use performance tools to display the number of data units retransmitted or received in error.

### 8.3.1.2 Performance Monitor Database Fields

The following fields in the performance monitor database file reflect the number of data units transmitted and retransmitted:

- XLITR The number of interface protocol data units transmitted
- **XLIRT** The number of interface protocol data units retransmitted. This field is only valid for link protocol ELLC because Data PDUs are never retransmitted when link protocol QLLC is used.

From these values, the percent of data unit retransmission can be derived:

Percent of data units retransmitted = (XLIRT \* 100) / XLITR

The following fields in the performance monitor database file reflect the number of data units received and data units received in error:

**XLIRC** Interface protocol data units received

**XLIRE** Interface protocol data units received in error (sequence). This field is only valid for link protocol ELLC.

From these values, the percent of data units received in error can be derived:

Percent of data units received in error = (XLIRE \* 100) / XLIRC

Appendix C, "X.25 Queries" on page 275 lists the sample queries (X25\_ALL and X25\_LLC) to show the values previously mentioned.

## 8.3.1.3 Recommendations

To avoid communications performance problems, the percent of data units received in error should be low. The error can be caused by problems with the remote data terminal equipment (DTE) (for example, configuration, system problem, and resources). The number of retransmissions can be decreased by decreasing the LLC data unit size. Larger LLC protocol data unit sizes can improve performance; however, if frequent line errors occur, performance may be degraded by larger LLC protocol data units due to the greater likelihood that a data unit may encounter an error and need to be transmitted again. The LLC data unit size can be controlled through the MAXFRAME parameter found in both the primary line and controller description. For SNA communications, the MAXFRAME value represents the maximum logical link control data unit that can be sent or received on the line. For non-SNA communications, this value represents the maximum data packet sequence that can be sent or received. This value should not be confused with the high-level data link control (HDLC) frame size.

## 8.3.2 LLC Rejects

This indicator represents the number of X.25 LLC rejects during a measured period. LLC rejects only occur for SNA controllers utilizing the ELLC link protocol. LLC rejects indicates that something inside the X.25 network is losing or corrupting data. LLC rejects cause the retransmission of data and can cause poor performance.

## 8.3.2.1 Using Performance Tools/400 to Display LLC Rejects

Performance tools do not create reports about the number of LLC rejects, nor can you use performance tools to display the number of LLC rejects.

### 8.3.2.2 Performance Monitor Database Fields

The following fields in the performance monitor database file reflect the number LLC rejects transmitted and received:

XLLJT Number of LLC rejects transmitted

XLLJR Number of LLC rejects received

Appendix C, "X.25 Queries" on page 275 lists the sample queries (X25\_ALL and X25\_LLC) to show the values previously mentioned.

#### 8.3.2.3 Recommendations

LLC rejects have a negative impact on performance because data is retransmitted. To avoid communications performance problems, these values should be low. The error can be caused by:

- Problems with the remote data terminal equipment (DTE)
- Configuration
- Other network resources

Look at the message help in the QSYSOPR message queue or take a communications trace during an X.25 communications error and inspect the cause and diagnostic codes to determine the source and cause of the error.

## 8.3.3 LLC Protocol Data Units Discarded

This indicator represents the number of LLC protocol units discarded.

## 8.3.3.1 Using Performance Tools/400 to Display LLC Protocol Data Units Discarded

Performance tools does not create reports about the number of LLC protocol data units discarded, nor can you use performance tools to display the number of LLC protocol data units discarded.

#### 8.3.3.2 Performance Monitor Database Fields

The following field in the performance monitor database file reflects the number LLC protocol data units discarded:

XLRLD Number of received LLC protocol data units discarded

Appendix C, "X.25 Queries" on page 275 lists the sample queries (X25\_ALL and X25\_LLC) to show the values previously mentioned.

### 8.3.3.3 Recommendations

LLC protocol data units discarded are normally due to sequence errors (only for ELLC). See Section 8.3.1, "Data Units Retransmitted and Data Units Received in Error" on page 138 for recommendations.

## 8.3.4 Timeouts

This indicator represents the number of timeouts that occurred during a measured period.

## 8.3.4.1 Using Performance Tools/400 to Display Number of Timeouts

Performance tools does not create reports about the number of timeouts, nor can you use performance tools to display the number of timeouts.

### 8.3.4.2 Performance Monitor Database Fields

The following field in the performance monitor database file reflects the number of timeouts:

XLTO Number of timeouts

Appendix C, "X.25 Queries" on page 275 lists the sample queries (X25\_ALL and X25\_LLC) to show the values previously mentioned.

### 8.3.4.3 Recommendations

Timeouts can be caused by problems with the remote data terminal equipment (DTE) (for example, configuration, system problem, and resources). Or the AS/400 system's timer values may be too small to receive responses from the remote system. Consider increasing the X.25 response timer (X25RSPTMR) or X.25 connection timer (X25CNNTMR) parameter in the controller description.

## 8.3.5 Checksum Errors Detected

This indicator represents the number of checksum errors detected during a measured period.

# 8.3.5.1 Using Performance Tools/400 to Display the Number of Checksum Errors

Performance tools does not create reports about the number of checksum errors, nor can you use performance tools to display the number of checksum errors.

#### 8.3.5.2 Performance Monitor Database Fields

The following field in the performance monitor database file reflects the number of checksum errors detected:

**XLCED** Checksum errors detected This field is only valid for link protocol ELLC.

Appendix C, "X.25 Queries" on page 275 lists the sample queries (X25\_ALL and X25\_LLC) to show the values previously mentioned.

#### 8.3.5.3 Recommendations

To avoid communications performance problems, the percent of data units received in error should be low; however, checksum errors should usually be recoverable using the ELLC protocol. The error is usually caused by problems with X.25 network corruption.

## 8.3.6 Number of Reset Indications from Packet Link Control

This indicator represents the number of reset indications from packet link control during a measured period.

## 8.3.6.1 Using Performance Tools/400 to Display the Number of Reset Indications

Performance tools do not create reports about the number of reset indications, nor can you use performance tools to display the number of reset indications.

#### 8.3.6.2 Performance Monitor Database Fields

The following field in the performance monitor database file reflects the number of reset indications from packet link control:

XLRSI Number of reset indications from packet link control

Appendix C, "X.25 Queries" on page 275 lists the sample queries (X25\_ALL and X25\_LLC) to show the values previously mentioned.

#### 8.3.6.3 Recommendations

A reset indication is issued when:

- A RESET packet arrives from the network.
- A RESTART packet was received or transmitted.
- The local PLC layer RESETs the virtual circuit due to a protocol error.

To determine if there are problems, you should check the cause and diagnostic code, (see Section 8.2, "Packet level Control (PLC)" on page 136).

#### 8.3.7 LLC Congestion

This indicator represents the number of receive-not-ready frames received during a measured period.

## **8.3.7.1 Using Performance Tools/400 to Display Information About Congestion**

Performance tools do not create reports about congestion, nor can you use performance tools to display information about congestion.

#### 8.3.7.2 Performance Monitor Database Fields

The following field in the performance monitor database file indicates LLC congestion:

XLRNR LLC receive-not-ready frames received

Appendix C, "X.25 Queries" on page 275 lists the sample queries (X25\_ALL and X25\_LLC) to show the values previously mentioned.

#### 8.3.7.3 Recommendations

Receive-not-ready frames are transmitted due a high system utilization, that is, the CPU is busy. To avoid problems, this number should be zero or low. Look for problems that are causing high CPU utilization.

## 8.4 Important Related Performance Manager Files

Related fields in other database files:

- IOP utilization
- Remote jobs

## 8.4.1 IOP Utilization

Each line is controlled by an IOP. The performance of a line may be affected by the IOP that controls the line. It is important not to overload an IOP to avoid a possible system performance bottleneck. See Chapter 6, "Communications I/O Processor (IOP)" on page 89 for more information about IOP performance.

### 8.4.1.1 Performance Monitor Database Fields

An important performance indicator for the IOP is the IOP utilization. How you calculate this value is described in Chapter 6, "Communications I/O Processor (IOP)" on page 89. To relate the line to the IOP, you need two files:

**QAPMX25** Contains performance data about the line

**QAPMCIOP** Contains performance data about IOPs

**Note:** If the communications adapter is connected to a multifunction IOP, the QPAMMIOP file must be used instead of QAPMCIOP. Appendix C, "X.25 Queries" on page 275 lists sample queries for both kind of IOPs.

The IOP is identified in both files (QAPMHDLC and QAPMCIOP) by the field:

**IOPRN** IOP Resource Name

This field should be used to relate IOP information to the line.

Utilization of the IOP can be seen in the sample query X25\_IOP in Appendix C, "X.25 Queries" on page 275.

#### 8.4.1.2 Recommendations

Keep the IOP utilization within the guideline of 45%. Exceeding this threshold in a large transfer environment or with a small number of concurrent users may still offer acceptable performance. If the performance capabilities of a single IOP are exceeded, it is important to distribute the workload across several IOPs. Consider moving one of the high speed lines attached to this communications IOP card to another one. If you still have problems, consider changing to a newer communications IOP card if you are using an older one.

To decrease the IOP utilization, you should consider increasing the frame size. The use of large frames generally improves performance in terms of capacity for the communications IOP and in terms of system response time.

The amount of time that the IOP spends processing a large frame is only slightly more than the amount to process a smaller frame. Using larger frames to transfer a given message or block of data decreases the total number of frames required to complete the transfer. Therefore, the total amount of processing time required by the IOP is smaller allowing other transactions to more effectively utilize the IOP. Also, for environments using high speed media, the response time is generally better by using larger frames because the IOP and the CPU require less total processing time. In communications environments where errors are common, the use of smaller frame sizes may offer better performance by limiting the size of the retransmission. Having errors may also impact the number of communications lines that can run concurrently.

#### 8.4.2 Remote Jobs

For a good understanding of the performance of a line, it is good to know which remote jobs are running on the communications line and which other resources they use.

#### 8.4.2.1 Performance Monitor Database Fields

To relate the line to the remote jobs, you need two files:

**QAPMX25** Contains performance data about the line

**QAPMJOBS** Contains performance data about jobs

In the file QAPMX25, a line is identified by the field:

XLLND The name of the X.25 line

To relate the job information to the line, you should use the following field in the QAPMJOBS file:

JBLND Name of the communications line the workstation and its controller are attached to

Important values in the QAPMJOBS file are:

- **JBRSP** Total transaction time. This field has a value other than zero only if this is an interactive or a pass-through target job.
- **JBNTR** Number of transactions. This field has a value other than zero only if this is an interactive or a pass-through target job.

JBCPU Processing unit time (in milliseconds) used

Important values that can be derived from the QAPMJOBS file are:

• The percentage of elapsed time during which the processing unit was utilized by the job:

Percent CPU was utilized by the job = ((JBCPU / 1000) \* 100) / INTSEC.

The sample query X25\_JOB in Appendix C, "X.25 Queries" on page 275 shows this utilization.

- The total number of remote jobs that are running on the X.25 line. You should add up all of the job entries, selecting by line name (JBLND).
- The total number of transactions performed by the jobs running on the X.25 line. You should add up the number of transactions (JBNTR) for each job running on the X.25 line.
- The average internal response time (in seconds) per transaction for each job:

Avg response time for a job = (JBRSP / JBNTR).

The sample query X25\_JOB in Appendix C, "X.25 Queries" on page 275 shows this response time.

• The average internal response time (in seconds) per transaction for all jobs:

Avg response time for all jobs = (Total transaction time / Total number of transactions). Look for periods of high utilization and correlate them with transaction rates and response times.

## 8.4.2.2 Recommendations

If there are high utilization and response times, but no increase in transaction load, there is a good chance that you are getting line errors. On the other hand, if the transaction load and line utilization increase and the response time is high, the system may be trying to handle more work than it has the capacity to do. In this case, the additional response time may be caused by queueing in a communications line, IOP, or control unit.

The CPU utilization for remote jobs is composed by other low-level performance communications indicators. However, the CPU utilization for remote jobs is lower when you use larger frame sizes.

## Chapter 9. SDLC

Synchronous data link control (SDLC) is a commonly used AS/400 data link protocol. It is a polling protocol that is compatible with Systems Network Architecture (SNA). SDLC can be used over duplex or half duplex, switched, or non-switched lines. The line may be a point-to-point or a multi-point configuration.

This chapter handles the most important values that the performance manager collects for the SDLC protocol. It describes how you can use these values to identify bottlenecks in an SDLC environment, where you can find these values, how they are related to each other, and what you can do to solve the bottlenecks. Most of these values come from the *QAPMHDLC* performance tools database file which is generated when you run the Performance Monitor (see Section 1.2.2, "How to Collect Performance Data" on page 3). In this chapter, references are made to performance tools reports and performance tools displays. Read Chapter 3, "Using Performance Tools/400" on page 27 to see how you can print these reports or reach these displays.

## 9.1 Important Fields in the SDLC Performance Manager File

The following list contains the main SDLC communications performance indicators:

- · Line utilization
- Line errors
- Congestion
- Data link resets
- Connect poll retries

## 9.1.1 Line Utilization

Line utilization is the percentage of elapsed time during which the line was utilized. Line utilization is an important performance indicator. Exceeding the utilization threshold value may lead to unacceptable response times. For line speeds of 19200 bits per second or less, most application programs can fully use the bandwidth of the line. The performance in this environment depends largely on the ability of the line to transfer data. For line speeds of greater than 19200 bits per second, some application programs cannot fully use the bandwidth of the line. The performance in this environment depends much more on the performance of the application itself.

#### 9.1.1.1 Using Performance Tools/400 to Display Line Utilization

Line utilization can be displayed using the DSPPFRDTA command after having collected performance data with the OS/400 Performance Monitor (see Chapter 1, "Tools Used for Finding Performance Problems" on page 1). You can also print the System or Resource report to view the line utilization.

Use the DSPPFRDTA command to access the Display Communications Interval Data display shown in Figure 58 on page 148. The display shows you the line speed and line utilization. This display can be accessed from the Display Performance Data display by pressing F21=Display Communications Detail. Choose the line to be analyzed and use option 7=Display Communications

Line ty Line sp Bus num	pe pe peed ber ress	· · · ·	9.6 0	Q953171314 QPFRDATA 09:58:09			
	tions, pres play remote		er.	Det		Det	
				Pct I Frames		Pct Frames	
	Itv	Line	I Frames	Trnsmitd	Frames		
Option	End	Util	Trnsmitd	in Error	Recd	in Error	
2221011	08:54:04	.1	0	0	12	100	
0,000	00:54:04		•	0	0	0	
-		.0	0	0	0	0	
- - -	09:09:23 09:24:22	.0 .0	0	0	0	0	
- - -	09:09:23 09:24:22 09:39:19	.0 .0	0 0	0 0	0	•	
- - - -	09:09:23 09:24:22	.0	0	0	0	0	
- - - -	09:09:23 09:24:22 09:39:19 09:54:17	.0 .0 .0	0 0 0	0 0	0 0 0	0 0 0	More

Interval Data. The line utilization for the sample interval selected is listed in the "Line Util" column heading.

Figure 58. Communications Interval Data - View 1

Use PRTSYSRPT to print the System Report. The Communications Summary shows average and peak line utilization over the total report period shown in Figure 59.

System Report Communications Summary Performance Data for SDLC Communications Analysis									12/04/95 11:33:3 Page 000			
lember : Q953171 Library : QPFRDAT		/Serial . n name						H : 11/13 H : 11/13				
Bus/IOP/ Line	Protocol	Line Speed	Avg Util	Max Util	Active Devices	Number Transactions	Average Response	Bytes Per Received	- Second Transmitter			
US 0 IOP 05 (6130) LIN032	SDLC	9.6	4	69	.7	88	4.2	16.6	37.7			
Bus/IOP/Line Protocol ine Speed	Line sp	rotocol (SD peed (1000	LC, ASY bits pe	NC, BSC, 2 r second)	K25, TRLAN,	ELAN, IDLC)						
Avg Util Max Util Active Devices	<pre>(For IDLC this is the maximum over the measurement) Average line utilization Maximum line utilization in all measurement intervals Average number of active devices on the line</pre>											
lumber Transactions Nverage Response Sytes /Sec Received	Number Average Average	of transac e system re	tions sponse	(service)	time (seco							
Sytes /Sec Transmitted	-		-			nd						

Figure 59. Communications Summary - SDLC

Use PRTRSCRPT to print the Resource Interval Report. The Communications Line Detail shows the utilization calculated per sample interval shown in Figure 60 on page 149.

					Resourc	e Interval	Report					
					COMMUNIC	ATIONS LINE	Detail					
					SDLC	resource re	port					
Member	: Q95	3171314	Model/Se	erial :	D60/10-1518	1 Mains	torage	: 80.0 M	Started	:	11/13/95	13:15:5
Libra	ary : QPF	RDATA	System n	ame :	SYSNM00	1 Versio	n/Release .	: 3/1.0	Stopped	:	11/13/95	14:10:5
PROTOCO	DL = SDLC (SO	RT BY INTE	RVAL)									
						Percent			Percent	Pct	Conges	stion
	Bus/			Bytes	Total	I Frames	Bytes	Total	Frames	Poll	Local	Remote
Itv	IOP/	Line	Line	Trnsmitd	I Frames	Trnsmitd	Recd	Frames	Received	Retry	Not	Not
End	Line	Speed	Util	Per Sec	Trnsmitd	in Error	Per Sec	Recd	in Error	Time	Ready	Read
	BUS 0											
	IOP 5											
	(6130)											
13:20	LIN032	9.6	10	102	82	0	21	2,118	0	8	0	
13:25	LIN032	9.6	8	81	73	0	18	2,282	0	9	0	
13:30	LIN032	9.6	6	69	76	0	13	1,163	0	13	0	
13:35	LIN032	9.6	5	51	29	0	16	2,324	0	9	0	
13:40	LIN032	9.6	2	16	0	0	16	2,426	0	9	0	
3=Exit	F12=Cancel	F19=Lef	+ 520-	Right F24	=More keys							

Figure 60. Resource Interval Report - Communications Line Detail

#### 9.1.1.2 Performance Monitor Database Fields

The following fields in the performance monitor database file QAPMHDLC are related to the line utilization:

- **SHBRCV** The number of bytes received including all bytes in frames that had any kind of error
- SHBTRN The number of bytes transmitted including bytes transmitted again

**SHLSP** The speed of the line in bits per second (bps)

Line utilization is derived from the following equation:

Line utilization = (SHBRCV + SHBTRN) \* 800 / (INTSEC \* SHLSP)

The 800 is really (100 \* 8) where 100 represents the result as a percentage, and 8 is the number of bits per byte (since line speed is bits per second). INTSEC indicates the number of seconds since the last elapsed interval. This is a field in the QAPMHDLC file.

To ensure that the AS/400 system provides accurate performance statistics, the LINESPEED parameter on the SDLC line definition should match the actual line speed. Line utilization is calculated per interval, that is, the time you have specified on the INTERVAL parameter of the STRPFRMON command.

Appendix A, "SDLC Queries" on page 227 lists the sample queries (SDLC\_ALL, SDLC\_IOP, SDLC\_HDLC and SDLC\_JOB) to show the values previously mentioned.

#### 9.1.1.3 Recommendations

- For interactive environments, keeping line utilization below 30% is recommended to maintain predictable and consistent response time.
- If you have batch jobs such as file transfers running on that line, it is normal to have the line utilization above 50%. However, for interactive jobs, performance begins to degrade around 40% line utilization.
- If the percentage of errors is also high, the line utilization can be driven by a lot of retransmission of data. Take the appropriate action to reduce line errors (see Section 9.1.2, "Line Errors" on page 150).
- Line utilization can also be driven by running large file transfer type work (for example, running a query over huge files). Besides affecting all genuine

interactive users, it increases the response time for all interactive users on the same communications line.

• If you cannot isolate the large file transfer traffic such as rescheduling the jobs or applications, you need to use pacing to throttle the large file transfer work (low pacing value) and consider increasing the line speed to minimize the impact (see Chapter 10, "SNA" on page 163).

## 9.1.2 Line Errors

Line errors often result in frames being retransmitted. If the retransmission still results in bad frames, the application is notified and has to resend the entire record or multiple records. This may result in one RU (request unit) or a chain of RUs being transmitted again.

## 9.1.2.1 Using Performance Tools/400 to Display Line Error Information

Line error information can be displayed using the DSPPFRDTA command after having collected performance data with the OS/400 Performance Monitor (see Chapter 1, "Tools Used for Finding Performance Problems" on page 1). You can also print the Resource Report to view the line error information.

Use DSPPFRDTA to access the Display Communications Interval Data display shown in Figure 58 on page 148. The display shows you the number of information frames transmitted, the percent of information frames transmitted in error, the number of frames received, and the percent of frames received in error. This display can be accessed from the Display Performance Data display by pressing F21=Display Communications Detail. Choose the line to be analyzed and use option 7=Display Communications Interval Data.

Use PRTRSCRPT to print the Resource Interval Report. The Communications Line Detail shows you the number of information frames transmitted, the percent of information frames transmitted in error, the number of frames received, and the percent of frames received in error per sample interval shown in Figure 60 on page 149.

#### 9.1.2.2 Performance Monitor Database Fields

The performance monitor collects data about the number of:

- Frames retransmitted
- Frames received in error
- · Invalid frames received

A frame can be an information, supervisory, or unnumbered frame:

#### Information frames

I-frames are used to transfer user data. If there are no I-frames transmitted, you can conclude that the remote stations on that line are inactive. *Inactive* means that the stations connected to the controller are not doing any work even though the controller has been successfully varied on.

#### Supervisory frames

S-frames are used to perform link supervisory control functions such as acknowledge I-frames, request retransmission of I-frames, or request a temporary suspension of transmission of I-frames.

#### **Unnumbered frames**

U-frames are used to provide additional link control functions and contain no sequence numbers.

A frame retransmission is normally caused due to frames received in errors and by link resets. To avoid communications performance problems, this number should be zero or low. The following fields from the performance monitor database file QAPMHDLC can be used to determine the retransmission error rates:

- **SHFTRN** Number of frames transmitted (I, supervisory, and frames not numbered) excluding frames transmitted again
- SHIFTR Number of I-frames transmitted excluding I-frames transmitted again
- SHIFRT Number of I-frames transmitted again

SHFRT Number of I, supervisory, and frames not numbered transmitted again

The percent frames transmitted with errors is derived from the following equation:

Percent of frames transmitted with errors = (SHFRT \* 100) / (SHFRT + SHFTRN)

The percent of I-frames transmitted with errors is derived from the following equation:

Percent of I-frames transmitted with errors = (SHIFRT \* 100) / (SHIFRT + SHIFTR)

The following fields from the performance monitor database file QAPMHDLC can be used to determine the number or percent of frames received in error or that are not valid:

- **SHEFFR** Error free frames received (I, S, and U)
- **SHFRIE** The number of I, S, and U frames received in error. There are three error possibilities:
  - An S or I-frame was received with an number count that is requesting retransmission of a frame.
  - An I-frame was received with an number count that indicates that frames were missed.
  - A frame was received with one of the following errors:
    - A frame check sequence error
    - An abnormal end
    - A receive overrun
    - A frame truncated error
- **SHIFR** Frames received that are not valid: The number of not valid frames received. These are frames received with either:
  - Short frame error: Frame is less than 32 bits.
  - Residue error: Frame is not on a byte boundary.

The percent of frames received in error is derived from the following equation:

Percent of frames received in error = ((SHIFR + SHFRIE) \* 100) / (SHEFFR + SHIFR + SHFRIE)

Appendix A, "SDLC Queries" on page 227 lists the sample queries (SDLC\_ALL and SDLC\_HDLC) to show the values previously mentioned.

## 9.1.2.3 Recommendations

Receive and transmit errors can occur when the host system or remote device has an error or cannot process received data fast enough (see also Section 9.1.3, "Congestion" on page 153 for congestion). Check for messages in the QSYSOPR message. Factors that can influence the number of retransmissions are:

- · Line quality
- Frame size
- Maximum outstanding frames
- Modem rate

Line quality: If the percentage of errors on a line is about 5% for a few intervals that had I-frames transmitted, check the local and remote connections. Ensure that all cables are properly shielded, are the correct cable type, and that all plug connections are secure. There should be no ribbon cables (flat, unshielded cables) anywhere between the system and the modem. Sometimes the errors can be caused by electrical "noise" or interference. If problems still occur, contact your line supplier to have the line tested. You might consider changing to a better quality line or modem. Normally, it is true that a non-switched line is a better quality line than a switched line.

Frame size is represented by the MAXFRAME parameter of the line and controller description. Larger frame sizes can improve performance; however, if frequent line errors occur, performance may be degraded by larger frame sizes due to the greater likelihood that a frame may encounter an error and need to be transmitted again. The frame size can be controlled through the MAXFRAME parameter found in both the primary line and controller description. The frame size used is usually based on the MAXFRAME parameter defined on the controller description. If you specify \*LINKTYPE on the MAXFRAME parameter of the controller description, the frame size used is a frame size defined on the line description. Between two communicating stations, the maximum frame size used is based on the smaller of the MAXFRAME values of either station.

The maximum outstanding frames is represented by the MAXOUT parameter on the line description. The MAXOUT parameter determines the maximum number of frames that can be sent before the receiving station must send an acknowledgement. As for frame size, better performance can be realized with a large MAXOUT value. In case of an error-prone line, a large MAXOUT value impacts performance because of retransmission requirements. All frames that have not been acknowledged must be retransmitted. The maximum for this parameter depends on the modulus (MODULUS) and maximum outstanding frames (MAXOUT) parameters that are part of the line description. If the value for MODULUS is set to eight, the maximum value that MAXOUT can be set to is seven. If the MODULUS value is set to 128, the maximum value that MAXOUT can be set to is 28. The MODULUS value should usually be set to eight except in special situations such as networks using satellite links. If the MODULUS value is 128, the MAXOUT value must be greater than seven. In order to support a MODULUS value of 128, you should ensure that the remote system is capable of supporting such a size.

The modem rate indicates whether the modem you are using is being operated at its full rated speed (\*FULL) or at an alternate or half speed (\*HALF). If many errors occur at the modem's higher transmission rate, errors and an associated retransmission can be reduced by selecting a slower data transmission rate for better overall performance. Modem data rate selection is valid only for \*RS232V24 and must match the modem setting at the remote system.

### 9.1.3 Congestion

Local or remote congestion occurs when data is not processed fast enough either while sending or while receiving. Congestion results in transmitting receive-not-ready frames by the system that is congested, either the host or remote device.

## 9.1.3.1 Using Performance Tools/400 to Display Information about Congestion

Information about congestion can be displayed using the DSPPFRDTA command after having collected performance data with the OS/400 Performance Monitor (see Chapter 1, "Tools Used for Finding Performance Problems" on page 1). You can also print the Resource Report to view the information about congestion.

Use DSPPFRDTA to access the Display Communications Interval Data display shown in Figure 61.

```
Display Communications Interval Data
Line ID . . . . . :
                                        Member . . . . . . :
                        LIN032
                                                                Q953171314
Line type . . . . :
                        SDLC
                                          Library . . . . :
                                                                  QPFRDATA
Line speed . . . . :
                        9.6
                                        Elapsed time . . . :
                                                                09:58:09
Bus number . . . . :
                        0
IOP address . . . :
                        5
Type options, press Enter.
 5=Display remote jobs
                         Pct
                               -Congestion--
                         Poll
                               Local Remote
                        Retry
                  Line
                                Not
                                        Not
       Itv
Option
       End
                  Util
                         Time
                                Rdy
                                        Rdy
       08:54:04
                          84
                                  0
                                          0
                    .1
       09:09:23
                    .0
                          85
                                  0
                                          0
 _
       09:24:22
                    .0
                          85
                                  0
                                          0
       09:39:19
                    .0
                          84
                                  0
                                          0
       09:54:17
                    .0
                          84
                                  0
                                          0
                                                                      More...
F3=Exit F11=View1
                       F12=Cancel
                                    F15=Sort by itv end
F20=Sort by line util
                       F24=More keys
```

Figure 61. Communications Interval Data - View 2

The display shows you the percentage of Receive Not Ready frames transmitted and received. This display can be accessed from the Display Performance Data display by pressing F21=Display Communications Detail. Choose the line to be analyzed and use option 7=Display Communications Interval Data. Press F11=View 2 to see the second display. The percentage of Receive Not Ready frames transmitted and received for the sample interval selected are the values listed in the Local Not Rdy and Remote Not Rdy column headings respectively. Use PRTRSCRPT to print the Resource Interval Report. The Communications Line Detail shows you the percentage of Receive Not Ready frames transmitted and received per sample interval shown in Figure 60 on page 149.

### 9.1.3.2 Performance Monitor Database Fields

The following fields in the performance monitor database file give an indication of the congestion at the local or remote side:

- SHRNRT Number of receive not ready supervisory frames transmitted (local congestion)
- SHRNRR Number of receive not ready supervisory frames received (remote congestion)

Both values should be close to zero in a well-performing system. High congestion increases both CPU and IOP utilization and directly affects remote response time.

Important values that can be derived from these fields are:

#### Local Not Ready

Receive Not Ready frames transmitted by the host as a percentage of all frames received by the host. A large number usually means the host IOP or system data buffers are not emptied fast enough. The Local Not Ready value can be derived from the following equation:

Local Not Ready = SHRNRT / (SHEFFR + SHFRIE + SHIFR + SHRRFR + SHRNRR)

#### **Remote Not Ready**

Receive Not Ready frames received by the host as a percentage of the information frames transmitted by the host. A large number usually means the remote device data buffers are not emptied fast enough. The Remote Not Ready value can be derived from the following equation:

Remote Not Ready = SHRNRR / (SHIFTR + SHIFRT + SHRRFT + SHRNRT)

Appendix A, "SDLC Queries" on page 227 lists the sample queries (SDLC\_ALL, SDLC\_IOP, and SDLC\_HDLC) to show the values previously mentioned.

#### 9.1.3.3 Recommendations

*Local Congestion:* A remote system is sending data too fast for your AS/400 system to process. This is probably caused by some sort of bottleneck such as high CPU, disk, or IOP utilization. Another cause might be a low machine pool size.

You can find more information about IOP in Section 9.2.1, "IOP Utilization" on page 159. For CPU, disk, and pool utilization, refer to the redbook *AS*/400 *Performance Management V3R1*, GG24-3723-02.

**Remote Congestion:** Another system receiving data from your AS/400 system cannot process the data fast enough and has sent out "NOT READY" messages. Check for possible bottlenecks on the system receiving data from your AS/400 system. This includes high CPU, IOP, or disk utilization. If the receiving system is an AS/400 system, the problem may also be a low machine pool size on that system.

## 9.1.4 Data Link Resets

Data link resets represents the number of times a set normal response mode (SNRM) was received when the station was already in normal response mode during a measured period. This is caused due to a procedure error.

#### 9.1.4.1 Using Performance Tools/400 to Display Data Link Resets

Performance tools do not create reports that show Data Link Reset values, nor can you use performance tools to display Data Link Reset values.

#### 9.1.4.2 Performance Monitor Database Fields

Data link resets are indicated by the following field:

**SHLNKR** The number of times a set normal response mode (SNRM) was received when the station was already in normal response mode

The performance monitor collects this number for each interval.

Appendix A, "SDLC Queries" on page 227 lists the sample queries (SDLC\_ALL and SDLC\_HDLC) to show the values previously mentioned.

#### 9.1.4.3 Recommendations

To avoid communications performance problems, this number should be zero or low. As this indication is caused by a procedure error, the line should be debugged. Check for messages in the QSYSOPR message. The link resets may be contributing to high line utilization. If the throughput or response time is unacceptable in your SDLC line, you may need to have the line or modem serviced; however, the amount of errors normally occurring changes depending on a number of variables such as the location and the quality and type of line.

Before servicing the lines, ensure that all cables are properly shielded, are IBM-supplied cables, and that all plug connections are secure. There should be no ribbon cables anywhere between the system and the modem.

## 9.1.5 Connect Poll Retries

Connect poll retries causes a line unavailable for a certain time because the IOP waits for a workstation controller to respond to a poll. Controllers that are varied on (vary on pending) but powered off (normal disconnect mode) can cause this condition. A high percentage of poll retries for a multi-point line increases the response time for all active stations that are connected to the same line. Polling also contributes to line and IOP utilization.

## 9.1.5.1 Using Performance Tools/400 to Display Connect Poll Retries

Information about connect poll retries can be displayed using the DSPPFRDTA command after having collected performance data with the OS/400 Performance Monitor (see Chapter 1, "Tools Used for Finding Performance Problems" on page 1). You can also print the Resource Report to view the information about connect poll retries.

Use DSPPFRDTA to access the Display Communications Interval Data display shown in Figure 61 on page 153. The display shows you the percentage of poll retry time. This display can be accessed from the Display Performance Data display by pressing F21=Display Communications Detail. Choose the line to be analyzed and use option 7=Display Communications Interval Data. Press F11=View 2 to see the second display. The percentage of poll retry time for the sample interval selected is the value listed in the Pct Poll Retry Time column headings.

Use PRTRSCRPT to print the Resource Interval Report. The Communications Line Detail shows you the percentage of poll retry time per sample interval shown in Figure 60 on page 149.

#### 9.1.5.2 Performance Monitor Database Fields

The following field in the performance monitor database file gives an indication of the connect poll retries:

**SHCPT** The length in time (in tenths of seconds) that the system waits for the response to a poll while in normal disconnect mode before polling the next station

An important value that can be derived from this field is the Percent Poll Retry Time, that is, the percent of the measured time interval when the line was unusable while the IOP waited for a workstation controller to respond to a poll. The Percent Poll Retry Time is derived from the following equation:

Percent Poll Retry Time = ((SHCPT \* (SHFRT - SHIFRT)) \* 100) / (INTSEC \* 10).

- **SHCPT** See preceding description
- SHFRT Number of I, supervisory, and frames not numbered transmitted again
- SHIFRT Number of I-frames transmitted again
- **INTSEC** Elapsed interval seconds

Appendix A, "SDLC Queries" on page 227 lists the sample queries (SDLC\_ALL and SDLC\_HDLC) to show the values previously mentioned.

#### 9.1.5.3 Recommendations

If there are intervals for multi-point lines that show a high percent poll retry time, you might want to increase the value for connect poll timer (CNNPOLLTMR parameter on line description) and decrease the NDM poll timer (NDMPOLLTMR parameter on controller description). You can also vary off those controllers until they are needed, if this is possible. The CNNPOLLTMR can effect response times for all controllers on the line. The CNNPOLLTMR controls how long the primary station waits after it polls a secondary controller and receives no response. While the primary station is waiting for a response, the line is idle, and the primary station cannot poll other stations on the line.

The connect poll retry (CNNPOLLRTY parameter on the controller description) is used in conjunction with the connect poll timer in normal disconnect mode and determines if the primary station should poll an offline, normal disconnect mode station periodically or if it should stop polling the controller after a limited number of polls. The system default value (\*CALC) allows seven retries on a switched line and unlimited (\*NOMAX) retries for a non-switched line.

The NDMPOLLTMR indicates how long the primary station must wait before sending a poll to a station in normal disconnect mode. While the timer is running, a controller that is offline is not polled even if its turn comes in the poll list. After the timer completes and the primary station finally reaches that station in the poll list, the station is polled. After the poll, the primary station waits for a response for the length of time specified by the connect poll timer. Besides the parameters previously described, the idle timer (IDLTMR parameter) and frame retry (FRAMERTY parameter) affects response times due to idleness of the line.

The *IDLTMR* parameter determines how fast the line recovers after a temporary error. If an error occurs after a station is polled and no response (or no final frame of a response) is received, the primary station waits for the idle timer to end. This parameter is important if the line is noisy or has frequent temporary frame errors such as frame checks. Too low a value for the idle timer can cause unnecessary timeouts and responses to be transmitted again.

The *FRAMERTY* parameter is used in conjunction with the idle timer. The frame retry limit determines the number of times the primary station retries a transmission to a remote station if consecutive temporary errors such as idle timeouts occur. Between retries to a station, a primary station continues to cycle through its poll list, transmitting to other stations.

The frame retry limit should be large enough to allow the system to recover from temporary errors such as those caused by line noise. You should note that a large frame retry value can cause unnecessary delays in reporting permanent errors (such as inoperable remote system or link) and degrade performance for other stations while SDLC is busy retrying.

Other poll parameters that may effect the response time are:

#### POLLPAUSE

The poll pause parameter. This parameter in the line description tells the primary station how long it should delay after making one complete pass through the poll list before recycling through the poll list again. This parameter is only used when SDLC is not sending data to any station.

Usually small values are recommended. However, if there are a number of lines physically attached to the same communications controller, and some lines are experiencing performance problems, increasing the poll cycle pause timer may give other tasks in the controller more time to run. The more stations there are on a line, the lesser the effect that the poll cycle pause timer has on overall performance.

- **POLLLMT** The poll limit parameter controls the number of additional polls SDLC sends to a station when that station responds with a number of frames equal to the maximum outstanding frames (MAXOUT) count. These additional polls determine if the remote controller has more frames to transmit that it was unable to do in its last transmission due to the MAXOUT limit. By polling the secondary station, the secondary station can send more frames to the primary station.
- **OUTLMT** The out limit controls how many sequences of information frames SDLC sends to a remote station before polling other stations in the poll list.

#### FAIRPLLTMR

The fair poll timer. This timer can be specified for multi-point lines to prevent one station from tying up the line for long periods of time. FAIRPLLTMR specifies the maximum length of time that the system sends data to one or more stations on the line before polling stations without pending output requests.

Lowering the fair poll timer makes polling more equitable by increasing the number of times every station is polled, but it degrades performance for busy stations and can increase the length of time it takes to send data. When some controllers are monopolizing the line at the expense of other controllers on the same line, lowering the fair poll timer may improve response time for other controllers. If possible, you may want to put the busy controller on a separate line to improve performance.

- **POLLPRTY** The poll priority parameter controls the extra polls that are sent to a station in situations where a poll may be denied due to the following situations:
  - When the primary station is only transmitting to other stations.
  - When the fair poll timer completes.
  - When the primary station is performing normal sequential polling.

When POLLPRTY is set to \*YES, the priority station obtains an extra poll. During sequential polling, the setting of this parameter enables the priority station to be polled twice as often as non-priority stations. Therefore, POLLPRTY can be used to give better response to some stations.

This parameter should be used with caution. Designating a secondary station as a priority station is almost equivalent to another controller on the line. Non-priority stations may experience increased response time.

#### POLLRSPDLY

The poll response delay parameter. This parameter in the line description tells the secondary station how long to wait after it has been polled before it returns a response.

Normally the delay timer is be set to zero unless the following conditions apply:

- The modem requires this delay.
- The primary station cannot handle a fast response.
- There is some unique requirement.

Specifying a nonzero value increases the time all other controllers on a multi-point line must wait before being polled and should, therefore, be avoided if possible. The value of POLLRSPDLY along with the internal delays and the time needed for increasing must be less than the idle timer on the remote system.

## 9.2 Other Related Performance Monitor Files

The following performance indicators can be retrieved from other database files:

- IOP utilization
- Remote jobs

## 9.2.1 IOP Utilization

Each line is controlled by an IOP. The performance of a line may be affected by the IOP that controls the line. It is important not to overload an IOP to avoid a possible system performance bottleneck. Keep the IOP utilization within the guideline of 40%. See Chapter 6, "Communications I/O Processor (IOP)" on page 89 for more information about IOP performance.

### 9.2.1.1 Performance Monitor Database Fields

An important performance indicator for the IOP is the IOP utilization. How you calculate this value is described in Chapter 6, "Communications I/O Processor (IOP)" on page 89. To relate the line to the IOP, you need two files:

**QAPMHDLC** Contains performance data about the line

**QAPMCIOP** Contains performance data about IOPs

**Note:** If the communications adapter is connected to a multifunction IOP, the QPAMMIOP file must be used instead of QAPMCIOP. Appendix A, "SDLC Queries" on page 227 lists sample queries for both kind of IOPs.

The IOP is identified in both files (QAPMHDLC and QAPMCIOP) by the field:

IOPRN IOP Resource Name

This field should be used to relate IOP information to the line.

Appendix A, "SDLC Queries" on page 227 lists the sample query (SDLC\_IOP) to show the values previously mentioned.

#### 9.2.1.2 Recommendations

Keep the IOP utilization within the guideline of 40%. If the performance capabilities of a single IOP is exceeded, it is important to distribute the workload across several IOPs. Consider moving one of the high speed lines that is attached to this communications IOP card to another one. If you still have problems, consider changing to a newer communications IOP card if you are using an older one. The following factors can help you to decrease the IOP utilization:

- Polling
- Frame size

Polling contributes to the IOP utilization. A long polling delay requires less overhead then a shorter polling delay; however, a short polling delay gives better response time in an interactive environment. See Section 9.1.5, "Connect Poll Retries" on page 155 for more information.

The OS/400 support for SDLC can use a range of frame sizes up to 2057 bytes. Usually the larger the frame size used, the better the performance. Larger frame sizes reduces the number of frames that need to be transmitted. When fewer frames are transmitted, the overhead and line turnaround are reduced. This means that the CPU and communication IOP processes fewer frames. When this happens, CPU and IOP utilization are reduced correspondingly. In addition, you can expect a higher throughput, thereby making more efficient use of your communication line. The frame size can be controlled through the MAXFRAME parameter found in both the primary line and controller description (see also Section 9.1.2.3, "Recommendations" on page 152)

### 9.2.2 Remote Jobs

For a good understanding of the performance of a line, it is good to know which remote jobs are running on the communications line and which other resources they use.

#### 9.2.2.1 Performance Monitor Database Fields

To relate the line to the remote jobs, you need two files:

**QAPMHDLC** Contains performance data about the line

**QAPMJOBS** Contains performance data about jobs

In the file QAPMHDLC, a line is identified by the field:

SHLND The name of the SDLC line

To relate the job information to the line, you should use the following field in the QAPMJOBS file:

JBLND Name of the communications line the workstation and its controller are attached to

Important values in the QAPMJOBS file are:

- **JBRSP** Total transaction time. This field has a value other than zero only if this is an interactive or a pass-through target job.
- **JBNTR** Number of transactions. This field has a value other than zero only if this is an interactive or a pass-through target job.
- JBCPU Processing unit time (in milliseconds) used

Important values that can be derived from the QAPMJOBS file are:

 The percentage of elapsed time during which the processing unit was utilized by the job.

Percent CPU was utilized by the job = ((JBCPU / 1000) \* 100) / INTSEC.

- The total number of remote jobs that are running on the SDLC line. You should add up all of the job entries, selecting by line name (JBLND).
- The total number of transactions performed by the jobs running on the SDLC line. You should add up the number of transactions (JBNTR) for each job running on the SDLC line.
- The average internal response time (in seconds) per transaction for each job:

Avg response time for a job = (JBRSP / JBNTR).

• The average internal response time (in seconds) per transaction for all jobs:

Avg response time for all jobs = (Total transaction time / Total number of transactions). Look for periods of high utilization and correlate them with transaction rates and response times.

Appendix A, "SDLC Queries" on page 227 lists the sample queries (SDLC\_ALL and SDLC\_JOB) to show the values previously mentioned.

## 9.2.2.2 Recommendations

If there are high utilization and response times but no increase in the transaction load, there is a good chance that you are getting line errors. On the other hand, if the transaction load and line utilization increase and the response time is high, the system may be trying to handle more work than it has the capacity to do. In this case, the additional response time may be caused by queueing in a communications line, IOP, or control unit.

An important factor for the response time of interactive jobs that has not been discussed so far is the support of full duplex. This is represented by the DUPLEX parameter on the line description. Duplex support minimizes the modem turnaround time. This is the amount of time required for a station to stop receiving data and to begin transmitting data. Non-switched lines generally have little modem turnaround because they normally have four wires. Duplex support makes use of the two-way nature of four-wire lines so that one set of wires is always conditioned to receive while the other set of wires is always conditioned to transmit. Although data is never sent or received simultaneously with SDLC, there is almost no modem turnaround time with duplex support.

Typical times for turnaround depending on the modem and the quality of the line connection range from 0.1 second to 0.5 second (it may be less for newer modem models). This can be significant for interactive applications if a station alternates frequently between sending and receiving data for the same transaction. Large transfer applications can see some degradation because the application requires multiple transitions between sending data and receiving acknowledgements to ensure data integrity. Eliminating modem turnaround time brings some improvement to these applications.

## Chapter 10. SNA

From a performance viewpoint, SNA protocol exists as a layer between what an application does to affect performance and the "maximum performance capabilities" controlled by line speed and line type protocols such as for local area networks and SDLC. SNA support affects primarily the communication between two programs or a program and a device whereas line type protocols primarily affect communication at the control unit level. User program I/O output operations are associated more closely to SNA capabilities than to communication type capabilities.

This chapter describes how you can use the SNA performance values and SNA traces to identify bottlenecks in an SNA environment, where you can find these values, how they are related to each other, and what you can do to solve the bottlenecks. Most of the performance values come from the *QAPMSNA* performance tools database file that is generated when you run the Performance Monitor (see Chapter 1, "Tools Used for Finding Performance Problems" on page 1). The QAPMSNA file contains a record for each active controller (APPC or HOST).

## 10.1 Important Fields in the SNA Performance Monitor File

The following list contains the main SNA communications performance indicators:

- Number of connections established
- Number of sessions and brackets started and ended
- Session level pacing wait time
- Internal session level pacing
- Transmission queue wait time
- · Line transmission time

The number of connections established records the frequency with which connections are established with the adjacent system. The other indicators record the *session* detail for each active APPC and host controller. The performance monitor collects data for each session type and session priority combination. The possible session types are:

- End-point
- Intermediate

End-point sessions may be established for the following device types:

APPC devices Host devices DHCF display devices NRF display and printer devices

Intermediate sessions may be established for:

APPN intermediate traffic SNA pass-through devices

Each session type can have traffic at any of four priorities:

1. Network priority

APPN SNA change number of sessions (CNOS) Alert support

2. High priority

APPC devices APPN intermediate sessions

3. Medium priority

APPC devices Host devices DHCF display devices NRF display and printer devices SNA pass-through devices APPN intermediate sessions

4. Low priority

APPC devices APPN intermediate sessions

The session priority is determined by the transmission priority (TMSPTY) specified in the Class-of-Service (COS). The COS is determined by the mode description used. You should run interactive-type functions at \*HIGH priority. Batch type functions should be configured to use \*LOW priority.

In the following sections, each session traffic field name is prefixed by the characters "tp", where "t" is the session type (E=End Point, I=Intermediate) and "p" is the session priority (N=network, H=high, M=medium, L=Iow).

## 10.1.1 Number of Connections Established

The number of connections established indicates the frequency with which connections are established with the adjacent system. A connection is established with the adjacent system when the status of the controller description goes from varied off or vary on pending to varied on or active.

On a non-switched line, the connection is established after the line and controller description are varied on, assuming the adjacent system is ready to establish the connection. The non-switched connection remains until the controller is varied off, a non-recoverable line error occurs, or the adjacent system drops the connection.

On a switched line, the connection is not established until a communications program needs to use the connection (for example, the program acquires a session). The switched connection is usually dropped after the connection has been inactive (for example, all sessions are unbound) for a period of time.

## 10.1.1.1 Using Performance Tools

Performance tools do not create reports that show connection values, nor can you use performance tools for displaying connection values.

#### **10.1.1.2 Performance Monitor Database Fields**

**SNLBU** Indicates the number of connections that were established with the adjacent system in the time interval

This is a field in the QAPMSNA file. To examine the value of this field, you can run the sample queries (SNA\_ALL and SNA\_CON) listed in Appendix E, "SNA Queries" on page 311.

### 10.1.1.3 Recommendations

Establishment of communications uses significant resource on the AS/400 system. This additional resource may be seen in the QLUS function. For example, an environment with a large number of switched lines where the controllers are frequently connecting for a short time and then disconnecting may see increased resources used in the QLUS job.

In addition, establishing connections increases the number of RUs flowing in the network priority session. These additional network RUs increase:

- T2 station and line IOM CPU usage
- IOP utilization
- · Line utilization

## 10.1.2 Number of Sessions and Brackets Started/Ended

A session is a logical connection between two network accessible units. A session starts when the positive response to an SNA bind command is sent or received. A session ends when an SNA unbind command is sent or received, or the session is abnormally ended (for example, the line fails).

The meaning of the number of brackets started and ended depends on the environment. In a non-APPC environment, the number of start and end brackets indicates the number of BIND and UNBIND commands. In an APPC environment, this counts the number of evokes/allocates and detach/deallocates. An APPC bracket is roughly equivalent to a conversation that is started when a program issues an ICF evoke operation or Common Programming Interface Communications (CPI-C) allocate verb and ends when a program issues an ICF detach operation or Common Programming Interface Communications (CPI-C) deallocate verb.

## 10.1.2.1 Using Performance Tools

Performance tools do not create reports about the number of sessions and conversations started and ended, nor can you use performance tools for displaying the number of sessions and conversations started and ended.

#### **10.1.2.2 Performance Monitor Database Fields**

- tpNSS Indicates the number of sessions that are started
- tpNSE Indicates the number of sessions that are ended
- tpNBB Number of request units with begin bracket sent and received
- tpNEB Number of request units with end bracket sent and received

To examine the value of these fields, you can run the sample queries (SNA\_ALL and SNA\_CON) listed in Appendix E, "SNA Queries" on page 311.

### 10.1.2.3 Recommendations

The session start and end fields may be examined if the overall session start/end count was high. These fields enable you to determine which controllers were connecting frequently to your system. Starting and ending sessions can cause significant system overhead, such as increase CPU usage in the T2 station IOM, line IOM, and QLUS task, plus increase in the line and IOP workloads. High CPU usage by the QLUS task may occur when a user-written APPC program uses the "Change Number of Sessions" function (CNOS). Re-writing APPC programs to avoid the CNOS function when the session was being closed can help to reduce CPU time. It is far more efficient to just UNBIND, avoiding CNOS altogether. Client Access/400 is an example of an APPC application that UNBINDs at session close rather than using CNOS.

### 10.1.3 Session Level Pacing Wait Time

Session-level pacing is a technique that allows a receiving session to control the rate at which it receives request units on the normal flow. It is used primarily to prevent a receiver with unprocessed requests from overloading because the sender can create requests faster than the receiver can process them. If the pacing factor is three, only three RUs can be sent and the session waits for a pacing response from the receiver. Session level pacing wait time indicates the amount of time that application data waits for a pacing response.

#### 10.1.3.1 Using Performance Tools

Performance tools do not create reports that show session level pacing wait time values, nor can you use performance tools for displaying session level pacing wait time values.

#### **10.1.3.2 Performance Monitor Database Fields**

- **tpSPWT** The cumulative wait time (in milliseconds) caused by session-level send messages. This wait time measures the amount of time application data was blocked (could not be sent) waiting for a pacing response to be received from the adjacent system.
- **tpSPNW** Number of waits occurring for session-level send pacing. That is, the number of times application data was blocked (could not be sent) waiting for a pacing response to be received from the adjacent system.
- **tpSPPW** Number of potential waits occurring for session-level send pacing. This is the worst case that can occur if the sending of application data was delayed waiting for every pacing response sent by the adjacent system.
- **tpSPWS** The cumulative window size for session-level send pacing. Each time a pacing response is received from the adjacent system on a network priority session, this count is increased by window size specified by the pacing response.

Important values that can be derived from the session-level pacing fields are:

The average amount of time spent waiting for a pacing response to be received = tpSPWT / tpSPNW.

To see this value, you can use the sample query (SNA\_PAC1) listed in Appendix E, "SNA Queries" on page 311.

The percentage of times application data waited for a pacing response to arrive = (tpSPNW \* 100) / tpSPPW.

To see this value, you can use the sample query (SNA\_PAC2) listed in Appendix E, "SNA Queries" on page 311.

The average pacing window size = tpSPWS / tpSPPW.

To see this value, you can use the sample query (SNA\_PAC2) listed in Appendix E, "SNA Queries" on page 311.

### 10.1.3.3 Recommendations

If excessive waiting is caused by session-level pacing, the OUTPACING (local system) and INPACING (remote system) parameters in the mode description may need to be increased. When the AS/400 system is functioning as a dependent LU and communicating with a System/390 host, the pacing used is specified on the S/390 system. On the S/390 VTAM macros such as GROUP or LU, pacing is specified with the PACING parameter. You should keep in mind that, with respect to internal session level pacing, a large wait time may be desirable if batch is being throttled to allow interactive to run faster. You must know the environment to know if there is a problem. However, if the average pacing window size is seven or more and you have excessive waiting, you should check:

- The remote system; it may be slow in sending pacing responses.
- · The line utilization
- · If the line has errors

# 10.1.4 Internal Session Level Pacing

For APPN and APPC sessions that are adaptively paced, internal session-level pacing is used to limit the amount of bandwidth used by a particular session. It only controls internal flow and does not have any external line flows. A sending session is allowed to transmit a limited number of request units and is not allowed to transmit additional request units until a request unit is successfully delivered to the adjacent system.

#### **10.1.4.1 Using Performance Tools**

Performance tools do not create reports that show internal session level pacing values, nor can you use performance tools for displaying internal session level pacing values.

### **10.1.4.2 Performance Monitor Database Fields**

- **tpIPWT** The cumulative wait time for internal session-level pacing. That is, the number of times application data was blocked (could not be sent) waiting for data to be delivered to the adjacent system.
- **tpIPNW** Number of waits occurring for internal session-level pacing. That is, the number of times application data was blocked (could not be sent) waiting for data to be delivered to the adjacent system.

An important value that can be derived from the internal session-level pacing fields is:

The average amount of time spent waiting because of internal session-level pacing = tpIPWT / tpIPNW.

To see this value, you can use the sample query (SNA\_IPAC) listed in Appendix E, "SNA Queries" on page 311.

### 10.1.4.3 Recommendations

In general, the following rules apply:

- · Controllers carrying interactive-only traffic should see minimal pacing waits.
- · Controllers carrying batch-only traffic should see minimal pacing waits.
- Controllers carrying a mix of interactive and batch traffic may see high pacing wait times. If the batch traffic is running at a different priority than the interactive traffic (this is desirable), it should be easy to determine if waiting is only occurring on the batch functions.

If excessive waiting is caused by internal session-level pacing and it is not desirable to limit the amount of bandwidth used, the OUTPACING and INPACING parameters in the mode description may need to be increased. These parameters are used to calculate the transmission limit. The limit used for a given session is (2\*n)-1, where *n* is the INPACING or OUTPACING parameter. On a slow speed line, it may be necessary to configure a small limit for batch traffic and a larger limit for interactive traffic to ensure acceptable interactive response time.

### 10.1.5 Transmission Queue Wait Time

When a request unit has to be transmitted to a remote system, it is placed on a transmission priority queue. The amount of time a request unit has to wait in the transmission priority queue influences the response time of the corresponding communication job.

#### **10.1.5.1 Using Performance Tools**

Performance tools do not create reports that show transmission queue wait time values, nor can you use performance tools for displaying transmission wait time values.

### **10.1.5.2 Performance Monitor Database Fields**

- **tpQNRE** Number request/response units entering the transmission priority queue
- **tpQLRE** Length of request/response units entering the transmission priority queue
- **tpQNRL** Number of request/response units leaving the transmission priority queue. Normally this field matches tpQNRE.
- **tpQLRL** Length of request/response units leaving the transmission priority queue. Normally this field matches tpQNRL.
- tpQTRR Cumulative wait time in transmission priority queue

If the RUs stay in the transmission priority queue for a considerable amount of time, the values of the fields tpQNRE/tpQLRE may differ from the values of the fields tpQNRL/tpQLRL. RUs stay in the transmission priority queue, for example, when using a low speed line that has many sessions using the same controller.

Important values that can be derived from the transmission priority fields are:

The average length of a request unit entering the transmission priority queue = tpQLRE / tpQNRE.

The average length of a request unit leaving the transmission priority queue = tpQLRL / tpQNRL.

The average amount of time a request unit waited in a transmission priority queue = tpQTRR / tpQNRL.

To see these values, you can use the sample query (SNA\_TRQ) listed in Appendix E, "SNA Queries" on page 311.

### 10.1.5.3 Recommendations

Normally the wait times should be in the order of a few milliseconds. The average wait time for higher priority data should typically be less than lower priority data. If you notice excessive waiting in a transmission priority queue, you should check:

- The line utilization, especially if it is a low speed line
- · The number of retransmissions on the line
- · IOP utilization

Section 10.2.1, "Line Utilization" on page 171 describes how you can retrieve line performance information. The line protocol chapters contain a section that describes how you can retrieve IOP performance information for a given line.

## **10.1.6** Line Transmission Time

Line transmission time indicates the amount of time required to successfully transmit data to the adjacent system. This measurement period begins after the data leaves the transmission priority queue and ends when the data is successfully delivered to the adjacent system.

#### **10.1.6.1 Using Performance Tools**

Performance tools do not create reports that show line transmission values, nor can you use performance tools for displaying line transmission values.

#### **10.1.6.2** Performance Monitor Database Fields

- **tpNRUD** Number of request/response units delivered to the adjacent system. This field should be almost identical to the fields tpQNRL.
- tpLRUD Length of request/response units delivered to the adjacent system. This field should be almost identical to the field tpQLRL.
- **tpTRUD** Cumulative service time to deliver a request/response unit to the adjacent system
- tpNRUR Number of request/response units received from the adjacent system
- tpLRUR Length of request/response units received from the adjacent system

The tpQNRL/tpQLRL counts might be slightly higher than the tpLRUD/tpNRUD counts if the IOP stopped sending for five minutes or more.

Important values that can be derived from the line transmission fields are:

The average length of a delivered request unit = tpLRUD / tpNRUD.

The average amount of time to deliver a request unit = tpTRUD / tpNRUD.

The average length of a received request unit = tpLRUR / tpNRUR.

To see these values, you can use the sample query (SNA\_LIN) listed in Appendix E, "SNA Queries" on page 311.

### 10.1.6.3 Recommendations

The average amount of time to deliver a request unit gives a good indication of the real response time of the communications network. To determine the transmission time for the data being received, you should examine the performance data of the sending system. If you notice an excessive average amount of time to deliver a request, you should check:

- The line utilization, especially if it is a low speed line. The busier the line, the longer your RU has to queue before being transmitted. Line queuing time is part of the line delivery time.
- IOP utilization. Each RU sent has to be serviced by the IOP on both the sending system and the receiving system.

A contributor on the SNA level (the level as discussed in the beginning of this chapter) to line and IOP utilization is segmentation. Segmentation takes place when an RU does not fit into a frame. The RU is divided (segmented) across frames. How you can control the frame size is discussed in the line protocol chapters. You can control the RU size using the MAXLENRU parameter. To ensure an optimum length, the value \*CALC is recommended. In this case, the system calculates the value to use.

For APPC/APPN devices, the Mode Description controls MAXLENRU values. For other device types such as 5250 displays, the AS/400 system defaults to a MAXLENRU based on the control unit MAXFRAME value supported. For other device types, such as Retail (4680) devices, MAXLENRU can be explicitly specified on the device description, although a default value is supported. In most cases, the default chosen by the system is the best value.

When the AS/400 system is functioning as a dependent LU and communicating with a System/390 host, the RU length used is specified on the S/390 system. On the S/390, RU send and receive lengths are specified in the log mode table through the MODEENT statement used for one or more LUs. Some VTAM applications such as CICS may override the VTAM MODEENT value. For example, the CICS Terminal Control Table (DFHTCT) entry for each LU can specify both send and receive RU values (RUSIZE and BUFFER).

Dependent LU support includes the AS/400 system running Remote Job Entry (RJEF), 3270 Device Emulation, Distributed System Node Executive (DSNX), and Distributed Host Command Facility (DHCF).

# **10.2 Important Related Performance Manager Files**

The following performance indicators can be retrieved from other database files:

- Line utilization
- Communications jobs

# 10.2.1 Line Utilization

Each controller is attached to a line. The performance of the controller may be affected by the line to which it is attached. It is important not to overload the line to avoid a possible system performance bottleneck. You might read the appropriate line protocol chapter to determine what the utilization guideline is for a given line and what you can do to decrease the line utilization.

## **10.2.1.1 Using Performance Tools for Line Utilization**

Read the appropriate line protocol chapter to determine how you can display the line utilization of a given line using performance tools.

# **10.2.1.2 Performance Monitor Database Fields**

Information about the controller is contained in the file QAPMSNA. In this file, the attached line is identified by the following field:

**SLINNM** Name of the line description that is attached to the controller description

If \*LOCAL is specified for the link type parameter on an APPC controller description, this field is blank.

To relate the controller to the attached line description, you need one of the following files, depending on the line protocol used:

- **QAPMECL** Contains token-ring statistics. The field ELLND must match the field SLINNM.
- **QAPMETH** Contains Ethernet statistics. The field that must match SLINNM is the field ETLLND.
- **QAPMHDLC** Contains SDLC/HDLC statistics. The field SHLND must match the field SLINNM.
- **QAPMX25** Contains X25 statistics. The field XLLND must match the field SLINNM.

You can use the sample query (SNA\_ALL or SNA\_LIN) to show the values. The sample query is listed in Appendix E, "SNA Queries" on page 311. Refer also to the appropriate line protocol chapter to determine where you can find the line utilization.

### **10.2.1.3 Recommendations**

In general, line utilization contributors are:

- Line speed
- Protocol overhead
- Error recovery
- · Data sent and received

For the first three contributors, refer to the appropriate line protocol chapter on how you can decrease line utilization.

When you use APPC, the amount of data sent and received can be decreased using data compression. Data compression can be specified using the DTACPR network attribute. This value may be overridden by its corresponding parameter in a mode description. Data compression at the session level reduces the amount of data sent across a communications line. It can increase the throughput on slower lines. However, data compression also uses processing unit cycles. It can actually reduce throughput on fast lines, which can send the data faster than the processing unit can compress it. Data compression varies in its effectiveness depending on the content of the data. For example, data compression is more effective on text than on binary data. You can use APPC data compression between any two systems that support APPC and data compression, including APPC over TCP/IP configurations.

# **10.2.2 Communications Jobs**

For a good understanding of the SNA performance, it is good to know which jobs are related to SNA and which resources they use. Communications jobs that are related to SNA are:

- T2 station IOM tasks
- · Line IOM tasks
- The logical unit services

The T2 station IOM task provides services for the controller description. Each APPC and host controller has a unique T2 station I/O manager task. The task name is assigned when the controller goes into the VARIED ON or ACTIVE state. Hence, if a controller is varied off and later varied on, the station IOM task is different. The task name is of the form T2-xxxxxxx, where *xxxxxxx* are the first seven characters of the name of the controller description.

The line IOM tasks provides services for the line description. The task name is of the form xxxx-yyyyy, where xxxx is the line protocol (length varies), followed by yyyyy, that is, as many characters of the name of the line description that the whole character string fits into the 10-character field JBNAME in the database file QAPMJOBS. Also, the first character of the task type extender JBTTYE contains a character that is related to the communication protocol. Here are a few examples of protocols and task type extenders:

- LWS-yyyyyy (A) Local workstation I/O manager
- ETH-yyyyyy (D) Ethernet
- X25-yyyyyy (G) X.25
- ISDN-yyyyy (J) ISDN (D-channel)
- IDLC-yyyyy (L) IDLC (ISDN B-channel)
- TRN-yyyyyy (3) Token-ring
- SDLC-yyyyy (7) SLDC

The logical unit services, identified by the job name QLUS, supports communications devices. QLUS handles the event handling for logical unit devices (communications devices) and also acts as the manager of communications devices.

# 10.2.2.1 Using Performance Tools

Job information can be displayed using the DSPPFRDTA command after having collected performance data with OS/400 Performance Monitor (see Chapter 1, "Tools Used for Finding Performance Problems" on page 1).

# 10.2.2.2 Performance Monitor Database Fields

To relate the controller to communications jobs, you need two files:

**QAPMSNA** Contains performance data about SNA

**QAPMJOBS** Contains performance data about jobs and tasks

In the file QAPMJOBS, the jobs and tasks are identified by the field:

JBNAME Name of the job/workstation

To relate the controller to the T2 station IOM task, the following field in the QAPMSNA file must match the value of the field JBNAME:

STSKNM T2 station I/O manager task name

To relate the controller to the line IOM task, the following field in the QAPMSNA file must match the value of the field JBNAME:

SLIOMT Line I/O manager task name

Because the JBNAME field in tha QAPMJOBS database file contains only the first few characters of the line/controller description name (as described in Section 10.2.2, "Communications Jobs" on page 172), and the fields STSKNM and SLIOMT in the database file QAPMSNA contain the first six characters of the T2 and line IOM task names, respectively, it is not always possible to find an exact match.

The QAPMJOBS file contains a record for the QLUS job. The JBNAME field for this record has the value QLUS.

# 10.2.2.3 Recommendations

You generally do not see significant CPU consumed by the station and line I/O tasks. The CPU used by the T2 task generally varies according to the number (not the size) of RUs processed.

It is possible that QLUS uses significant CPU resource. CPU utilization can be 2-10% if a large number of APPC device descriptions are varied on during the same short period of time. If QLUS CPU utilization is greater than 10% for some performance monitor interval or multiple time intervals, there is usually an APPC application design problem. One known cause is the short time span ending and starting hundreds of APPC conversations that includes the APPC verb equivalent to the Change Session Maximum command function. This high CPU usage may occur when a user-written APPC program uses the "Change Number of Sessions" function (CNOS).

# 10.3 SNA Traces

Sometimes communications performance problem determination tasks are easier if you can see the data that is sent and received using a trace. For SNA, you can use the following traces:

- Communications trace
- · CPI communications trace
- · ICF communications trace

The AS/400 system communications trace can be used to verify the amount of data going over a line, the time it takes for a response to be returned, and to check for abnormalities. Interpreting communications traces requires detailed knowledge of the line protocols being used. How you start and stop a communications trace is described in Chapter 5, "Using System Service Tools" on page 71. After you have taken a communications trace, you should print the trace. You probably want to view the listing from your terminal first so you can search for certain byte strings and let the system do the work for you. It is advised to print the trace data twice, one with the default option "Format SNA data only = N" and one with the option "Format SNA data only = N" and one with the option (Format SNA data only = N) includes a timer, but the formatted SNA data is easier to read and understand. The timer is handy when trying to determine how long your system had to wait for a

response from another system. For information about the data stream layout, refer to *Systems Network Architecture Formats*, GA27-3136.

A CPI or ICF communications trace may be useful if you have a performance problem with a specific CPI-C or ICF program. You can use the Trace Common Programming Interface (CPI) Communications (TRCCPIC) command to capture information about CPI-Communications calls that are being processed by your program. The trace information can be collected in a current job or in a job being serviced by a Start Service Job (STRSRVJOB) command.

You can use the Trace Intersystem Communications Function (TRCICF) command to trace communications information concerning the intersystem communications function (ICF) operations and functions that are used by a user program. The trace information can be collected in the current job or in the job being serviced by a Start Service Job (STRSRVJOB) command. The TRCICF command is similar to the TRCCPIC command. Detailed information concerning the TRCICF command and the output it creates is found in the *ICF Programming*, SC41-3442.

# Chapter 11. TCP/IP Performance Investigation

TCP/IP is the protocol suite consisting of applications and transport layers. From a performance point of view, you may have to look at a broader range of the protocols. However, we are focusing on the transport layers in this document.

# **11.1 Performance Expectation**

What do you expect when you use TCP/IP?

- A comparison to other systems such as OEM systems and other IBM platforms.
- A comparison to the documented values in the communications chapters of the AS/400 Performance Capabilities Reference for PowerPC Technology, ZC41-0607.

If you do not get similar performances compared to the values mentioned here, you may want to investigate your TCP/IP performance.

## 11.2 TCP/IP Overview

This section discusses performance related TCP/IP topics to give you a better understanding of performance implications. For complete TCP/IP information for the AS/400 system, please refer to the *TCP/IP Configuration and Reference*.

# 11.2.1 Data Format

The same as many other protocols, TCP/IP protocol suite uses several headers to describe the contents of a datagram. Apart from application-unique headers, major headers of TCP/IP are the IP header, UDP header, and TCP header.

The headers are added or removed as data goes through the corresponding protocol.

Let's take a look at an example:

The following figure shows an example of this header encapsulation using FTP as the application and X.25 as the communication link. One thing we should mention is that FTP uses TCP for the transport layer.

Application		data	
TCP layer		TCP header	data
IP layer	IP header	TCP header	data

Figure 62. Encapsulation with Headers

When an application program (FTP is one of the examples) puts its data in the next layer of the protocol suites, the next layer (TCP) adds the TCP header. Usually the TCP header is 20 bytes in length. Then TCP puts the entire data in the next layer, IP. IP also adds its own IP header and sends it out to the communication link. The communication link may be a LAN or X.25. X.25, of course, adds its own X.25 header.

In our example, let's assume that the packet size is 256 bytes and FTP sends 600 bytes data. The data including the headers is divided into multiple 256-byte packets to fit in the packet size. Each packet looks similar to the following diagram:

IP datagram	IP header (20)	TCP header (20)	data(600)	
packet (1)	packet header	r IP header (20)	TCP header (20)	data (216)
			, <b>L</b>	
packet (2)	packet header	data(2	256)	
	r	· · · · · · · · · · · · · · · · · · ·	· · · · · · · · · · · · · · · · · · ·	
packet (3)	packet header	data(1	.28)	

Figure 63. Format of IP Datagram and Link

For more detail about the header formats, please refer to the manual, *TCP/IP Tutorial and Technical Overview*, GG24-3376.

Each packet is called an MTU (Maximum Transmission Unit) in TCP/IP terms. So the longer the packet size (MTU) is, the more efficient the throughput is. The AS/400 system determines its MTU size based on the buffer length parameter in the TCP/IP configuration. This is true for UDP also. For FTP, which uses TCP, the fixed length of 8192 bytes is used.

# 11.2.2 Flow Control

Since most applications use TCP rather than UDP, we can focus on TCP in this document for performance considerations.

To ensure a reliable data transmission, TCP uses a "window" to control the data flow. The "window" is the data length that a sender can send data through before receiving a confirmation from the receiving host.

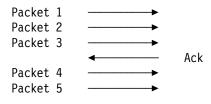


Figure 64. Windowing Technique

The figure shows how two host systems exchange data using the "window" technique. As you may notice, the longer the window size is, the better throughput you get. But the disadvantage of having a longer window size is that you may have poor throughput on a poor quality link. Because the window size is the unit of error recovery, once communication errors occur, you have to retransmit an entire window length.

# 11.2.3 Version 3 Performance Improvements

In addition to the major restructuring of TCP/IP for the AS/400 system, you can get better performance when you use the newer IOPs. From V3R1, some TCP/IP functions are put down below in IOPs, so that less overhead is needed. This is called a TCP/IP-assist function. Some TCP/IP-assist functions are:

- Checksum calculation
- Fragmentation and re-assembly of datagram
- · Address resolution for ARP

These IOPs are #2617, #2619, #2618, #2665, #2666 (frame relay only), and #2668. As you may notice, these are all LAN-type shared media, which means when you use X.25 for TCP/IP, you cannot get better performance.

### 11.3 Performance Tool/400 Databases

Performance Tool/400 does not give you TCP/IP protocol-specific data, unlike SNA. SNA has its database files in the Performance Tool, but TCP/IP does not. Therefore, more details for TCP/IP are not available but you can use QAPMSAP and QAPMJOBS files for information about the TCP/IP.

# 11.3.1 QAPMSAP

The performance tool database QAPMSAP collects UI frame data and TCP/IP uses the UI frames. This data, however, as the DB file name implies, is only for LAN links. You cannot relate the numbers in the database fields to a specific TCP/IP application, or a port number from this database. So, if you have the LAN connection for TCP/IP and other protocols such as SNA, you can measure how much TCP/IP contributes to the line or IOP utilization by comparing the number of UI frames to other non-UI frames, which are collected in the file QAPMECL or QAPMETH on the same line.

The database fields in QAPMSAP are:

SCSSAP SAP address. TCP/IP uses the address AA.

- SCLND Line description name
- SCIRCV Total number of UI frames received at this SAP

- SCIXMT Total number of UI frames transmitted through this SAP
- SCBRCV Total number of bytes received at this SAP contained in UI frames
- **SCBXMT** Total number of bytes transmitted through this SAP contained in UI frames

Please note that those UI bytes do not necessarily represent data bytes that your applications send or receive. There may be a chance to route IP data to other TCP/IP hosts and those data bytes are counted in the fields.

# 11.3.2 QAPMJOBS

QAPMJOBS collects performance data for each job. There are TCP/IP related fields in this database.

JBSKSCNumber of sockets sentJBSKRCNumber of sockets receivedJBSKBSNumber of socket bytes sentJBSKBRNumber of socket bytes received

Those fields are related to a specific application using a socket interface so that you may be able to tell which application contributes to the resource utilization. But for those that do not use the socket interface such as TELNET or PASCAL APIs, these fields do not tell anything. If this is the case, you can collect the values in the fields of QAPMSAP.

# 11.4 Bottlenecks

Even though the Performance Tool/400 does not collect TCP/IP specific data, you can still use the Performance Tool to figure out if the bottleneck is with the line or IOP. Please refer to Chapter 6, "Communications I/O Processor (IOP)" on page 89 for IOP, Chapter 7, "Local Area Network Performance Analysis" on page 97 for LAN, and Chapter 8, "X.25" on page 127 for X.25 to find the utilizations.

These chapters at least give some idea which area you have to investigate in more detail.

# 11.5 Tools We Can Use for TCP/IP

Since Performance Tool/400 does not collect performance data for TCP/IP, we have to look at other areas.

Error log

Error log entries show which kind of errors have occurred in which lines to give you a rough idea about how many error recovery activities have taken place. But there is no absolute number to determine how many is too many.

Entries with error log reference code '7004' means AS/400 TCP/IP discarded IP datagrams because of protocol errors such as checksum error and invalid destination address. The entries have IP, TCP, or UDP headers, so you can determine where they are sent and which port was used.

You need to specify "Log protocol errors=\*YES" in the TCP/IP attribute to enable this error logging capability. But be aware that this causes a significant load on the IOP and CPU.

Communication trace

The communication trace gives you detailed activities on a line. You can find information regarding the contents of transmitted data, TCP/IP headers, and hand shaking activities. But the number of trace entries is quite large so use this tool only when you can identify which part of the trace entries may have useful information.

· Network Status

AS/400 TCP/IP gives information about the status of TCP/IP routes, links, and connections on your local AS/400 system. The connection status function of the network status can be used to measure how many bytes are sent or received. Because those numbers are accumulated since TCP/IP was started or each TCP/IP application was started, it is not easy to correlate those numbers to the performance database's numbers. That is, the performance data is collected in a sampling interval, but the network status data is collected from the time when TCP/IP or applications were started to the time when the network status command (NETSTAT CL command) is issued.

# Chapter 12. Analyzing APPN Communications Performance

The AS/400 system provides a rich offering of network function with APPN. However, you should be aware of the APPN considerations that may affect the performance of your system and of your network. In this chapter, we examine the impact that intermediate session traffic has on your network nodes in order to understand the impact of configuration changes and network growth.

We look at the significant fields in the OS/400 Performance Monitor database that relate to APPN activity.

If you are experiencing poor response times or throughput, it is not necessarily due to APPN overhead and so you should conduct your normal performance analysis first and then focus on the issues discussed in this chapter once you determine for certain that the bottleneck is caused by APPN.

# 12.1 Advanced Peer-to-Peer Networking (APPN) Performance

When a node enters an APPN network, there are a number of things it must do to get started, particularly if it is a network node. First, it must establish control point sessions with its adjacent nodes to allow it to participate in the exchange of network control information.

Second, it must have its topology database updated to reflect the current state of the network. With the AS/400 system, it only receives an update of the changes that have occurred on the network since it was last present. If the network is unstable with many changes taking place, this results in a lot of data transfer and may take some time to complete. CPU and disk utilization may be significantly higher during this initial period. However, in a stable network, this process should not take long.

Third, any attached end nodes register their LU names with the network node server. The network node stores the LU names in a directory that is used to reply to search requests for those LU names from other network nodes.

The OS/400 Performance Monitor collects statistics regarding APPN activity on the network and stores it in a database file called QAPMAPPN. This chapter explains some of the relevant fields found in that file.

The QAPMAPPN file does not contain any data regarding CPU utilization or disk unit accesses associated with the tasks that perform APPN functions. This information is found in the performance monitor file QAPMJOBS. Similarly, QAPMAPPN does not contain session traffic data. The file, QAPMSNA, provides this data for each active controller description on the system, giving a breakdown of intermediate routing and session endpoint traffic.

An important reference to be used in conjunction with this chapter is Chapter 9 -Transaction Boundaries, in the *AS/400 Performance Tools/400*, SC41-4340. This publication contains details about APPN work activities and is not repeated here. However, this chapter follows the same layout as the APPN section of Chapter 9 in the AS/400 Performance Tools/400 Guide to allow you to combine the information easily. That publication and this chapter are arranged in the order of the fields in the QAPMAPPN file. Before examining that data, there are some higher-level indicators of APPN performance that should be considered. One of them is the CPU utilization of the various tasks involved in processing APPN traffic. By understanding how much CPU is being used by the various tasks, you can focus on the high usage tasks and the fields in the QAPMAPPN file that explain the activities for those particular tasks.

# 12.1.1 APPN System Tasks

The following main tasks perform work for APPN. It is helpful if you gather baseline data during a normal workload for your installation so you know when the utilization for these tasks is unusually high.

**QLUS** System Logical Unit Services:

The functions performed by QLUS include:

- · General management of APPC communications devices
- Initial processing of received start requests and routing to the appropriate subsystem monitor
- LU6.2 session management at vary on, vary off, for the Change Session Maximum (CHGSSNMAX) command function and for ending an APPC conversation
- **TRS** Topology Routing Services:

This task is responsible for route selection, selecting a transmission group (controller description), and transmission priority based on the class of service definition. It is also responsible for maintaining the topology database on the local system.

**CPPS** Control Point Presentation Services:

This task handles all of the data transfer that occurs on the control point-to-control point (CP-CP) sessions for the various APPN transaction programs such as:

- Control point capabilities
- Topology database updates
- · Directory services for search processing
- Registration/deletion
- **CPMGR** Control Point Manager
- **DS** Directory Services:

Sends asynchronous search requests and responses to other nodes on the network.

- MSCP Machine Services Control Point
- LOCMGR Location Manager

### T2 Station I/O Manager

There is a T2 station I/O manager task for each active controller description with a name of the form T2-xxxxxxxx, where xxxxxxxxx represents the name of the controller description.

The following approach may be used to analyze a possible APPN performance problem on your network:

1. First examine the overall system, disk, and communications performance using the Performance Monitor, Performance Tools, and Performance

Advisor (if you have them installed on your system). Look for performance bottlenecks such as high line, CPU, or disk utilization. It is most useful to have baseline data from a normal workload interval for comparison.

- 2. Determine how much of the system CPU is being used for the APPN tasks by using the queries in Appendix D, "Queries for APPN Tasks" on page 293. In general, the percentage of CPU used for these tasks should be low if the network is stable.
- 3. If you find unusually high CPU utilization for any of the various APPN tasks compared to baseline performance measurements, examine the specific fields in the QAPMAPPA database file described in the following section to help you understand the type of work being done.

Pay particular attention to the CPU utilization for the CPPS task as this is responsible for handling all of the data on the CP-CP sessions and gives a good indication of the general overhead associated with the APPN functions.

4. Follow the recommendations provided for each APPN task to reduce the CPU utilization.

# 12.1.2 QLUS Task

This system job started by QSYSARB is responsible for, among other things, startup and termination of APPN sessions and CNOS task.

### 12.1.2.1 QLUS Task Recommendations

If the CPU utilization for QLUS is unusually high compared to baseline data that you have collected, you can decrease it by following these suggestions:

- It is not unusual to see a QLUS CPU utilization of 2-10% if a large number of APPC devices are varied on during the performance monitor measurement interval. If hundreds of APPC devices are varied on or Change Session Maximum (CHGSSNMAX) commands are issued over a short period of time, the utilization may be as high as 10-25%.
- If QLUS CPU utilization is consistently greater than 10% for several monitor intervals, you should look for an APPC application design problem such as remote systems repetitively issuing the API equivalent of CHGSSNMAX. For more information, refer to Section 10.6, APPC Programming Tips and Techniques in AS/400 Performance Management Version 3 Release 6, GG24-4735.
- The APPC controller description parameter NODETYPE should specify the correct node type for the remote system being described. If the remote system is an AS/400 system, you should use NETNODE or ENDNODE as the NODETYPE. Check the remote system node type by using the DSPNETA command on the remote system.
- If you do not really need APPN functions, you can change the controller description to APPN \*NO. Consider this if the remote system does not need to access another system through this AS/400 system and through this controller description. Perhaps the remote system is a PC using Client Access/400 and only needs access to this AS/400 system. You can completely eliminate the use of APPN tasks by creating the controller with APPN \*NO. If you do so, you need to manually create the device descriptions as auto-create does not work with APPN \*NO.
- One option is to create the controller description with APPN \*YES, but configure the NODETYPE as \*LENNODE. This keeps the APPN control flow

down to a minimum. Do this only if the remote system is a low-entry networking node (such as a PC without APPN support). Do not use \*LENNODE to connect to another AS/400 node.

- When using SDLC, it is better to code one side of the session as primary and the other as secondary instead of letting it negotiate. Coding the parameter saves time at vary-on since negotiation does not need to be done. The line description and controller description parameter is called *data link role* (ROLE). The line description describes the local system and the controller description description descriptem.
- QLUS is responsible for the creation and deletion of auto-created APPC device descriptions. System performance may be degraded if the number and frequency of these creations and deletions is excessive. Therefore, it may be better to increase the number of minutes specified for the *Auto-delete Device* parameter on the controller description or not delete them at all.

# 12.1.3 Topology Maintenance

Advanced Peer-to-Peer Networking (APPN) maintains a topology database on each AS/400 network node and end node. The topology database keeps information about links and nodes in the network. This is based on local network attributes and the status of controllers to adjacent systems, as well as on information received about network nodes and the links to other network nodes through topology database updates (TDUs). TDUs are transmitted between nodes through control point (CP) sessions.

A *transmission group* (TG) update occurs when a local controller's status changes from *inactive* to *active*, or *active* to *inactive*. If the transmission group defines a connection between two network nodes, the local system issues a TDU. A single TDU may contain multiple TG updates blocked together. TDUs are distributed to every network node in the network using control point sessions.

If a change occurs in the network, for example, a link fails, the topology information is updated using TDUs. The task that performs this update is the Topology and Routing Services Task (TRS). The TRS task also handles the route selection in an APPN network based on the *class-of-service* (COS) selected by the user.

The CPU utilization for the TRS task should be fairly consistent. However, topology maintenance can account for high CPU utilization and disk I/O in complex or unstable networks. By unstable, we mean there are frequent activations and deactivations of transmission groups, or frequent line or system failures.

APPN network node support provides powerful routing facilities. However, network nodes may exhibit significant disk I/O in complex networks comprising of many nodes. The primary reason for this is that the TRS task may receive a large number of transmission group (TG) updates to process when end nodes are connecting and disconnecting. For each TG update, TRS has to perform eight to 10 operations to its internal topology index. Some of the overhead can be reduced by grouping nodes into smaller sub-networks with different network names, having fewer network nodes, and specifying APPN CP-CP Session Support = \*No on end node controller descriptions.

### 12.1.3.1 Transmission Group Update

The following fields in the QAPMAPPN file refer to Transmission Group updates and are of interest when looking at TRS and CPPS activity. You can run queries over the file QAPMAPPN to examine the fields of interest.

- **INTNUM** Interval number since the start of the performance monitor
- **DTETIM** Interval date (yy/mm/dd) and time (hh:mm:ss)
- **INTSEC** Elapsed interval time since the last sample interval.

(These three fields apply to all of the data fields in QAPMAPPN.)

- **ANTGU** Total number of transmission group updates processed by this node during this monitor interval
- **ATTGU** Cumulative time (msec) to process the TG updates
- **ANTGUM** Number of TG updates resulting in one or more updates to the TDU buffer (network nodes only)
- **ANRATG** Number of resources added to TDU buffer due to TG updates (network nodes only)
- **ANTSTG** Number of TDUs sent as a result of buffering TG updates
- **ANNTTG** Number of network nodes that had TDUs sent to them to inform them of the TG updates

If this number appears to be high, you may have a configuration problem that is causing updates to be sent to more nodes than is necessary. You may have configured nodes as network nodes when they could have been configured as end nodes.

### 12.1.3.2 Node Congestion

An APPN node is considered to be congested if 90% of the allowed intermediate sessions have been established. The status changes back to non-congested when this number drops down to 80% or less. A change in a node's congestion status results in the issuing of a TDU by the local system. This is reflected in the amount of TRS and CPPS activity on the system. If you suspect a high TRS or CPPS utilization is resulting from congestion TDUs, examine the following fields in QAPMAPPN.

- **ANNCTC** Total number of congestion transition changes in this interval
- **ATNCTC** Cumulative time to process the congestion transition changes. This does not include the time it takes to send out the TDU.
- ATRSNC Count of times TRS entered non-congested state
- ATRSC Count of times TRS entered congested state
- ATNCS Cumulative elapsed time (in msec) that the system has been in non-congested state
- ATCS Cumulative elapsed time (in msec) that the system has been in congested state
- **ATSCP** Number of TDUs sent as a result of node congestion transitions

**ANTSCP** How many network nodes were informed of the congestion state changes. This can be an indication of the network traffic created by these updates.

# 12.1.3.3 Topology Database Update Processing

Topology Database Updates (TDUs) affect the TRS and CPPS activity on network nodes only. TDUs are transmitted from network node to network node and may potentially be forwarded to all attached network nodes with which CP-CP sessions are established.

If TDUs are received too frequently, system performance may be degraded. If one particular network node is always receiving more TDUs than the others, a configuration problem may exist. This is evident from the field ANTRFN described in the following section. A distinction is made in the QAPMAPPN file records between updates made to the TDU buffer as a result of changes to old and new resources.

**ANTDUP** Number of TDUs received by this node:

If this number increases dramatically, there may be a failure in the network causing topology updates.

- **ANNRTD** Number of new resources received in TDUs that cause addition to TDU buffer for forwarding
- **ANORTN** Number of old resources received in TDUs that *do not* cause addition to the TDU buffer for forwarding
- **ANORTA** Number of old resources received in TDUs that *do* cause addition to TDU buffer
- **ANTSRT** Number of TDUs sent as a result of creating a TDU buffer from incoming TDUs
- **ANNTST** Number of network nodes that had TDUs sent to them as a result of creating a TDU buffer from incoming TDUs
- **ACNTID** Network ID of the node for which the most TDUs were received within the performance monitor interval
- **ACCPNM** Control point name of the node for which the most TDUs were received within the performance monitor interval
- **ANTRFN** Number of TDUs received by the node for which the most TDUs were received in the interval:

The two fields, ACNTID and ACCPNM, can be used to track the node most affected by the TDU updates. When many TDUs are received and the same node is always listed, this can indicate a configuration problem where a listed node has updates sent continuously.

### 12.1.3.4 Initial Topology Exchange Indications

An initial topology exchange is an examination of the resources in the intermediate routing portion of the topology database that occurs when control point sessions are established between two network nodes. TDUs are sent between these nodes to reflect any changes that have occurred with resources or any new information that has been received in TDUs.

The following fields reflect this initial topology exchange during CP-CP session establishment that affects TRS and CPPS activity on network nodes only.

ANITEP Total number of initial topology exchanges processed by this node due to a new CP-CP session establishment with another network node.

This is an indication of the work being done when the controller descriptions are varied on between network nodes with control point sessions.

- **ATPIE** Cumulative time for processing the initial topology exchange TDUs
- **ANTECT** Number of times the entire network node topology was transmitted during initial topology exchange due to it being the first exchange since a system IPL or a refresh of the topology database
- **ANTDE** Total number of entries in the entire topology database:

This can be used to indicate the rate of growth of the network.

- **ANTERS** Number of resources (nodes and TGs) added to the TDU buffer as a result of the initial topology exchange
- ANTETS Number of TDUs sent as a result of initial topology exchange

### 12.1.3.5 Obsolete Topology Entry Removal

Every 24 hours, the topology database is examined and any entries that have not been updated in the last 15 days are deleted. Network nodes send a TDU every five days to prevent other nodes from deleting them from their database.

The following fields relate to Obsolete Topology Removal activity that affects TRS and CPPS activity:

- ANGCP Number of times obsolete topology entries were removed from database
- ATGCP Cumulative time to delete obsolete topology entries
- **ANTEDG** Number of topology entries deleted due to cleanup:

These fields indicate the workload arising from the necessary cleanup of the local nodes topology database. You are able to see if the cleanup is working efficiently and how much overhead it creates.

### 12.1.3.6 Displaying APPN Information

Each time the DSPAPPNINF command is run to display APPN information with INFTYPE = \*TOPOLOGY, the entire APPN topology database is examined. This can result in significant disk I/O for large networks.

The number of times this information is displayed is recorded in the following QAPMAPPN field:

ANDAII Number of times APPN information was displayed by using the DSPAPPINF command in the monitored time interval

### 12.1.3.7 Topology Maintenance Recommendations

If you see a high percentage of CPU being used for TRS, look for error messages indicating that a line is failing. This may be on your system or on another system in the network. Also verify that your lines are not being varied off and on needlessly. Any changes to the status of links in the network cause updates to the topology database.

# 12.1.4 Directory Services Registrations and Deletions

Each APPN end node makes registration and deletion requests to their network node server reflecting changes in their local location names. These requests may result from a configuration change or the activation or deactivation of a control point session.

The fields defined in the following list that are found in the QAPMAPPN file give a good indication of the amount of activity associated with these registrations and deletions per monitored time interval. In general, these requests do not adversely affect the performance of the network nodes as they are not forwarded on to every network node in the network.

- ANRRP Total number of registration requests processed
- ANNLRR Total number of locations registered; multiple locations may be registered by a single request.
- ATPRR Cumulative time spent processing registrations
- ANDRP Total number of deletion requests processed
- **ANLDDR** Total number of locations deleted; multiple locations may be deleted by a single request.
- ATPDR Cumulative time spent processing deletions

The APPN tasks involved with these registrations and deletions are DS and CPPS. We shall now examine in more detail the fields in QAPMAPPN that indicate the specific activity involved in performing these updates due to configuration changes and control point session activation.

# 12.1.5 Configuration Changes

Configuration changes affect the CPU utilization of APPN tasks. If you find high CPU utilization for the following tasks, examine the associated fields for unusually high activity.

#### 12.1.5.1 Change Network Attributes

All of the APPN tasks are involved in processing a Change Network Attributes (CHGNETA) command. TRS sends out a TDU if the local node is a network node and the Route Addition Resistance (RAR) is changed.

If the local node type, local network ID, or local control point name is changed, the APPN directory and topology databases may be deleted. This may cause significant CPU utilization when the databases are rebuilt.

The tasks involved are: MSCP, TRS, DS, LOCMGR, CPMGR, and CPPS.

The following QAPMAPPN fields are useful in analyzing this activity:

- ANCNAP Total number of CHGNETA requests processed
- ATCNA Cumulative time to process CHGNETA requests
- ANDDRC Number of times the directory database was deleted and re-created due to CHGNETA requests
- ANTDRC Number of times the topology database was deleted and re-created due to CHGNETA requests
- **ANLRSC** Number of location registrations sent due to CHGNETA requests

- **ANLDSC** Number of location deletions sent due to CHGNETA requests
- **ANCART** Number of times a node entry resource was added to a TDU buffer as a result of CHGNETA requests
- ANTSTC Number of TDUs sent as a result of CHGNETA requests
- ANNTSC Number of network nodes that received TDUs as a result of CHGNETA requests

#### 12.1.5.2 APPN Local Location List Updates

These updates cause an addition or deletion to the APPN directory database. If the local system is an end node with a CP-CP session to a network node server, the update also initiates a registration or deletion request to the node server.

The APPN tasks involved in this activity are: LOCMGR, DS, CPPS, and CPMGR.

The following QAPMAPPN fields are useful in analyzing this activity:

- ANLLUP Total number of local location list updates processed
- ATLLUP Cumulative time to process the local location list updates
- ANLRSL Number of location registration requests resulting from local location list updates
- ANLDLL Number of location deletion requests resulting from local location list updates

#### 12.1.5.3 APPN Remote Location List Updates

These cause a remote location to be added or deleted from the APPN directory database.

The APPN tasks involved in this activity are: LOCMGR and DS.

The following QAPMAPPN fields are useful in analyzing this activity:

- ANRLUP Total number of remote location list updates processed
- ATRLUP Cumulative time to process the remote location list updates

#### 12.1.5.4 Mode Updates

These cause the control point manager (CPMGR) task to update its mode tables to reflect the addition, deletion, or update of a mode description.

The APPN task involved in this activity is CPMGR.

The following QAPMAPPN fields are useful in analyzing this activity:

ANMDUP Total number of mode description updates processed

**ATMDUP** Cumulative time to process the mode description updates

#### 12.1.5.5 Class-of-Service (COS) Updates

These cause the control point manager (CPMGR) and topology routing services (TRS) tasks to update their class-of-service tables to reflect the addition, deletion, or update of a COS description.

The APPN tasks involved in this activity are: CPMGR and TRS.

The following QAPMAPPN fields are useful in analyzing this activity:

- ANCSUP Total number of COS updates processed
- ATCSUT Cumulative time to process the COS updates by the TRS task
- ATCSUC Cumulative time to process the COS updates by the CPMGR task

## 12.1.6 Control Point Session Activation and Deactivation

Control point (CP) sessions are special APPN sessions used to transfer information between nodes in an APPN network. It takes some amount of CPU to set up and end a CP session.

Contention winner (locally controlled) CP-CP sessions are primarily used for sending data such as TDUs and directory searches. Contention loser (remotely controlled) CP-CP sessions are primarily used to receive control point data from other systems. If you see a high CPU percentage being used by the CPMGR or CPPS tasks, you can use the following fields in the QAPMAPPN file to determine if session activation and deactivation is excessive. The performance measurements also contain counts of the number of currently active CP-CP sessions that can help explain changes in resource utilization over different time intervals. Do not have more control point sessions than you need for connectivity and backup as every CP session between network nodes increases the amount of work performed by the CPMGR and CPPS tasks. For more information about the steps involved with session activation, see "Session Setup Work Activity Details" on page 9-14 of *AS/400 Performance Tools/400 Guide*, SC41-8084.

The APPN tasks involved in this activity are: CPMGR and CPPS.

The following QAPMAPPN fields are useful in analyzing this activity:

- ANCSSA Number of contention winner CP-CP session setups attempted
- ANCSSS Number of contention winner CP-CP session setups successful requests
- ANLSAP Number of contention loser CP session activations processed
- ATCCSA Cumulative time spent processing contention winner CP session activation
- ANCST Number of contention winner CP-CP session ended
- ATCST Cumulative time spent processing contention winner CP-CP session deactivation
- ANLST Number of contention loser CP-CP session ended
- ATLST Cumulative time for processing contention loser CP-CP session ended
- ANCWSA Number of contention winner CP-CP sessions currently active
- ANCLSA Number of contention loser CP-CP sessions currently active

### 12.1.7 Control Point Presentation Services (CPPS)

All of the data transfer occurring on the CP-CP sessions for the various APPN tasks is handled by the CPPS task. The QAPMAPPN fields discussed in this section give a good indication of the type of activities that the CPPS task is involved with. While this activity is absolutely essential in an APPN network, it may be an excessive CPU overhead if your network is not optimally configured. The performance measurements for CPPS should be one of the first things you check when investigating an APPN problem.

The query called APPNALL in Appendix D, "Queries for APPN Tasks" on page 293 shows you if you have a high CPU percentage for CPPS. You should run APPNJOINx queries before using the APPNALL query.

The performance data is grouped according to the following APPN transaction programs:

- Control Point (CP) Capabilities
- Topology Database Update
- Directory Services for Search Processing
- Registration and Deletion

### 12.1.7.1 Control Point (CP) Capabilities

This is used to send and receive CP capabilities to adjacent systems immediately after activating CP sessions. In general, this activity has only a slight affect on performance.

The following fields in file QAPMAPPN can be useful:

- ANCDRR Number of data-received requests processed
- ANCBDR Number of bytes of data received
- ATCDRR Cumulative time spent processing the data-received requests
- ANCSDR Number of send-data requests processed
- ANCBDS Number of bytes of data sent
- ATCSDR Cumulative time spent processing send-data requests

#### 12.1.7.2 Topology Database Update

This is used to send TDUs on contention winner CP sessions and receive TDUs on contention loser CP sessions. TDUs can significantly affect performance for network nodes. If the CPPS measurements are higher than for other time intervals, check the topology maintenance data to determine the cause.

The following fields in file QAPMAPPN can be useful:

- ANTDRR Number of data-received requests processed
- ANTBDR Number of bytes of data received
- ATTDRR Cumulative time spent processing the data-received requests
- ANTSDR Number of send-data requests processed
- ANTBDS Number of bytes of data sent
- ATTSDR Cumulative time spent processing send-data requests

#### 12.1.7.3 Directory Services for Search Processing

The Directory Services (DS) task sends and receives asynchronous search requests to other nodes on the network. This may have a significant effect on network node performance, but generally little effect on end nodes. If the CPPS measurements are unusually high, check the session setup performance measurements to determine the cause.

The following fields in file QAPMAPPN can be useful:

- ANDDRR Number of data-received requests processed
- ANDBDR Number of bytes of data received

- ATDDRR Cumulative time spent processing the data-received requests
- ANDSDR Number of send-data requests processed
- ANDBDS Number of bytes of data sent
- ATDSDR Cumulative time spent processing send-data requests

#### 12.1.7.4 Registration and Deletion

This is used to send location registration and deletion requests from an end node to a network node server. In general, these requests should not significantly affect performance on either node. If the CPU utilization for CPPS or DS is unusually high as a result of registration and deletion requests, check the directory services registration and deletion requests measurements.

The following fields in file QAPMAPPN can be useful:

- **ANRDRR** Number of data-received requests processed
- ANRBDR Number of bytes of data received
- ATRDRR Cumulative time spent processing the data-received requests
- ANRSDR Number of send-data requests processed
- ANRBDS Number of bytes of data sent
- ATRSDR Cumulative time spent processing send-data requests

### 12.1.7.5 CPPS Recommendations

Check that there are one or two control point (CP) sessions between a network node and the network, but do not have more control point sessions than you need to provide connectivity and backup. Every control point session activated (controller description parameter CPSSN \*YES configured) between network nodes increases the work of the CPPS task since it must update all of the network nodes to which there are CP sessions with any changes in the links or nodes in the network. You must have at least one CP session from a network node into the network, and you may want two for backup purposes. Do not, however, default all controller descriptions to CPSSN \*YES without some thought to the mesh topology you are creating.

# 12.1.8 Session Setup Activities

Session setup activity, as with other APPN activities, varies with node type. Network nodes have to perform many more session setup functions than end nodes. The APPN tasks involved in session setup are primarily the following tasks:

- · Location Manager
- T2 Station I/O Manager
- Directory Services
- Control Point Manager
- Topology Routing Services
- MSCP (for switched line)

These session setup tasks perform the following functions:

- Determine if an existing session may be used.
- Search the directory to find the system that owns the destination location.

- Determine the optimal route based on class-of-service.
- · Activate switched links if needed.
- Select or create a new device.
- For remotely started sessions, receive binds for session setup requests.

Because the activities performed and resources used by the APPN control point tasks for session setup vary between network nodes and end nodes, the performance measurements in the QAPMAPPN file are divided into different work activities.

The following work activities are described together with a definition of when an activity yields a successful result.

1. Local system initiated sessions:

Sessions started on the local system, including explicit session initiation requests by a user as well as internal session initiation requests.

Success is when one or more device descriptions are returned to the operating system.

2. Receiver of search requests as an end node:

The local system (an end node) receives a search request from its network node server.

Success is when DS returns a positive response to the search request.

3. Network node performing search requests on behalf of an end node:

The local node (a network node) has received a search request from a served end node that is initiating a session. The local system is responsible for searching for the target system and calculating a route to the destination control point.

Success is when DS returns a positive response to the search request and routing information is supplied to the end node.

4. Intermediate node on a directed search request:

The local system (a network node) has received a directed search request from another network node. The only functions that need to be performed in this case are forwarding the search request to the next hop of the route, and also forwarding the search response to the system that had sent the search to the local system.

Success is when DS forwards the directed search on to the next hop, receives a positive response, and successfully returns the search response to the originating node.

5. Destination network node on a directed search:

The local system (a network node) has received a directed search request from another network node. In this case, the local system is the target of the directed search because the location being searched for had at one time resided on the local system or an end node that was being served by the local system.

Success is when DS returns a positive response to the search request.

6. Broadcast search received:

Broadcast searches are processed only by network nodes. When the local system receives a broadcast search, it sends the search to all of the

adjacent network nodes and determines if the location being searched for resides on the local system or on a served end node. Broadcast searches are the most costly search type from a performance point of view because of the number of nodes involved.

Success is when DS returns a positive response to the search request.

7. Network node processing a received search from a node in a different network (different net ID):

This work activity tracks the number of searches processed that are started by systems in a different APPN network. Only the systems on the boundaries of the network maintain these measurements.

Success is when DS returns a positive response to the search request.

8. Network node processing a received BIND from a node in the local network without routing information:

The local system (a network node) is responsible for determining the control point that the target system resides on, calculating a route to the destination control point, and forwarding the BIND on to the next hop of the route.

Success is when a positive response is returned indicating that the next hop has been determined and is active.

- 9. Network node processing a received BIND from a node in a different network without routing information.
- 10. Network node processing a received BIND from a node in the local network with routing information.
- 11. Network node processing a received BIND from a node in a different network with routing information:

The fields in the QAPMAPPN file starting with buffer position 672 (ANWAP1) through to the end of the file are all concerned with session setup. The fields are grouped according to the last hexadecimal character of the field names that equals the number of the work activity previously listed.

For example, the fields ending in "1" are measuring *local system initiated session setup*, and the fields ending in "B", which equals 11 in hexadecimal, are measuring a *network node processing a received BIND from a node in a different network with routing information*.

This breakdown of the session setup activity into work activities helps to differentiate between the work performed by an end node and that done by a network node. This is seen from the following groupings by work activity.

- Locally Initiated Session Setup is reflected in the performance measurements for work activity 1.
- End Node Session Setup is reflected in the performance measurements for work activity 2.
- Network Node Session Setup is reflected in the measurements for the remaining work activities 3 to B.

For each of these work activities, the file QAPMAPPN maintains a count of the number of activities processed and the number of activities that yielded a successful result. There is also a field giving the cumulative elapsed time spent to complete these activities. These fields are defined as follows where the last character "X" of the field names corresponds to the activity number "1-B" previously listed.

- ANWAPX (X=1-B) Total number of work activities of this type processed
- ATWASX (X=1-B) Total number of work activities yielding a successful result
- ATWAPX (X=1-B) Cumulative time to complete work activities of this type
- **ASPSPX** (X=1,8,9,A,B) Number of session setup requests that were pended because another setup was in progress for the same remote location name, local location name, and mode.

If this number is high, you may want to use preestablished sessions. This causes session setup to take place when the mode is started.

**ASFNS1** Number of searches that failed due to no network services being available for the local end node.

If this occurs, check the network attributes (DSPNETA) and verify that the local system (end node) has a network node server defined. Perhaps an alternate server should be considered. Up to five servers may be defined for an end node. These are used starting with the first one in the list.

**Recommendation:** Run the query called APPNJOINx in Appendix D, "Queries for APPN Tasks" on page 293 to find the percentage of successful session setup work activities performed by your network node.

% Successful = (ATWASX / ANWAPX) \* 100

If this shows less than 100%, you can examine the other fields in the QAPMAPPN file for greater detail. Refer to Appendix A of *AS/400 Work Management Version 3*, SC41-3306, for a description of all other performance fields in QAPMAPPN.

## 12.2 APPN Transmission Priority

This section looks at the performance considerations for mixing interactive session and large transfer transmissions on a single communication line. This has traditionally been a cause of poor interactive response time during periods of concurrent large transfer activity. The large transfer is capable of consuming the entire line bandwidth, causing severe queueing delays for the interactive users.

Prior to OS/400 Version 2 Release 1, the strategy to improve interactive response time was to "hold back" the throughput of the APPC large transfers by reducing the RU sizes and pacing values. Unfortunately, this also had the effect of reducing the throughput of the large transfer traffic.

For Version 2 Release 1 and later, enhancements were made to the APPN transmission priority to allow users to "hold back" the large transfers without such a severe throughput penalty.

These "hold back" options are not the default and require the following configuration changes to be made.

- 1. The interactive users and large transfer data should use different mode and class-of-service (COS) descriptions.
- 2. The MAXLENRU parameter, which determines the maximum amount of SNA data that can be sent in a single Request/Response Unit (RU), can be

decreased from \*CALC to 256 for the large transfer mode description (MODD). Keep the interactive MAXLENRU parameter at a high value.

This reduces the average wait time for the interactive users to use the line because the large transfer frames queued up ahead are smaller in size. Large transfer throughput is reduced.

3. The OUTPACING parameter, which determines how many RUs can be exchanged before a response is required from the receiving station, can be decreased from seven to one for the large transfer mode. Keep the interactive OUTPACING parameter at a high value. description. This method can be used for systems prior to V2R1.

This reduces the average wait time for the interactive users because there are fewer large transfer frames queued up ahead.

 For configurations using APPN = \*YES on the APPN controller descriptions, define a class-of-service description (COSD) with a transmission priority of \*HIGH for the interactive COSD, and a priority of \*LOW for the large transfer COSD.

When poor response time is detected for frames with \*HIGH priority, the APPN support restricts the throughput for lower priority frames by decreasing the number of allowed outstanding frames.

Using APPN transmission priorities does not have much of an effect for versions prior to Version 2 release 1.

Unlike reducing MAXLENRU and pacing values, using transmission priorities does not negatively impact large transfer performance when there is no interactive traffic.

In summary, for configurations with APPN = \*NO, or prior to V2R1, the RU size and pacing values can be reduced to give better interactive response time with some performance degradation for the large transfer traffic.

For systems running V2R1 or later, the recommendation is to define different modes and classes-of-service for interactive and large transfer traffic, using \*HIGH and \*LOW priorities respectively. Interactive response times can be improved even more if large transfer RUs are reduced, but this is at the expense of large transfer throughput when there is no interactive traffic.

# Chapter 13. AnyNet

AnyNet is a family of software products designed to make it easier for customers to choose the applications regardless of what protocol is used. AnyNet products implement the Multiprotocol Transport Networking (MPTN) architecture. The functions implemented with the AS/400 system are:

- APPC over TCP/IP
- Socket over SNA

This chapter discusses the performance considerations using AnyNet on the AS/400 system.

# **13.1 MPTN Architecture**

Multiprotocol Transport Networking (MPTN) is an architecture developed by IBM. The objective of this architecture is to allow an application that uses a certain network protocol communicate with its partner application through a "different network protocol". This makes the application "independent" from the network. Traditionally, communication programs use APIs that are tied to the underlying network protocols. Such as FTP needs TCP/IP, the AS/400 system's display pass-through needs SNA. MPTN frees the protocol bound limits so that any communication programs can run on any network protocols. Some examples are FTP running on an SNA network or display pass-through running on a TCP/IP network. Network protocols are completely transparent to the applications.

# 13.2 Types of MPTN Nodes

According to the MPTN architecture, there can be three kinds of nodes:

- Native Node: These nodes do not use/support of MPTN. This requires the attached node to implement all of the protocol stacks. A network of native nodes is called a "Single Protocol Transport Network" (SPTN). A pure SNA connection of two or more AS/400 systems is an example of SPTN.
- MPTN Access Node: This provides a semantic interface that allows an application to communicate with its partner through a different transport protocol. An MPTN access node can communicate with other access nodes or with an MPTN gateway. With this support, you can run FTP on SNA, for example.
- MPTN Gateway: This includes two functions:
  - It connects a native node to an MPTN so that the native node can participate in the MPTN without the MPTN access node capability.
  - 2. It connects an SPTN to form an MPTN. In this configuration, you can connect an IP network to another IP network through an SNA network with the support of two gateways.

The AS/400 system provides MPTN access node functions but not an MPTN gateway.

# 13.2.1.1 Examples of MPTN/SPTN Network

Figure 65 shows possible connections using the MPTN capability.

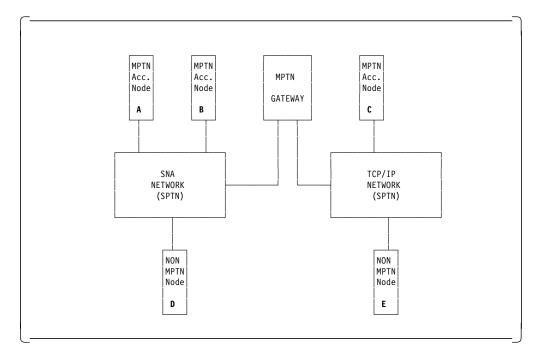


Figure 65. MPTN/SPTN Examples

- A socket program on System A can communicate with a socket application on System B. The socket information is delivered from one system to the other through the SNA Network.
- A CPI-C program on System A can communicate with System D. System D is a native node that does not support MPTN.
- A socket program on System **B** can communicate with System **E** through the **MPTN Gateway**. Notice that System E is a native NON-MPTN node.
- A CPI-C program on System C can communicate with System D through the MPTN Gateway. Notice that System D is a native NON-MPTN node.
- A socket program on System B can communicate with System C through the MPTN gateway. Notice that System C acts as a native node in this scenario.

### 13.2.2 AnyNet

AnyNet is a family of products that implements the MPTN architecture. AnyNet products are available for many operating systems: OS/400, OS2, MVS, and AIX. The AS/400 AnyNet support is part of the operating system.

# 13.2.3 AnyNet/400 Summary

- **Same communications APIs**: Two applications can use the same APIs to communicate with each other through a different transport layer.
- Access Node functions: The AS/400 system only provides access node function. It is not an MPTN Gateway. The AS/400 system can connect to an "MPTN Gateway" either "natively" or as an "MPTN Access Node".

- Sockets over SNA: Only sockets applications can be used with AnyNet. This
  means that the Telnet requester (which is not a socket application) cannot
  use AnyNet.
- **APPC over TCP/IP**: APPC applications can communicate with their partners using either ICF or CPI-C.

# **13.3 AnyNet Performance Considerations**

The use of AnyNet implies CPU overhead since there is always a conversion, either from SNA to TCP/IP or vice versa. Both protocols have their strength and weakness, so depending on the scenario of your applications, behavior might be different from what was expected.

When the AnyNet function is used, several layers (operating system, License Internal Code, and IOPs) are involved. Fewer layers involved means less system overhead, thus it also means better performance; less CPU overhead means better performance. That is the reason why the native protocols provide better performance than AnyNet. Depending on the conversion required (APPC to TCP/IP or SOCKETS to SNA), there are different layers involved. The following picture is a rough flow of control of the AnyNet process (for simplicity, TCP/IP is represented as a single layer). Notice that for APPC over TCP/IP, there is one more layer than for Sockets over SNA.

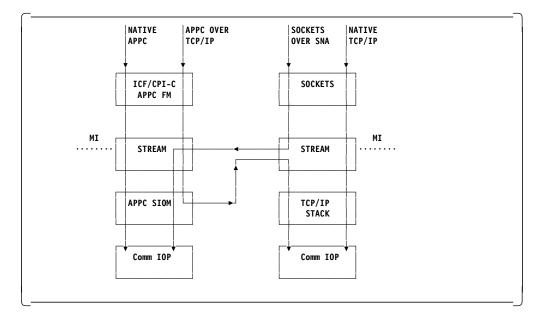


Figure 66. AnyNet System Layers

The AnyNet performance depends on the environment. There are four combinations with the APIs and protocols.

- 1. Native APPC
- 2. Native TCP/IP
- 3. Sockets over SNA
- 4. APPC over TCP/IP

Generally speaking, the AS/400 system's SNA protocol is faster than TCP/IP protocols. Depending on the application data length and the frame size of the communication link, the performance varies.

There are many factors that influence the communications performance of both protocols:

- **RU size**: The use of \*CALC for RU size in the MODE description provides an optimized RU size compatible with the frame size.
- **APPC buffering**: APPC provides buffering technique. Buffering means that when an application performs a "write", the data is not really sent but buffered for a later transmission. This allows the system to block the data and transmit the entire block together. This consideration is also true when using APPC over TCP/IP.
- Sockets: Only sockets applications can be used with AnyNet. In other words, it is not possible to use the PASCAL API with AnyNet. Sockets does not provide any blocking such as the APPC buffering. It is important to limit the number of send/receive operations when coding an application. This lack of buffering means that the data is really sent when the application performs a write.

# **13.3.1 Some Guidelines for Performance Analysis**

Since AnyNet involves **SNA** and **TCP/IP**, the guidelines in the previous chapters of SNA and TCP/IP can be used. There are few considerations for better understanding of the performance data. This section covers the tools available to gather information when using AnyNet.

The system has a **dual** behavior when using AnyNet. For example, from an application point of view, it is a pure TCP/IP, but from the communications adapter, it is a pure SNA.

### 13.3.1.1 Sockets over SNA

When using sockets over SNA, Option 3 (TCP/IP connection STATUS) of the NETSTAT command shows the same information as for a native TCP/IP application. In other words, it is not possible to distinguish a pure TCP/IP application from Socket applications running over SNA.

			n TCP/IP Conn		System:	SYSTEMO
Loca	l internet addr	ess		.: *ALL		
-						
	options, press					
4=	End 5=Display	details				
	Remote	Remote	Local			
0pt	Address	Port	Port	Idle Time	State	
·	*	*	as-dtaq	147:51:04	Listen	
	*	*	as-file	004:19:23	Listen	
	*	*	as-netprt	022:46:25	Listen	
	*	*	as-rmtcmd	000:06:28	Listen	
	*	*	as-signon	000:07:14	Listen	
	2.2.2.1	1179	ftp-data	000:00:00	Established	
	2.2.2.1	1178	ftp-con >	000:00:03	Established	
	9.5.93.142	1027	telnet	000:00:00	Established	
	9.5.93.142	1029	telnet	000:03:43	Established	
	9.5.93.155	1201	as-cent >	000:07:12	Established	
	9.5.93.160	1028	as-cent >	000:13:38	Established	
						More
F5=R	efresh F11=Di	splav byte o	counts F13=	Sort by col	umn	

Figure 67. Work with TCP/IP Connection Status

In Figure 67, the connection with remote IP address **2.2.2.1** uses Sockets over SNA. As you can see, there is no difference with a native TCP/IP connection.

Option 5 shows the details of the connection. This time the information provided differs from a native TCP connection. See Figure 68.

Display IPS Connection Status	System:	SYSTEMO
Connection identification:		
Remote host name		
Remote internet address : 2.2.2.1		
Remote port		
Local host name		
Local internet address : 2.2.2.5		
Local port ftp-data		
Associated user profile : A960303C		
Programming interface information:		
State Established		
Connection open type Active		
Idle time		
	50.14	
Last activity date/time : 11/14/96 14: Transmission information:	50:14	
Bytes out 0		
Bytes in		
		Bottor
Press Enter to continue.		DULLU
	v nowt numb	
F3=Exit F5=Refresh F6=Print F12=Cancel F14=Display	y por c numbe	61.2
F22=Display entire field		

Figure 68. Display IPS Connection Status

		Work with Configura		SYSTEM05 17:05:17
Posi	tion to	. Start	ing characters	17.00.17
1=	options, press E Vary on 2=Vary Display mode stat	off 5=Work with job	8=Work with description	
Opt	Description ETHLINE MO5ETH LLLLLL01	Status ACTIVE ACTIVE ACTIVE	Job	
		ACTIVE/SOURCE	QPADEV0008 A960303C	064209
	meters or command			Bottor
===> F3=E:	xit F4=Prompt	F12=Cancel F23=More	options F24=More keys	

The WRKCFGSTS \*CTL command provides information about the status of the SNA connection.

Figure 69. Work with Configuration Status

Performance Data: Here is where the dual behavior of AnyNet becomes evident.

**QAPMSNA** Contains performance data about SNA

**QAPMJOBS** Contains performance data about jobs

The **QAPMSNA** file shows information about the SNA side. In this case, the data is passed to the other systems as **SNA PIUs** (Path Information Unit). Those PIUs carry the imbedded TCP/IP data. From the point of view of this performance file, it is a pure SNA connection. Chapter 10, "SNA" on page 163 covers SNA performance in detail. All of the queries can be applied to Sockets over SNA. However, it is not possible to tell if the contents are APPC data or Socket data. By selecting the proper records, it is possible to gather information about PIUs that may transport TCP data. For example, the **SCTLNM** field is the controller description name. This field can be used to select the records that contain information about PIUs in which TCP data is transported. This same controller can be used for other SNA applications. For example, SNADS, DSPT, and DDM can be using the same controller at the same time with AnyNet. So a query shows information about all of the PIUs used by these applications including, of course, AnyNet.

The **QAPMJOBS** file shows performance data about jobs. From this file, it is possible to see if a job is using Sockets or not. So with the proper query, it is possible to gather information about applications that use sockets but it is not possible to know if AnyNet is being used. If a particular application is using Sockets over SNA, there is information about Sockets in this file, but no information about APPC PUTs or GETs (since that application does not use APPC). This file can provide information about applications that use sockets over SNA as well as information about native TCP/IP applications that also use Sockets.

The following hints can be used to isolate the desired information based on fields of QAPMJOBS.

- **JBSKSC** field: This is the number of socket sends. By selecting the records where this field is not zero, it shows all of the applications where there is Socket activity.
- **JBSKRC** field: This is number of Socket receives. The previous field considerations are valid here.
- JBUSER field: This is the job user identification. TCP server jobs use the QTCP user profile. QTCP can be used to identify the TCP server jobs. For the requester jobs, it is more difficult since it is necessary to know who originates the TCP requirements.

Appendix G, "AnyNet Queries" on page 351 provides sample queries.

#### 13.3.1.2 APPC over TCP/IP

When using APPC over SNA, Option 3 (TCP/IP connection status) of the NETSTAT command shows information about the TCP session used to transport the imbedded SNA data. Before the connection is established, a special TCP server is "listening" on port "397". This port number is assigned to APPC over TCP/IP.

		Work with	TCP/IP Conn	ection Stat		SYSTEM05
Loca	1 internet addre	ss		.: *ALL	0	3131LH03
Tuno	options, press	Tataa				
• •	End 5=Display					
	Remote	Remote	Local			
Opt	Address	Port	Port	Idle Time	State	
	*	*	as-dtaq	152:17:10	Listen	
	*	*	as-file	008:45:29	Listen	
	*	*	as-netprt	027:12:31	Listen	
	*	*	as-rmtcmd		Listen	
	*	*	as-signon			
	2.2.2.1	ftp-con >	•		Established	
	3.3.3.1	APPCove >			Established	
	3.3.3.1	1190			Established	
	9.5.93.142				Established	
	9.5.93.142				Established	
	9.5.93.142	1029			Established	
	9.5.95.101	1030	as-cent >	001:49:02	EStabilSheu	Maxa
	5	1	F10	C		More
	efresh F11=Dis					
-14=	Display port num	pers F22=D	isplay enti	re field	F24=More keys	

Figure 70. Work with TCP/IP Connection Status

The WRKCFGSTS \*CTL command provides information about the SNA connection.

Work with Configuration Status SYSTEM05 11/13/96 19:22:07 Position to . . . . Starting characters Type options, press Enter. 1=Vary on 2=Vary off 5=Work with job 8=Work with description 9=Display mode status ... Opt Description Status -----Job-----ANYNETM01 ACTIVE M01 ACTIVE BLANK ACTIVE/TARGET M01 QUSER 064210 #INTER ACTIVE/SOURCE QPADEV0004 A960303C 064275 Bottom Parameters or command ===> F3=Exit F4=Prompt F12=Cancel F23=More options F24=More keys

Figure 71. Work with Configuration Status

Notice that there is no line associated to the APPC controller ANYNETM01 since this is an AnyNet connection. WRKCFGSTS provides the same information as in native SNA. In Figure 71, notice the active SNA applications using different MODES.

Performance Data: Again, the dual behavior of AnyNet is evident.

QAPMSNA Contains performance data about SNA

**QAPMJOBS** Contains performance data about jobs

The **QAPMSNA** file shows information about the SNA side. However, this time, the data is passed to the other system imbedded in IP datagrams. Again, all of the queries related to SNA can be applied. The **SCTLNM** field is the controller name. Using this field, the query shows information about those PIUs that are transmitted over TCP/IP. The information provided is the same as a native connection. The controller description specifies an "AnyNet" connection instead of using a regular line description. The queries provide information about those PIUs that are effectively delivered by AnyNet.

The **QAPMJOBS** file shows jobs performance data. From this field, it is possible to see if a job is using communications APIs or not. With the proper query, it is possible to gather information about applications that use APPC. However, it is not possible to know if AnyNet is being used. If a particular application is using APPC over TCP/IP, there is information about communications PUTs and GETs in this file but no information about Sockets PUTs or GETs (since the application we are investigating does not use Sockets). This file can provide information about applications that use APPC over TCP/IP as well as information about native APPC applications.

The following hints can be used to isolate the desired information based on fields of QAPMJOBS.

- **JBCPT** field: This is the number of communications puts. Bu selecting the records where this field is not zero, it shows all of the applications where there is SNA activity.
- **JBCGT** field: This is the number of communications puts. The previous field considerations are valid here.

Appendix G, "AnyNet Queries" on page 351 provides sample queries.

#### 13.3.2 AnyNet Summary

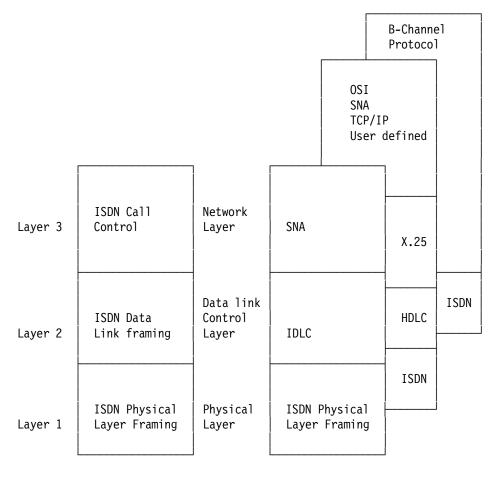
- AnyNet is a mix of protocols. Any performance investigation must be based on the analysis of both protocols.
- AnyNet introduces CPU overhead so native protocols provide better performance.
- The performance when using AnyNet depends on the scenario.
- All of the systems using AnyNet should be analyzed. Bad performance of an AnyNet Gateway, for example, can lead to bad performance of the entire AnyNet Network.

# Chapter 14. ISDN

An ISDN (Integrated Digital Services Network) provides a means to carry digital or digitized data over medium speed (64 kbps) channels. Data types include digitized voice, computer data, packet switched data, images, fax, remote signalling, and so on. Because ISDN is a digital network, there is no need to transform computer data to analog signals for transmission as was the case with traditional analog telephone networks. Moreover, separate channels are available for data transmission and for call signaling, such as call setup and breakdown. Permanent connections are also possible. ISDN is capable of duplex transmission. This provides higher throughput in those environments where multiple conversations are running over the same connection.

The current AS/400 implementation provides a basic rate interface (BRI). A basic rate interface consist of two 64 000 bps bearer (B) channels used for data transfer and a 16 000 bps D-channel (normally used for signaling). A direct high speed (T1 or E1) primary rate interface (PRI) is not available. It is also possible to connect an AS/400 system to a *passive bus* where up to up to eight devices share a basic rate interface. These devices contend for the use of the available B-channels, but only two B-channels may be used at any time. This configuration may not be available with some network providers.

ISDN has a layered architecture and complies with the lowest three levels of the seven layer Open Systems Interconnection (OSI) communications model. Recommendations for ISDN are defined by the Telecommunication Standardization Sector (ITU-T, formerly known as CCITT). These recommendations describe layer 1 through layer 3 for the D-channel and layer 1 for the B-channel. Thus, for layer 2 and layer 3 of the B-channel, different implementations are possible. On the AS/400 system, you can either use IDLC and SNA or LAP-B and X.25 for data transfer on the B-channel. Though the ITU-T recommendations allow the use of the D-channel for data transmission, this is not implemented on the AS/400 system at present. A simplified representation of the layered structure is shown in Figure 72 on page 208.



Signaling Channel	Bearer Channel
(D-Channel)	(B-Channel)

Figure 72. Examples of ISDN used with SNA or OSI

For a more detailed description of ISDN concepts and facilities, see the redbook *IBM AS/400 ISDN Connectivity* or the manuals *AS/400 ISDN Support*, *ISDN Data Link Control Architecture Reference*, and *ISDN Circuit Switched Signaling Control Architecture Reference*.

This chapter describes the most important data that the performance monitor collects for ISDN. Due to the different layer structure on the channels, you can find performance data in different database files. For the D-channel (or network interface), the data is collected in the *QAPMLAPD* file. The performance values are related to the following layers:

- · Physical layer
- · Data link layer
- Network layer

The physical layer (Layer 1) deals with the electrical, functional, and procedural characteristics of the connection over the physical medium. This layer is common for the B channel and D channel.

The data link layer (Layer 2, LAP-D on the D-channel) is responsible for the error-free transmission of frames on the physical connection.

The network layer (Layer 3, call control) establishes, maintains, and disconnects end-to-end connections (calls) for the B-channels into the ISDN. This function is also referred to as call control or signalling.

The QAPMLAPD database file also contains statistical fields or counters.

If you use IDLC protocol on the B-channel, you can find performance data for the B-channel usage in the *QAPMIDLC* database file. These are related to the data link layer (Layer 2, in this case, IDLC) on the B-channel. This file also contains statistics data.

If you use X.25 protocol on the B-channel, look for performance data in the *QAPMX25* database file.

For the layer structure and the performance data interpretation, refer to Chapter 8, "X.25" on page 127.

#### 14.1 Link Access Protocol for D-Channel (LAP-D)

The data link control layer defines the procedures for the connection, error free transfer of information, and disconnection between two entities of Layer 3, call control (Q.931). At the data link control layer, the information uses HDLC framing.

The following list contains the main LAP-D communications performance indicators:

- · Line utilization
- Line errors
- Frame errors
- Number of calls
- Number of call errors

Some performance problems may be caused by line errors (on the physical layer) or frame errors (on the data link control layer) as they require the re-transmission of frames. These can be isolated by reviewing the QSYSOPR message queue, the problem log, or the system error log.

#### 14.1.1 Line Utilization (LAP-D)

Line utilization is the percentage of elapsed time during which information transfer took place on the line. Because ISDN is full duplex, line utilization should be determined for both directions. Usually, line utilization is an important performance indicator, but the utilization on LAP-D is something unique to ISDN. Because the D-channel is used only for call setup, the utilization of LAP-D shows those activities not representing user data transmission activities. High line utilization of this channel may mean lots of status messages or status enquiries. Then you may want to collect a communication trace to determine what causes this high utilization.

#### **14.1.1.1 Performance Monitor Database Fields**

The following fields in the performance monitor database file QAPMLAPD are related to the line utilization:

**LSBRCV** The total number of bytes received from the remote station. This includes no errors.

- **LSBTRN** The total number of bytes transmitted including re-transmission bytes.
- LDLSP The speed of the line in bits per second (bps)
- **INTSEC** Number of seconds since the last elapsed interval

The transmit line utilization is derived from the following equation:

Transmit line utilization = LSBTRN \* 8 \* 100 / (INTSEC \* LDLSP)

The receive line utilization is derived from the following equation:

Receive line utilization = LSBRCV \* 8 \* 100 / (INTSEC \* LDLSP)

Since LSBRCV does not include bytes in error frames, this may show lower number when the line has errors. Before determining the utilization is high or low, it is good idea to see the error percentage of the line.

You have to multiply by eight to get the number of *bits* transmitted (because the line speed is given in *bits* per second and multiply by 100 to get the percent value instead of a fraction.

Line utilization is calculated per interval, that is, the time you specified on the INTERVAL parameter of the STRPFRMON command.

See Appendix H, "ISDN Queries" on page 361 for the sample queries (NWI\_ALL and NWI\_LAPD) to show the values previously mentioned.

# 14.1.1.2 Using Performance Tools/400 to Display Line Utilization (LAP-D)

Line utilization can be displayed using the DSPPFRDTA command after having collected performance data with OS/400 Performance Monitor (see Chapter 1, "Tools Used for Finding Performance Problems" on page 1). You can also print the System or Resource report to view the line utilization.

Use the DSPPFRDTA command to access the Display Communications Line Detail display shown in Figure 73 on page 211.

		Display	Communicatio	ns Line De	etail		
	ry		I21422 E FRDATA	lapsed tir	ne :	00:20:	58
	tions, press E blay remote jo		isplay commun	ications	interval data	1	
	Line	Line	Line	Tns	Average	Job	%
Option	ID	Туре	Speed	Count	Response	Count	Busy
_	ETHLINE	ELAN	10000.0	0	.00	0	.0
_	TRNLINE	TRLAN	4000.0	0	.00	0	.0
_	ITSOX2506P		64.0	0	.00	0	75.1
_	ITSOX2507P	X.25	64.0	0	.00	0	75.1
_	ITSOISDN06	-	64.0	0	.00	0	73.4
-	ITSOISDN07	IDLC	64.0	0	.00	0	73.4
							Bottom
	F12=Cancel by line ID		splay network rt by transac				

Figure 73. Communications Line Detail

This display can be accessed from the Display Performance Data display by pressing F21=Display Communications Detail. The display shows you, among others, the line speed and the average line utilization. As you can see from the line speed, this is for the B-channel. You have to press F13 to display the network interface data shown in Figure 74.

Туре ор	ry tions, press	Enter.	PFRDATA				
7=Dis	play channel Network	interval	data Transmit/ Receive/ Average	Total Frames	Percent Frames Trnsmitd	Total Frames	
Option	Interface	Channe1	Line Util		Again	Received	
-	ITSONWI06	B2 B2	73/73/73	8991	0	8991	0
-	ITSONWI07 ITSONWI06	BZ D	73/73/73 00/00/00	8991 0	0 0	8991 0	0 0
_	ITSONWI00	D	00/00/00	0	0	0	0
F3=Exit	F12=Cance	el F15=	Sort by net	work inter	face F16	=Sort by c	<b>Botton</b> hannel

Figure 74. Network Interface Data (View 1)

Use option 7=Display Channel Interval Data for the D-channel. The transmit, receive, and average line utilization for the sample interval selected are the values listed in the Transmit/Receive/Average Line Util column heading.

Channel Line spee	nterface .  d 	: D : 16.3	}	Lib	r rary ed time .	:	Q962981049 QPFRDATA 00:19:58
	Transmit/ Receive/	-	ng Calls-		ng Calls-	Loss of	
Itv End	Average	Total	Percent	Total	Percent	Frame	
	Line Util		Rejected		Rejected	•	
10:54:28		0	0	0	0	0	
10:59:28		0	0	0	0	0	
11:04:28		0	0	0	0	0	
11:09:28	00/00/00	0	0	0	0	0	
Press Ent	er to conti	nue.					Bottom
F3=Fxit	F11=View2	F12=Car	cel F24	=More ke	vs		

Figure 75. Channel Interval Data (View 1) - D-Channel Sample

Use PRTRSCRPT to print the Resource Interval Report. The Communications Line Detail shows the utilization calculated per sample interval shown in Figure 75.

							ource Inte nunications					11/0	1/96 11:00:28 Page 7
							DWSIZ(31)						
Member	: 0	6298104	9 Model/	'Serial	. : 510			Main stora		384.0 M	Started .	: 10/24	/96 10:49:28
	ary : QI							Version/Re					/96 11:09:28
PROTOC	OL = ISDN NE	TWORK I	NTERFACE	(SORT	BY INTER	VAL)							
	IOP		Outgo	ing	Inco	ming	LAPD	LAPD Pct	LAPD	LAPD Pct			
	Name/		Call	s	Cal	1s	Total	Frames	Total	Frames	Loss of	Local	
Itv	Network	Line		Pct		Pct	Frames	Trnsmitd	Frames	Recd	Frame	End Code	Collision
End	Interface	Speed	Total	Retry	Total	Reject	Trnsmitd	Again	Recd	in Error	Alignment	Violation	Detect
	CC04												
	(2605)												
	ITSONWI06	16.3	0	0	0	0	60	0	60	0	0	0	0
	ITSONWI07	16.3	0	0	0	0	60	0	60	0	0	0	0
	ITSONWI06	16.3	0		0	0	60	0	60	0	0	0	0
	ITSONWI07	16.3	0		0	0	60	0	60	0	0	0	0
	ITSONWI06	16.3	0		0	0	60	0	60	0	0	0	0
	ITSONWI07	16.3 16.3	0	0	0	0	60	0	60	0	0	0	0
	ITSONWIO6 ITSONWIO7	16.3	0	0	0	0	58 58	0	58 58	0	0	0	0
II:09 Itv Fn			-	-	-	-	on interva	-			0	0	0
ILV EN	u	-		curred	.ne uata	correcti	ion incerva	ti or time	that vary				
IOP Na	me/	-			name and	model	number, Net	work inter	face desc	rintion			
	rk Interface		101 10		indine dire	moder	iumber, nei	anor k meet	race acou	riperon			
Line S			- Line s	peed (1	000 bits	per sec	cond)						
	ng Calls Tot				going ca								
	ng Calls	-	- Percen	t of ou	tgoing c	alls tha	it were rej	ected by t	he networ	k			
Pct R	5												
	ng Calls Tot				oming ca								
	ng Calls		- Percen	it of ir	coming c	alls tha	it were reg	jected					
Pct R	-												
	otal Frames	-	- Number	• ot tra	imes trar	smitted	(applies t	o D-channe	i oniy)				
Trnsm	itd ct Frames		Domorr	+ fun	+···		l due to er						
	itd Again	-		nel onl		nsmitted	due to er	ror (appi)	es to				
	otal Frames					ived (ar	oplies to D	) channol (	n1v)				
Recd	ocar rraines	-	- Number	01 110	lines rece	iveu (ap	ipiles to t	-channer (	(IIIy)				
	ct Frames in Frror	-	- Percen	it frame	s receiv	ed in en	rror (appli	ies to D-cł	annel onl	y)			
Loss o	f Frame		- Number	of tim	es a tin	e period	l equivaler	t to two 4	8 bit fra	mes			
Align	ment						id pairs o						
	End Code	-					lations de						
Viola	tion		for fr	ames re	ceived o	n the T	interface	-					
Collis	ion Detect		- Number	of tim	es that	a transm	nitted fram	ne corrupte	d by				
			anotho	r frame	was det	ected							

Figure 76. Resource Report - Communications Line Detail

### 14.1.2 Line Errors

Line errors result in frames being retransmitted. If the re-transmission still results in bad frames and the errors occur on the B-channel, the application is notified and eventually has to resend the entire record or multiple records. This may result in one RU (request unit) or a chain of RUs being transmitted again.

#### 14.1.2.1 Performance Monitor Database Fields

The performance monitor collects data about physical line errors on the terminal equipment, network termination 1 (TE/NT1) interface. The following fields are related to physical line errors and affect the entire NWI, that is, not only D-channel but also B-channels.

- LPLOFA Loss of frame alignment: Total number of times when a time period equivalent to two 48-bit frames has elapsed without receiving valid frames.
- **LPLECV** Local end code violation: Counted by the TE to indicate unintended polarity violations (that are not framing bits) for frames received on the T interface.
- LPDTSI Detected access transmission error in: The number of times the TE received an indication from the network termination type 1 (NT1) that a cyclic redundancy check (CRC) error has been detected by the NT1 across the NT1-LT (U) interface.

- **LPDTSO** Detected access transmission error out: The number of times the TE received an indication from the NT1 that a CRC error has been detected by the NT1 across the U interface.
- **LPFECV** Far end code violation: Counted by the TE to indicate unintended polarity violations detected by the NT1 for frames transmitted to the NT1 on the T interface.
- LPES Errored seconds: Total number of seconds that had at least one DTSE-in or DTSE-out error.
- **LPSES** Severely errored seconds: Total number of seconds that had more than three DTSE-in or DTSE-out errors.
- LPCOL Collision detect: The number of times the TE detected that its transmitted frame has been corrupted by another TE attempting to use the same bus.

The sample queries (NWI\_all and NWI\_errors) in Appendix H, "ISDN Queries" on page 361 show you the previously mentioned fields. Note that the contents of the fields LPDTSI, LPDTSO, LPFECV, LPES, and LPSES are not included in the Performance Tools reports, so you have to run queries or develop your own programs to examine these types of line errors.

#### 14.1.3 Using Performance Tools/400 to Display Line Error Information

Line error information can be displayed using the DSPPFRDTA command after having collected performance data with OS/400 Performance Monitor (see Chapter 1, "Tools Used for Finding Performance Problems" on page 1). You can also print the Resource Report to view the line error information.

Use the DSPPFRDTA command to access the Communications Line Detail display shown in Figure 73 on page 211. Press F13 to display Network Interface Data and use option 7=Display Channel Interval data (Figure 75 on page 212). You can see the times of Loss of Frame Alignment (LPLOFA) per interval.

Press F11 to access Channel Interval Data View 2.

		Display	Channel I	nterval Da	ta		
Channel Line spee	interface .  ed	: D : 16.3		Member Library Elapsed ti		: QPF	081049 FRDATA 0:58
Itv End	Local End Code Violation	Collision Detect	Total Frames Trnsmitd	Percent Frames Trnsmitd Again	Total Frames Received		
10:54:28	0	0	60	0	60	0	
10:59:28	0	0	60	0	60	0	
11:04:28 11:09:28	0 0	0 0	60 58	0 0	60 58	0 0	
Press Ent	er to conti	nue.					Bottom
F3=Exit	F11=View1	F12=Cance	1 F24=Mo	re keys			

Figure 77. Channel Interval Data (View 2) - D-Channel Sample

The display shows you the number of local end code violations (LPLECV) and the number of call collisions (LPCOL) per interval.

You can use the PRTRSCRPT command to print the Resource Interval Report. The Communications Line Detail section shows you the total number of frame alignment losses, local end code violations, and call collisions per sample interval shown in Figure 76 on page 213.

#### 14.1.4 Frame Errors (LAP-D)

This is only for the D-channel and is only interesting, if the customer is having trouble making calls or also having similar problems on the B-channels.

The performance monitor collects data about the number of:

- Frame re-transmissions
- · Frames received in error
- Invalid frames received

A frame can be an information, supervisory, or unnumbered information frame:

#### Information frames

I-frames are used to transfer user data. If there are no I-frames transmitted, you can conclude that the remote stations on that line are inactive. *Inactive* means that the stations connected to the controller are not doing any work even though the controller has been successfully varied on.

#### Supervisory frames

S-frames are used to perform link supervisory control functions such as acknowledge I-frames, request re-transmission of I-frames, or request a temporary suspension of transmission of I-frames.

#### **Unnumbered information frames**

UI-frames are used to provide additional link control functions and contain no sequence numbers.

Frame re-transmission is normally caused due to frames received in error and by link resets. To avoid communications performance problems, this number should be close to zero.

#### 14.1.5 Performance Monitor Database Fields

The following fields in the database file QAPMLAPD from the performance monitor can be used to determine the re-transmission error rates:

- **LSFTRN** Number of frames transmitted (information (I), unnumbered information (UI), and supervisory (S)). This includes frames retransmitted and frames sent on transmission stopped by transmit underrun.
- **LSFRT** Number of frames retransmitted.

The percent of frames transmitted with errors is derived from the following equation:

Percent of frames transmitted with errors = (LSFRT \* 100) / LSFTRN

The following fields from the performance monitor can be used to determine the number or percent of frames received in error or that are not valid:

- **LSFRCV** Total number of frames received (information (I), unnumbered information (UI), and supervisory (S)). This includes no errors.
- **LLFRIE** The total number of frames received in error. The individual error types are also counted in separate fields. Those fields are listed below.
- LLCRCE The number of frames received that contained a cyclic redundancy check (CRC) error
- **LLSFE** Short frame error. A short frame has fewer octets between its start and end flag than permitted.
- **LLORUN** Receive overrun. The ISDN subsystem could not keep pace with incoming data because of local controller overload.
- **LLURUN** Transmit underrun. The ISDN subsystem could not keep pace with outgoing data because of local controller overload.
- LLABRT Frame abort. A frame was received with HDLC abort indicator.
- **LSSEQE** Frame sequence error. A frame received with a sequence number indicating frames were lost.

The percent of frames received in error is derived from the following equation: Percent of frames received in error = (LSFRIE \* 100) / (LSFRCV + LSFRIE)

Appendix H, "ISDN Queries" on page 361 lists the sample queries (NWI\_ALL and NWI\_ERRORS) to show the values previously mentioned.

### 14.1.6 Using Performance Tools/400 to Display Frame Error Information

You can find frame error information in the Channel Interval Data (View 2) display shown in Figure 77 on page 215. Follow the steps described in Section 14.1.3, "Using Performance Tools/400 to Display Line Error Information" on page 214 to navigate through Performance Monitor displays.

You can also print the Resource Interval Report using the PRTRSCRPT command. The Communications Line Detail section lists the total number of LAPD frames transmitted, the percent of frames transmitted again, the total number of frames received, and the percent of frames received in error (Figure 76 on page 213).

#### 14.1.7 Call Processing

Especially for short data transfers, a lengthy call processing may severely impact performance. Also, if a system needs a long time to process a call, either the ISDN or the calling system may time out. In most cases, these problems are caused by improper configuration.

#### 14.1.7.1 Performance Monitor Database Fields

The following fields of the QAPMLAPD database file are related to ISDN call processing:

- LQTOC Total number of outgoing call attempts. This includes outgoing SETUP messages requesting a packet switched connection (defined by CCITT Recommendation X.31).
   LQROC The total number of outgoing calls that were rejected by the network. This includes outgoing SETUP messages for packet switched (X.31) connections.
   LQTIC Total number of incoming call attempts. This includes incoming setup messages for packet switched connections (X.31).
- LQRIC Total number of incoming calls that were rejected by the terminal equipment (TE). For a passive bus configuration, the call may have been intended for another TE that shares the passive bus. This count also includes rejected incoming SETUP messages for packet switched connections (X.31).

The sample queries (NWI\_ALL and NWI\_CALLS) in Appendix H, "ISDN Queries" on page 361 show you the previously mentioned fields.

#### 14.1.8 Using Performance Monitor/400 to Display Call Information

Information about incoming and outgoing calls and call errors is included in the Channel Interval Data display. Please refer to Section 14.1.1.2, "Using Performance Tools/400 to Display Line Utilization (LAP-D)" on page 210 for information on how to access this display. A sample is shown in Figure 75 on page 212. You can also use the PRTRSCRPT command to print the Resource Interval report. The Communications Line Detail section lists the number of incoming and outgoing calls and the percent of incoming and outgoing calls rejected per interval. A sample report is shown in Figure 76 on page 213.

#### 14.1.8.1 Recommendations

Normally, line utilization is not an issue for the D-channel because this is used only for call setup and call clearing.

However, the overall performance of a given data transfer may be degraded if the system needs a long time to establish the connection. Also, the call acceptance time may exceed that required by the network. If you see a non-zero value in Figure 75 on page 212 for the incoming calls that had been rejected, try to find out which lines were in *VARIED ON* status at that time and which connection lists were associated with them. Check if the LCLNBR, LCLSUBADR, RMTNBR, and RMTSUBADR parameters are correct.

For optimal performance, also check if there is only one unique entry in all connection lists for a given RMTNBR-LCLNBR pair. This reduces system search time for entries matching the incoming call. Do not use the value \*ANY in the connection list entries. Likewise, after you have a working configuration, do not use the system-supplied default connection list QDCCNNLANY.

For outgoing calls that get rejected with cause code 31, check if all ISDN communication objects are in the appropriate state on the remote system.

#### 14.2 ISDN Data Link Control (IDLC)

IDLC is IBM's implementation of the CCITT recommendation for the Layer 2 protocol on the B channel. Because only the B-channel is used for actual data transfer, this is the most important field for performance investigation. On the other hand, because IDLC is a Layer 2 protocol, you cannot find any Layer 1-related information (physical line errors) here. As seen before, these are collected together with D-channel data.

The following list contains the main IDLC communications performance indicators:

- Line utilization (IDLC)
- Frame errors (IDLC)

#### 14.2.1 Line Utilization (IDLC)

Line utilization is the percentage of elapsed time during which information transfer took place on the line. Because ISDN is full duplex, line utilization should be determined for both directions. Line utilization is an important performance indicator that requires special attention. Exceeding the guideline for line utilization may lead to unacceptable response times.

# 14.2.1.1 Using Performance Tools/400 to Display Line Utilization (IDLC)

Line utilization can be displayed using the DSPPFRDTA command after having collected performance data with OS/400 Performance Monitor (see Chapter 1, "Tools Used for Finding Performance Problems" on page 1). You can also print the System or Resource report to view the line utilization.

Use the DSPPFRDTA command to access the Communications Line Detail display shown in Figure 73 on page 211. The display shows you the line speed and the average line utilization for both transmit and receive in the column % Busy. This display can be accessed from the Display Performance Data display by pressing F21=Display Communications Detail. Press F13 to display the

network interface data and use option 7=Display Channel Interval Data for the B-channel. The transmit, receive, and average line utilization for the sample intervals selected are listed in the Transmit/Receive/Average Line Util column heading.

Chan _ine	ork Interf nel speed name	: B	TSONWI06 2 4.0 CCO4	Libr	ary d time	:	Q962981049 QPFRDATA 00:19:58
	options, Display re	press Enter. mote jobs					
			Transmit/ Receive/	Total	Percent Frames	Total	Percent Frames
	Itv	Line	Average				
Dpt	End	ID	Line Util			Received	in Error
_	10:54:28	ITSOISDN06	92/00/46	1347	0	1345	0
_	10:59:28	ITSOISDN06	99/00/49	1450	0	1450	0
_	11:04:28	ITSOISDN06	99/00/49	1454	0	1453	0
-	11:09:28	ITS0ISDN06	16/00/08	245	0	248	0
							Botton
-3=E	xit F11=	View2 F12=	Cancel F1	.5=Sort by	itv end	F19=Sort b	y line ID

Figure 78. Channel Interval Data (View 1) - B-Channel Sample

Use PRTRSCRPT to print the Resource Interval Report. The Communications Line Detail shows the utilization calculated per sample interval as shown in Figure 78.

				Com	source Inte munications WDWSIZ(31)	5 Lin	e Detail	1				11/01/96	11:00:2 Page
Member :	0962981049	Model/S	erial					: 384	0 м	Started		10/24/96	10.49.28
Library :													
PROTOCOL = IDLC		-											
IOP			Transmit/		Frames-			Frames					
Name/			Receive/	Bytes	-Transmit	ted-	Bytes	Receive	d	Receive			Short
Itv Network	Line	Line	Average	Trnsmitd		Pct	Recd		Pct	CRC	Aborts	Sequence	Frame
End Interface	Descriptn	Speed	Line Util	Per Sec	Total	Err	Per Sec	Total	Err	Errors	Recd	Error	Errors
CC04 (2605)													
10:54 ITSONWIO6	ITSOISDN06	64.0	92/00/46	7,364	1,347	0	29	1,345	0	0	0	0	
10:54 ITSONWI07			00/91/46	29	1,345		7,350	1,345		0	0	0	
10:59 ITSONWIO6			99/00/49	-	1,450		30	1,450		-	0	0	
10:59 ITSONWI07			00/99/49	30	1,450		7,937	1,450		0	0	0	
11:04 ITSONWI06			99/00/49	.,	1,454		31	1,453		0	0	0	
11:04 ITSONWI07			00/99/49	31	1,454		7,948	1,454		0	0	0	
11:09 ITSONWIO6			16/00/08	1,328	245		5	248	-	0	0	0	
11:09 ITSONWIO7 Ity End			00/16/08	5	247		1,341	247	0	0	0	0	
ITV ENd		ena tim off occ	e of the da	ita collect	ion interva	ii or	time tha	t vary					
IOP Name/			ource name	and model	number Ne	twork	interfac	a descript	ion				
Network Interfa		101 103	ource nume	und moder	number, ne		. inceriae	e deseripe					
Line Descriptn		Line De	scription										
Line Speed		Line sp	eed (1000 b	its per se	cond)								
Transmit/Receive	/ :	In full	duplex mod	e, the per	cent of tra	ansmi	t line ca	pacity					
Average Line Ut	il	used, t	he percent	of receive	line capad	ty	used, and						
			rage of tra										
Bytes Transmitd		Average	number of	bytes tran	smitted per	r sec	ond						
Per Sec													
Frames Transmitt	ed	Number	of frames t	ransmitted									
Total Frames Transmitt			frames re-										
Pct Err	ed	Percent	trames re-	transmitte	a aue to ei	rror							
Bvtes Recd Per S	ec .	Averaco	number of	hytes roce	ived ner s	acord							
Frames Received					iven hei, si	conu							
Frames Received			frames rec		rror								
Pct Err													
Receive CRC Erro	rs I	Number	of received	frames th	at containe	ed a	CRC error						
Aborts Recd		Number	of frames r	eceived th	at containe	ed HD	LC						
		abort i	ndicators										
Sequence Error		Number	of frames r	eceived th	at containe	ed se	quence er	rors					
Short Frame Erro	nc	Numbor	of short fr	amos rocoi	vod								

Figure 79. Resource Report - Communications Line Detail

You can also print the system report with the PRTSYSRPT command, and analyze the Communications Summary section shown in Figure 81 on page 223. But be careful if you achieve an average line utilization approaching 50% (as in this example). ISDN lines are full duplex, so it can happen that one direction (transmit or receive) may be utilized nearly 100% while the other is utilized 0% giving an average near 50%. In these cases, always examine the Resource Interval report where you can see both directions separately.

				Sys	stem Report			11.	/01/96 10:54:18
				Communi	ications Su	mmary			Page 0006
			II	DLCWDWSIZ	(31) MAXFRA	ME(8192)			
Member : Q962981	.049 Model/Se	erial . :	510-2144	4/10-16CAD	) Main ste	orage : 384	.0 M Started	: 10	/24/96 10:49:28
Library : QPFRDAT	A System r	1ame :		SYSTEMO	l Version	/Release : 3/	6.0 Stopped	: 10	/24/96 11:09:28
IOP Name/		Line	Avg	Max	Active	Number	Average	Bytes	Per Second
Line	Protocol	Speed	Util	Util	Devices	Transactions	Response	Received	Transmitted
CC04 (2623)									
ITS0ISDN06	IDLC	64.0		49	0	0	.00	24.1	6147.4
ITS0ISDN07	IDLC	64.0	38	49	0	0	.00	6147.4	24.1
IOP Name/Line	IOP Res	source name	and mod	del number	∿, Line ID				
Protocol	Line pr	rotocol (SD	LC, ASYM	NC, BSC, X	(25, TRLAN,	ELAN, IDLC, DDI	, FRLY)		
Line Speed	Line sp	eed (1000)	bits per	r second)					
	(For If	JLC this is	the max	ximum over	r the measu	rement)			
Vg Util	Average	e line util	ization						
Max Util	Maximum	n line util	ization	in all me	easurement	intervals			
Active Devices	Average	a number of	active	devices o	on the line				
Number Transactions	Number	of transac	tions						
Average Response	Average	a system re	sponse /	(service)	time (seco	nds)			
Bytes /Sec Received	Average	a number of	bytes r	received p	per second	-			
Bytes /Sec Transmitted	Average	number of	hytes f	transmitte	ed ner seco	nd			

Figure 80. Resource Report - Communications Line Detail

#### 14.2.1.2 Performance Monitor Database Fields (IDLC)

The following fields in the performance monitor database file QAPMIDLC are related to the line utilization:

- **ISBRCV** The total number of bytes received from the remote station. This includes no errors.
- **ISBTRN** The total number of bytes transmitted including bytes transmitted again
- **ISLSP** The speed of the line in bits per second (bps)
- **INTSEC** Number of seconds since the last elapsed interval

The transmit line utilization is derived from the following equation:

Transmit line utilization = ISBTRN \* 8 \* 100 / (INTSEC \* ISLSP)

The receive line utilization is derived from the following equation:

Receive line utilization = ISBRCV \* 8 \* 100 / (INTSEC \* ISLSP)

You have to multiply by eight to get the number of *bits* transmitted (because the line speed is given in *bits* per second and multiply by 100 to get the percent value instead of a fraction.

Line utilization is calculated per interval, that is, the time you have specified on the INTERVAL parameter of the STRPFRMON command.

Appendix H, "ISDN Queries" on page 361 lists the sample queries (IDLC\_ALL, and IDLC\_UTIL) to show the values previously mentioned.

#### 14.2.2 Line Errors (IDLC)

The Performance Monitor does not collect line error data for IDLC. Please see Section 14.1.2, "Line Errors" on page 213 for line errors occurring on the network interface.

#### 14.2.3 Frame Errors (IDLC)

The performance monitor collects data in the QAPMIDLC file about the number of:

- Frame retransmissions
- · Frames received in error
- Invalid frames received

Frame retransmission is normally caused due to frames received in error and by link resets. To avoid communications performance problems, this number should be zero or low. The following fields from the performance monitor can be used to determine the retransmission error rates:

- **ILCRCE** The number of frames received that contained a cyclic redundancy check (CRC) error
- **ILSFE** The number of short frames received. A short frame is a frame that has fewer octets between its start and end flags than is permitted.
- **ILORUN** Receive overrun. The number of times the ISDN subsystem could not keep pace with incoming data because of local controller overload.

- **ILURUN** Trasmit underrun. The number of times the ISDN subsystem could not keep pace with outgoing data because of local controller overload.
- **ILABRT** The number of frames received that contained an HDLC abort indicator.
- **ISFTRN** Number of frames transmitted (information (I), unnumbered information (UI), and supervisory (S)). This includes frames retransmitted and frames sent on transmission stopped by transmit underrun.
- **ISFRT** Number of frames transmitted again

The percent of frames transmitted with errors is derived from the following equation:

Percent of frames transmitted with errors = (ISFRT \* 100) / ISFTRN

The following fields from the performance monitor can be used to determine the number or percent of frames received in error or that are not valid:

- **ISFRCV** Total number of frames received (information (I), unnumbered information (UI), and supervisory (S)). This includes no errors.
- **ILFRIE** The total number of frames received in error. This is the sum of the following errors :
  - Cyclic redundancy check (CRC) error (ILCRCE)
  - Short frame error (ILSFE)
  - Receive overrun (ILORUN)
  - Transmit underrun (ILURUN)
  - Frame abort (ILABRT)
  - Frame sequence error (ISSEQE)

The percent of frames received in error is derived from the following equation: Percent of frames received in error = (ILFRIE \* 100) / (ISFRCV + ILFRIE)

Appendix H, "ISDN Queries" on page 361 lists the sample queries (IDLC\_ALL and IDLC\_UTIL) that show the values previously mentioned.

## 14.2.4 Using Performance Tools/400 to Display Frame Errors (IDLC)

Use DSPPFRDTA to access the Channel Interval Data display as described in Section 14.2.1.1, "Using Performance Tools/400 to Display Line Utilization (IDLC)" on page 218. This display shows you the total number of frames transmitted, the percent of frames transmitted again, the total number of frames received, and the percent of frames received in error. Please refer to Figure 78 on page 219.

Press F11 to view frame counters.

Chan Line	ork Interf nel speed name	· · · :			mber Library apsed tim		. :	62981049 QPFRDATA :19:58
• •	options, Display re		r.					
0pt	Itv End		Bytes Recd Per Sec	Sequence Error		Frame	Aborts Recd	
	10:54:28	7364	29	0	0	0	0	
_	10:59:28	7937	30	0	0	0	0	
_		7948	31	0	0	0	0	
_ _ _	11:04:28						<u>^</u>	
- - -	11:04:28 11:09:28		5	0	0	0	0	

Figure 81. Channel Interval Data (View 2) - B-Channel Sample

#### 14.3 ISDN Used with X.25 (X.31)

There are two different methods to use X.25 on an ISDN: circuit mode and packet mode. In either mode, the ISDN may be accessed by switched or permanent channels. Some access methods may not be available from some network providers. Permanent ISDN channels, defined by the network subscription, are always ready to be used for X.25 communications.

#### 14.3.1 Circuit Mode

- X.25 DTE-to-DTE (as defined in the ISO 8208 standard): The X.25 standards define procedures for the connection of one DTE directly to another DTE without actually using a packet-switched network. This type of connection requires that one of the DTEs provide a subset of the DCE functions. The procedure for the packet transfer is transparent to the ISDN. The D-channel provides call control to set up the connection for switched B-channels.
- X.31 case A: CCITT recommendation X.31 case A describes the use of an ISDN B-channel as a high-speed transportation medium. This establishes a connection between a DTE and a DCE. The D-channel provides the necessary call control to establish the connection. Again, once the B-channel connection is established, the packet transfer is transparent to the ISDN. Likewise, for the X.25 connection, the use of the ISDN is transparent.

#### 14.3.2 Packet Mode

Recommendation X.31 Case B describes how an X.25 DTE can use ISDN packet services. For switched B-channels, the D-channel is used to set up an ISDN connection to a *packet handler* within the ISDN that routes packets through the ISDN much in the same way as an X.25 network.

#### 14.3.3 Performance Monitor Database Fields

The Performance Monitor collects data about X.25 on an ISDN in the QAPMX25 database file. Please see Appendix C, "X.25 Queries" on page 275 for a detailed description about analyzing X.25 performance data.

#### 14.4 Recommendations

#### – Note –

The AS/400 system is designed to connect to several types of ISDN networks. You can find the complete listing of networks in the *AS/400 ISDN Support* manual. Some changes described in this chapter may influence your network subscription parameters. Contact your network provider before making changes to the network interface description.

Receive and transmit errors can occur when the AS/400 system, the network, or the remote device have an error or cannot process received data fast enough (see also Section 8.1.3, "Congestion" on page 133 for congestion). Factors that can influence the performance because of a retransmission are:

- · Line quality
- Frame size
- · Window size
- Packet size (X.25 only)

Line quality: If the percentage of errors on a line is about 5% for a few intervals that had I-frames transmitted, check the local and remote connections. Ensure that all cables are properly shielded, that they are the correct cable type, and that all plug connections are secure. There should be no ribbon cables (flat, unshielded cables) anywhere between the system and the network termination (NT). Sometimes the errors can be caused by electrical "noise" or interference. If problems still occur, contact your line supplier to have the line tested. You might consider changing to a better quality line.

#### 14.4.1 Frame Size

• AS/400 support for IDLC allows a range of frame sizes up to 8196 bytes. The frame size is specified with the MAXFRAME parameter in the line and controller descriptions. If you specify different values in the line and controller descriptions, the smaller value is used. In general, large frames provide better performance, especially with large file transfers. However, large frames do not perform well with error-prone lines due to longer retransmission times. Also, if a large frame is transmitted, the line is unavailable to any other transport so interactive sessions that normally use less amount of data might be adversely affected by batch file transfers, even if the right mode descriptions (MODD) and class-of-service (COS) are used.

Maximum length of Request/Response Unit (RU): The maximum length of an SNA request/response unit (RU) can be specified with the MAXLENRU

parameter in a mode description or in some device descriptions. If you specify \*CALC on the MAXLENRU parameter, an SNA RU size is automatically selected that is compatible with the frame size. If you choose to set the value yourself, use an RU size that is slightly less than the frame size or a multiple of a frame size. The reason for this is that SNA adds an additional nine bytes of overhead (three bytes request/response header (RH), and six bytes transmission header (TH)). Therefore, a RU size should be chosen so that the RU size plus nine equals the frame size or a multiple of frame sizes. If you choose an RU size that is slightly greater than a multiple of frame sizes, this results in an extra short frame carrying only a small amount of data.

• For X.25, the frame size is also specified with the MAXFRAME parameter in the line and controller descriptions. The AS/400 supports frame sizes up to 4096 bytes. The considerations for the maximum length of a request/response units are similar to the IDLC case. If you use \*CALC for the MAXLENRU parameter, the system selects an efficient size that is compatible with the packet size.

#### 14.4.2 Window Size

- For IDLC, the window size is specified with the IDLCWDWSIZ parameter in the line and controller descriptions. The AS/400 support for IDLC allows a maximum window size of 31. As with large frame sizes, a large window size may not work well for error-prone networks.
- For X.25, the packet window size is a similar parameter. The maximum packet window size you can set depends on the MODULUS parameter of the line description. If you set MODULUS to eight, you can set the default window size (DFTWDWSIZE) to seven. If MODULUS is set to 128, DFTWDWSIZE can be set to 15. Usually (especially in an environment with large batch file transfers) a larger window size yields better performance. This parameter must match your X.25 subscription value.

#### 14.4.3 Packet Size (X.25 Only)

- The packet size is specified using the DFTPKTSIZE parameter in the line and controller descriptions and the MAXPKTSIZE parameter in the line description. Larger packet sizes provide better performance. However, in case of an error-prone line, large packet sizes may not work well. The large packets have a higher probability for errors in this environment and take longer to transmit again. However, in general, it is preferable to use the largest packet size supported by the X.25 network. In conjunction with the packet size, if you specify \*CALC for the MAXLENRU parameter, the system selects an efficient RU size. If you choose to set the value for this parameter yourself, select an RU size so that the RU size is a multiple of the packet size less the length of the SNA headers. The following SNA headers must be considered:
  - LLC header. If you use ELLC, the length of the ELLC header is six bytes.
     QLLC does not use an LLC header.
  - Transmission header (TH). The length of the TH is six bytes.
  - Request/response header (RH). The length of the RH is three bytes.

Thus, for ELLC, use an RU size that is 15 bytes less than a multiple of the packet size and for QLLC, the RU size should be nine bytes less than a multiple of the packet size.

This parameter must match your X.25 subscription value.

In general, IDLC is expected to give better performance results in an error-free environment because of the larger frame and window sizes and because it adds less protocol overhead.

### 14.4.4 A Case Study

A series of tests were conducted at the ITSO to investigate the impact of the parameters previously described. The tests involved two 2605 adapters in the same 2623 communications IOP connected through a special loop wiring. One of the B-channels was used for a permanent IDLC connection, and an X.25 PVC was defined over the other permanent ISDN connection. A file of approximately 1.5MB was sent using these connections through SNA Distribution Services (SNADS) in one direction at one time.

The results are summarized in the following table:

Table 15. SNAD	S Transfer with Diff	erent Protocols			
Protocol	Frame size	Packet size	Window size	Transfer time	IOP Utilization
IDLC	2048	N/A	7	181	5.8
IDLC	8192	N/A	31	180	2.3
X.25	1024	128	2	231	92.8
X.25	4096	4096	15	187	24.3

# Appendix A. SDLC Queries

This section provides query definitions that can be used to examine SDLC environments. All of the queries use input from the OS/400 Performance Monitor run with the trace option. There are four queries defined:

- SDLC\_ALL
- SDLC\_HDLC
- SDLC\_IOP
- SDLC\_JOB

The SLDC\_ALL query is simple. It shows you all of the values in the QAPMHDLC file. The only thing you have to define is the file name and member name that contains the performance data. The rest are defaults so it takes you only a few minutes to create the query.

The SLDC\_HDLC query shows you the most important performance values for the SDLC environment.

The SDLC\_IOP query shows you performance values of the IOP to which the line is connected.

The SDLC\_JOB query shows you performance values of the JOBS that are running on the SDLC line.

# A.1 SDLC\_ALL

Query							
Use rounding No (default) Ignore decimal data errors No (default) Ignore substitution warnings Yes Use collating for all compares Yes Special conditions *** All records selected by default *** Selected files ID File Library Member Record Format TO1 QAPMHDLC QPFRDATA SDLC QAPMHDLR Ordering of selected fields Field Sort Ascending/ Break Field Name Priority Descending Level Text INTNUM Interval Number DTETIM Interval Date and Time INTSEC Elapsed Interval Seconds SHTYPE IOP Type SHLND Line Description SHSTN Bytes Transmitted SHBRN Bytes Transmitted SHBRN Frames Transmitted SHFTR Frames Transmitted SHFTR Frames Received SHFTR Frames Received SHFTF RR Frames Received SHFTF RR Frames Received SHFTF RR Frames Received SHFTF RR RR Frames Transmitted SHFTF RR RR RR Frames Transmitted SHFTF RR RR Frames Received SHFTF RR RR Frames Received SHFTF RR RR Frames Received SHFTF RR RR Frames Received SHFTF RR RR RR Frames Received SHFTF RR RR RR RR Frames Transmitted SHFTF RR RR Frames Received SHFTF RR RR RR RR Frames Received SHRFR RR RR RR Frames Received SHRFR RR RR RR Frames Received SHRFR RR RR RR RR Frames Transmitted SHRFR RR RR RR RR RR Frames Transmitted SHRFR RR RR RR RR RR RR Frames Transmitted SHRFR RR RR RR RR RR Frames Transmitted SHRFR RR RR RR RR RR Frames Received SHRNT RR RR RR RR RR RR Frames Transmitted SHRFR RR RR RR RR RR Frames Transmitted SHENRR RR RR Frames Received SHENRR RR RR RR RR Frames Received SHENRR RR RR RR Frames Received SHENRR RR RR Frames Transmitted SHENRR RR RR Frames Transmitted SHENRR RR RR Frames Transmitted SHENRR RR RR Frames Received SHEN	Libri Query Query Query Query	ary text CCSID language id country id	· · · · ·	· · · · · · · ·	. ITSC . All . 3 . ENU . US	DD3 SDLC Performance fields 7	
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SHBTRN     Bytes Transmitted       SHBRCV     Bytes Received       SHPRCL     Protocol       SHFTRN     Frames Transmitted       SHIFTR     I Frames Retransmitted       SHIFTR     I Frames Retransmitted       SHFRT     Frames Retransmitted       SHEFTR     Error Free Frames Received       SHFRT     Invariant Received       SHFR     Error Free I Frames Received       SHFR     Invalid Frames Received       SHRFR     RR Frames Transmitted       SHRRR     RR Frames Transmitted       SHRNR     RR Frames Transmitted       SHENRR     RR Frames Transmitted							
SHBRCV     Bytes Received       SHBRCL     Protocol       SHFRCL     Protocol       SHTFRN     Frames Transmitted       SHIFRT     I Frames Transmitted       SHIFRT     I Frames Retransmitted       SHFRT     Frames Retransmitted       SHFFR     Error Free Frames Received       SHFFR     Error Free I Frames Received       SHFRT     Rames Received in Error       SHFRT     RR Frames Received       SHRRT     RR Frames Received       SHRRT     RR Frames Received       SHRNT     RN Frames Transmitted       SHRNR     RN Frames Transmitted       SHRNR     RN Frames Creived       SHNNR     Link Resets							
SHPRCL     Protocol       SHFTRN     Frames Transmitted       SHIFTR     I Frames Transmitted       SHIFRT     I Frames Retransmitted       SHFRT     Frames Retransmitted       SHFRT     Error Free Frames Received       SHFRE     Error Free I Frames Received       SHFRE     Frames Received in Error       SHFRE     Invalid Frames Received       SHRRFT     R Frames Transmitted       SHRRFR     RR Frames Transmitted       SHRNNT     RNR Frames Transmitted       SHENRR     RNR Frames Transmitted       SHENRR     Link Resets						-	
SHFTRN     Frames Transmitted       SHFTR     I Frames Transmitted       SHIFRT     I Frames Retransmitted       SHFRT     Frames Retransmitted       SHEFR     Error Free Frames Received       SHFR     Error Free I Frames Received       SHFR     Frames Received       SHFR     Invalid Frames Received       SHRFR     RR Frames Transmitted       SHRRR     RR Frames Transmitted       SHRNR     RR Frames Transmitted       SHENRR     RR Frames Transmitted       SHENRR     RR Frames Transmitted       SHENRR     Link Resets						<b>3</b> · · · · · · · · · · · · · · · · · · ·	
SHIFTR     I Frames Transmitted       SHIFRT     I Frames Retransmitted       SHEFRT     Frames Retransmitted       SHEFR     Error Free Frames Received       SHEFR     Error Free I Frames Received       SHEFR     Frames Received in Error       SHIFR     Invalid Frames Received       SHRFT     RR Frames Transmitted       SHRRR     RR Frames Transmitted       SHRNR     RNR Frames Transmitted       SHRNR     RN Frames Transmitted       SHRNR     Link Resets							
SHIFRT     I Frames Retransmitted       SHFRT     Frames Retransmitted       SHEFR     Error Free Frames Received       SHEFIR     Error Free I Frames Received       SHFRE     Frames Received in Error       SHFRE     Rrames Received in Error       SHRRF     R Frames Received       SHRRFT     R Frames Transmitted       SHRRFR     RR Frames Transmitted       SHRNT     RNR Frames Transmitted       SHENRR     RN Frames Transmitted       SHENRR     RN Frames Transmitted       SHENR     RN Frames Transmitted       SHENR     Link Resets							
SHFRT     Frames Retransmitted       SHFFR     Error Free Frames Received       SHEFIR     Error Free I Frames Received       SHFRIE     Frames Received in Error       SHIFR     Invalid Frames Received       SHRFR     RR Frames Transmitted       SHRRR     RNR Frames Transmitted       SHRNRT     RNR Frames Transmitted       SHENRR     RNR Frames Transmitted       SHENRR     Link Resets							
SHEFFR     Error Free Frames Received       SHEFIR     Error Free I Frames Received       SHFRIE     Frames Received       SHIFR     Invalid Frames Received       SHRRFT     RR Frames Transmitted       SHRRRR     RN Frames Received       SHRNRT     RNR Frames Transmitted       SHRNR     RNR Frames Received       SHRNR     Link Resets							
SHEFIR     Error Free I Frames Received       SHFRIE     Frames Received in Error       SHIRR     Invalid Frames Received       SHRRT     RR Frames Transmitted       SHRRRR     RN Frames Received       SHRNRT     RNR Frames Transmitted       SHRNR     RNR Frames Created       SHRNR     Link Resets							
SHFRIE     Frames Received in Error       SHIFR     Invalid Frames Received       SHRRFT     RR Frames Transmitted       SHRRFR     RR Frames Received       SHRNRT     RNR Frames Transmitted       SHENRR     RNR Frames Cecived       SHENRR     RNR Frames Transmitted       SHENRR     RNR Frames Transmitted       SHENRR     RNR Frames Transmitted							
SHIFR     Invalid Frames Received       SHRRFT     RR Frames Transmitted       SHRRR     RR Frames Received       SHRNRT     RNR Frames Transmitted       SHRNR     RNR Frames Received       SHRNR     Link Resets							
SHRRFT     RR Frames Transmitted       SHRRFR     RR Frames Transmitted       SHRNRT     RNR Frames Transmitted       SHRNR     RNR Frames Received       SHLNKR     Link Resets							
SHRRFR     RR Frames Received       SHRNNT     RNR Frames Transmitted       SHENRR     RNR Frames Received       SHLNKR     Link Resets							
SHRNRT RNR Frames Transmitted SHRNRR RNR Frames Received SHLNKR Link Resets							
SHRNRR RNR Frames Received SHLNKR Link Resets	••••••						
SHLNKR Link Resets							
	2.1011						

Figure 82. SDLC\_ALL Query, Part 1

Summary	functions: 1-Tota	1, 2-Aver	age, 3-Minimum, 4-Ma	aximum, 5-	-Count			0verr	ides	
Field	Summary	Column			Dec	Null		Dec	Numeric	
Name			Column Headings	Len	Pos		Len		Editing	
INTNUM		0		5	0					
			Interval							
		_	Number							
DTETIM		2	Interval Date	12						
			Time							
INTSEC		2	Elapsed	7	0					
			Interval							
		_	Seconds							
IOPRN		2	IOP Resource	10						
			Name							
SHTYPE		2	Hune	4						
			IOP							
			Туре							
SHLND		2	Lino	10						
			Line Description							
SHLSP		2	202011201011	11	0					
-			Line	-						
			Speed							
SHBTRN		2	Dutas	11	0					
			Bytes Transmitted							
SHBRCV		2	Transmitteu	11	0					
			Bytes							
			Received							
SHPRCL		2		1						
SHFTRN		2	Protocol		0					
SHFIRN		2	Frames	11	0					
			Transmitted							
SHIFTR		2		11	0					
			I Frames							
		_	Transmitted		-					
SHIFRT		2	I Frames	11	0					
			Retransmitted							
SHFRT		2		11	0					
			Frames							
0115555			Retransmitted		0					
SHEFFR		2	Error Free Frames	11	0					
			Received							
SHEFIR		2	Error Free	11	0					
			I Frames							
0115075		0	Received		~					
SHFRIE		2	Frames Received	11	0					
			in Error							
SHIFR		2	Invalid	11	0					
			Frames							
			Received							
SHRRFT		2	RR Frames	11	0					
			Frames Transmitted							
SHRRFR		2	RR	11	0					
			Frames							
			Received							
SHRNRT		2	RNR	11	0					
			Frames Transmitted							
SHRNRR		2	RNR	11	0					
			Frames	-						
			Received							
SHLNKR		2	Link	11	0					
			Link Resets							
SHCPT		2	Polling	3	0					
		-	Wait	5	Ŭ					
			Time							

Figure 83. SDLC\_ALL Query, Part 2

Figure 84. SDLC\_ALL Query, Part 3

# A.2 SDLC\_HDLC

Query	SDL	C_HDLC			
Library	ITS	CID03			
Query text	SDL	C performance fields			
Query CCSI	)	37			
Query langu	Jage id ENU				
	try id US				
	the decimal separator character	for this guery ***			
	sequence Hex				
5					
Processing	options				
Use roun	ding Yes	(default)			
Ignore d	ecimal data errors No	(default)			
Ignore s	ubstitution warnings Yes				
Use coll	ating for all compares Yes				
Special co	nditions				
*** A11	records selected by default ***				
elected fil					
ID Fil	e Library Member	Record Format			
TO1 QAPI	MHDLC QPFRDATA SDLC	QAPMHDLR			
esult field	S				
Name	Expression	Column Heading	Len	Dec	
LINEUTIL	(SHBRCV + SHBTRN) * 800 / INTSE		4	1	
	/ SHLSP				
PCERRTR	(SHFRT * 100) / (SHFRT + SHFTRN	) Pct Frames	4	1	
		Trnsmitd			
		in Error			
PCIERRTR	(SHIFRT * 100) / (SHIFRT +	Pct I Frames	4	1	
	SHIFTR)	Trnsmitd			
		in Error			
PCERRRCV	((SHIFR + SHFRIE) * 100) /	Pct Frames	4	1	
	(SHEFFR + SHIFR + SHFRIE)	Recd			
		in Error			
PCPOLL	((SHCPT * (SHFRT - SHIFRT)) *	Pct Poll	4	1	
	100) / (INTSEC * 10)	Retry			
		Time			
DATE	substr(DTETIM,3,2)    '/'	Date			
	substr(DTETIM,5,2)				
TIME	substr(DTETIM,7,2)    ':'	Time			
	substr(DTETIM,9,2)				
LCLNOTR	SHRNRT / (SHEFFR + SHFRIE +	Local	4	1	
	SHIFR + SHRRFR + SHRNRR)	Not			
		Ready			
RMTNOTR	SHRNRR / (SHIFTR + SHIFRT +	Remote	4	1	
	SHRRFT + SHRNRT)	Not		-	
	Sinta - Sintary	Ready			
		uy			
rdering of	selected fields				
Field	Sort Ascending/ Break	Field			
Name	Priority Descending Level				
SHLND	10 A 1	Line Description			
DATE		and bescription			
TIME					
LINEUTIL					
PCERRTR					
PCIERRTR					
PCERRRCV					
PCPOLL					
LCLNOTR					
RMTNOTR		Link Resets			
SHLNKR					

Figure 85. SDLC\_HDLC Query, Part 1

			age, 3-Minimum, 4-Ma						rides	
Field Name	Summary Eunctions	Column Spacing	Column Headings	len	Dec Pos	Null Can	len		Numeric Editing	
SHLND	Tunctions	0	corumn nearrigs	10	FUS	cap	Len	rus	Luiting	
			Line							
			Description							
DATE		2	Date	5						
TIME LINEUTIL	24	2 2	Time Line Util	5	1					
PCERRTR	24	2	Pct Frames	4	1					
- ochier in	2 1	-	Trnsmitd in Error		-					
PCIERRTR	2 4	2	Pct I Frames	4	1					
			Trnsmitd							
			in Error							
PCERRRCV	2 4	2	Pct Frames	4	1					
			Recd in Error							
PCPOLL	24	2	Pct Poll	4	1					
		-	Retry		-					
			Time							
LCLNOTR	2 4	2	Local	4	1					
			Not							
RMTNOTR	2 4	2	Ready Remote	4	1					
RELINGTR	2 4	2	Not	4	1					
			Ready							
SHLNKR	1	2		11	0		11	0		
			Link Resets							
Break New	Suppress Bi	reak								
Level Page	Summaries Te									
Level Page O No	Summaries Te Yes	ext	· line &SHLND							
Level Page O No 1 No	Summaries Te Yes No Su	ext	'line &SHLND							
Level Page 0 No 1 No elected output	Summaries Te Yes No Su attributes	ext ummary for								
Level Page 0 No 1 No elected output 0utput type .	Summaries Te Yes No Su attributes	ext ummary for	Printer							
Level Page 0 No 1 No elected output Output type . Form of output	Summaries Te Yes No Su attributes  t	ext ummary for	Printer Detail							
Level Page 0 No 1 No elected output 0utput type . Form of outpu Line wrapping	Summaries Te Yes No Su attributes  t	ext ummary for	Printer Detail							
Level Page 0 No 1 No elected output 0utput type . Form of output Line wrapping	Summaries Te Yes No Su attributes  t	ext ummary for 	Printer Detail No							
Level Page 0 No 1 No elected output 0utput type . Form of output Line wrapping rinter Output Printer device	Summaries Te Yes No Su attributes  t	ext ummary for 	Printer Detail No							
Level Page 0 No 1 No elected output 0utput type - Form of output Line wrapping minter Output Printer devic Report size	Summaries Te Yes	ext ummary for	Printer Detail No							
Level Page 0 No 1 No Pletted output Output type . Form of output Line wrapping rinter Output Printer device Report size Length	Summaries Te Yes	ext ummary for	Printer Detail No *PRINT 66 (default)							
Level Page 0 No 1 No Pletted output Output type . Form of output Line wrapping rinter Output Printer device Report size Length	Summaries Te Yes No Su attributes	ext	<ul> <li>Printer</li> <li>Detail</li> <li>No</li> <li>*PRINT</li> <li>66 (default)</li> <li>132</li> </ul>							
Level Page 0 No 1 No elected output Output type . Form of output Line wrapping winter Output Printer devic Report size Length Width Report start Report send 1i	Summaries Te Yes St attributes  t e line	ext	<ul> <li> Printer</li> <li> Detail</li> <li> No</li> <li> *PRINT</li> <li> 66 (default)</li> <li> 132</li> <li> 6 (default)</li> <li> 60 (default)</li> </ul>							
Level Page 0 No 1 No elected output Output type . Form of output Form of output Line wrapping winter Output Printer devic Report size Length Report start Report end li Report line s	Summaries Ter Yes Su attributes	ext	<ul> <li>Printer</li> <li>Detail</li> <li>No</li> <li>*PRINT</li> <li>66 (default)</li> <li>132</li> <li>6 (default)</li> <li>60 (default)</li> <li>Single space</li> </ul>							
Level Page 0 No 1 No elected output Output type . Form of output Line wrapping winter Output Printer devic Report size Length Width Report start Report send 1i	Summaries Ter Yes Su attributes	ext	<ul> <li>Printer</li> <li>Detail</li> <li>No</li> <li>*PRINT</li> <li>66 (default)</li> <li>132</li> <li>6 (default)</li> <li>60 (default)</li> <li>Single space</li> </ul>							
Level Page 0 No 1 No elected output Output type . Form of output Form of output Printer Output Printer devic Report size Length Width Report start Report start Report line spoiled	Summaries Ter Yes St attributes	ext	<ul> <li>Printer</li> <li>Detail</li> <li>No</li> <li>*PRINT</li> <li>66 (default)</li> <li>132</li> <li>6 (default)</li> <li>60 (default)</li> <li>Single space</li> <li>No</li> </ul>							
Level Page 0 No 1 No elected output form of output Line wrapping rinter Output Printer device Length Report size Length Report end li Report line s Print definit rinter Spooled	Summaries         Term           Yes         attributes           attributes	ext	<ul> <li>Printer</li> <li>Detail</li> <li>No</li> <li>*PRINT</li> <li>66 (default)</li> <li>132</li> <li>6 (default)</li> <li>60 (default)</li> <li>Single space</li> <li>No</li> <li>(Defaults to valuate to val</li></ul>							
Level Page 0 No 1 No elected output Output type . Form of output Printer devic Report size Length . Width Width Report start Report line s Print definit rinter Spooled Spool the out	Summaries Ter Yes attributes	ext	<ul> <li>Printer</li> <li>Detail</li> <li>No</li> <li>*PRINT</li> <li>66 (default)</li> <li>132</li> <li>6 (default)</li> <li>60 (default)</li> <li>Single space</li> <li>No</li> <li>(Defaults to va</li> <li>(Defaults to va</li> </ul>							
Level Page 0 No 1 No elected output Output type . Form of output Printer Output Printer devic Report size Length Width Report start I Report start I Report lines Print definit rinter Spooled Spool the out Form type	Summaries Ter Yes St attributes	ext	<ul> <li>Printer</li> <li>Detail</li> <li>No</li> <li>*PRINT</li> <li>66 (default)</li> <li>132</li> <li>6 (default)</li> <li>60 (default)</li> <li>Single space</li> <li>No</li> <li>(Defaults to value)</li> <li>(Defaults to value)</li> <li>1</li> </ul>	alue in p	rint f	ile, Q	PQUPI	RFIL)		
Level Page 0 No 1 No elected output Form of output Line wrapping rinter Output Printer device Report size Length Report end li Report line s Print definit rinter Spooled Spool the out Form type Copies	Summaries Ter Yes St attributes	ext	<ul> <li>Printer</li> <li>Detail</li> <li>No</li> <li>*PRINT</li> <li>66 (default)</li> <li>132</li> <li>6 (default)</li> <li>60 (default)</li> <li>Single space</li> <li>No</li> <li>(Defaults to va</li> <li>(Defaults to va</li> </ul>	alue in p	rint f	ile, Q	PQUPI	RFIL)		
Level Page 0 No 1 No elected output Form of output Line wrapping rinter Output Printer device Report size Length Report end li Report line s Print definit rinter Spooled Spool the out Form type Copies	Summaries Terms No Sumaries Terms No Sumaries	ext	<ul> <li>Printer</li> <li>Detail</li> <li>No</li> <li>*PRINT</li> <li>66 (default)</li> <li>132</li> <li>6 (default)</li> <li>60 (default)</li> <li>Single space</li> <li>No</li> <li>(Defaults to value of the second of the seco</li></ul>	alue in p	rint f	ile, Q	PQUPI	RFIL)		
Level Page 0 No 1 No elected output Form of output Line wrapping rinter Output Printer device Report size Length Report size Length Report end li Report line s Print definit rinter Spooled Spool the out Form type Copies Hold Syser Page Print cover page	Summaries         Term           Yes         stributes           attributes         stributes           t            t            e                e                pacing            jon            Output                age	ext	<ul> <li>Printer</li> <li>Detail</li> <li>No</li> <li>*PRINT</li> <li>66 (default)</li> <li>132</li> <li>6 (default)</li> <li>60 (default)</li> <li>Single space</li> <li>No</li> <li>(Defaults to value of the second of the seco</li></ul>	alue in p	rint f	ile, Q	PQUPI	RFIL)		
Level Page 0 No 1 No elected output Form of output Line wrapping rinter Output Printer devic Report size Length Width Width Report line s Print definit rinter Spooled Form type Copies Hold Hold Cover page age headings a	Summaries Ter Yes	ext	<ul> <li>Printer</li> <li>Detail</li> <li>No</li> <li>*PRINT</li> <li>66 (default)</li> <li>132</li> <li>6 (default)</li> <li>60 (default)</li> <li>Single space</li> <li>No</li> <li>(Defaults to value)</li> <li>1</li> <li>(Defaults to value)</li> <li>No</li> </ul>	alue in p	rint f	ile, Q	PQUPI	RFIL)		
Level Page 0 No 1 No elected output Form of output Line wrapping rinter Output Printer device Length Width Report size Length Report end li Report line s Print definit rinter Spooled Spool the out Form type Copies Hold Over Page Print cover page	Summaries Ter Yes	ext	<ul> <li>Printer</li> <li>Detail</li> <li>No</li> <li>*PRINT</li> <li>66 (default)</li> <li>132</li> <li>6 (default)</li> <li>60 (default)</li> <li>Single space</li> <li>No</li> <li>(Defaults to value)</li> <li>1</li> <li>(Defaults to value)</li> <li>1</li> <li>(Defaults to value)</li> <li>No</li> </ul>	alue in p	rint f	ile, Q	PQUPI	RFIL)		

Figure 86. SDLC\_HDLC Query, Part 2

## A.3 SDLC\_IOP

### A.3.1 IOP Query for a Communications Processor

```
. . . . . . . . . . . . SDLC and IOP related performance fields
 Query CCSID . . . . . . . . . . . . . . .
                                          37
 *** . is the decimal separator character for this query *** Collating sequence . . . . . . . . Hexadecimal
 Processing options
   Use rounding . . . . . . . . . . Yes (default)
   Ignore decimal data errors . . . . No (default)
Ignore substitution warnings . . . Yes
Use collating for all compares . . . Yes
 Special conditions
*** All records selected by default ***
Selected files
 ID File
                                    Member
                                                  Record Format
                      Library
        OAPMHDLC
 T01
                      OPFRDATA
                                    SDLC
                                                  OAPMHDLR
        QAPMCIOP
                      QPFRDATA
                                   SDLC
                                                  QAPMCIOR
 T02
Join tests
 Type of join . . .
                       . . . . . . . . . Matched records
              Test
EQ
                         Field
TO2.INTNUM
 Field
 T01.INTNUM
 T01.IOPRN
                   EQ
                                     T02.IOPRN
Result fields
 Name
            Expression
                                               Column Heading
                                                                      Len Dec
 LINEUTIL
             (SHBTRN + SHBRCV) * 800 /
                                               Line
                                                                        4 1
             T01.INTSEC / SHLSP
                                               Util
             substr(T01.DTETIM,3,2) || '/' || Date
 DATE
             substr(TO1.DTETIM,5,2)
substr(TO1.DTETIM,7,2) || ':' || Time
 TIME
             substr(T01.DTETIM,9,2)
            SHRNRT / (SHEFFR + SHFRIE +
SHIFR + SHRRFR + SHRNRR)
                                               Loca1
 LCLNOTR
                                                                        4
                                                                            1
                                               Not
                                               Ready
 RMTNOTR
             SHRNRR / (SHIFTR + SHIFRT +
                                                                        4
                                                                            1
                                               Remote
             SHRRFT + SHRNRT)
                                               Not
                                               Ready
             100 - ((CIIDLC * CIIDLT) /
                                               Pct IOP
                                                                        4 1
 IOPUTIL
             (1000000 * T02.INTSEC))
                                               Util
Ordering of selected fields
                Sort Ascending/ Break Field
 Field
 Name
T01.INTNUM
                 Priority Descending Level Text
                                             Interval Number
 T01.IOPRN
                                     1
                                             IOP Resource Name
 T01.SHTYPE
                                             IOP Type
                                             Line Description
                                      2
 T01.SHLND
 DATE
 TIME
 LINEUTIL
 IOPUTIL
 T01.SHBTRN
                                             Bytes Transmitted
 T01.SHBRCV
                                             Bytes Received
 LCLNOTR
 RMTNOTR
```

Figure 87. SDLC\_IOP Query, Part 1

Summary funct	ions: 1-Tota	1, 2-Aver	age, 3-Minimum, 4-Maxi	imum, 5-	Count			Overr	ides
Field Name T01.INTNUM	Summary Functions	Column Spacing O	Column Headings	Len 5	Dec Pos 0	Null Cap			Numeri Editin
101.101000		0	Interval	5	0				
			Number						
T01.IOPRN		2	IOP Resource	10					
T01.SHTYPE		2	Name	4					
101.301002		2	IOP	4					
			Туре						
T01.SHLND		2		10					
			Line Description						
DATE		2	Date	5					
TIME		2	Time	5					
LINEUTIL	2 4	2	Line	4	1		4	1	
TOPUTTI		2	Util	4					
IUPUIIL	2 4	Z	Pct IOP Util	4	1		4	1	
T01.SHBTRN	1	2	0011	11	0		8	0	
			Bytes						
			Transmitted						
T01.SHBRCV	1	2	Bytes	11	0		8	0	
			Received						
LCLNOTR	2 4	2	Local	4	1		4	1	
			Not						
DHINGTO	2 4	0	Ready	4			4		
RMTNOTR	24	2	Remote Not	4	1		4	1	
			Ready						
Report breaks									
		reak							
	Summaries Te Yes	xt							
	res Yes								
	No								
selected output									
Output type .									
Form of outpu Line wrapping	t		Detail						
cine mapping									
Printer Output									
Printer devic	e		*PRINT						
			66 (dofault)						
Report size			00 (uerauri)						
Length									
Length Width			132						
Length Width Report start	 line	· · · · ·							
Length Width Report start Report end li Report line s	 line ne pacing	· · · · · ·	. 132 . 6 (default) . 60 (default) . Single space						
Length Width Report start Report end li	 line ne pacing	· · · · · ·	. 132 . 6 (default) . 60 (default) . Single space						
Length Width Report start Report end li Report line s Print definit	 line ne pacing ion	· · · · · ·	. 132 . 6 (default) . 60 (default) . Single space						
Length Width Report start Report end li Report line s Print definit Printer Spooled	 line ne pacing ion Output	· · · · · ·	. 132 . 6 (default) . 60 (default) . Single space . No	ue in pr	int f	ile.	QPQUPR	FIL)	
Length Width Report start Report end li Report line s Print definit Printer Spooled Spool the out		· · · · · · ·	. 132 . 6 (default) . 60 (default) . Single space . No (Defaults to valu	ue in pr ue in pr	rint f	ile,	QPQUPR QPQUPR	FIL)	
Length Width Report start Report end li Report line s Print definit Printer Spooled Spool the out Form type Copies		· · · · · · · · · · · · · · · · · · ·	<ul> <li>. 132</li> <li>. 6 (default)</li> <li>. 60 (default)</li> <li>. Single space</li> <li>. No</li> <li> (Defaults to vali</li> <li> (Defaults to vali</li> <li>. 1</li> </ul>	ue in pı	rint f	ile,	QPQUPR	FIL)	
Length Width Report start Report end li Report line s Print definit Printer Spooled Spool the out Form type Copies Hold		· · · · · · · · · · · · · · · · · · ·	132 6 (default) 60 (default) 	ue in pı	rint f	ile,	QPQUPR	FIL)	
Length Width Report start Report end li Report line s Print definit Printer Spooled Spool the out Form type Copies Nod Cover Page		· · · · · · · · · · · · · · · · · · ·	132 6 (default) 60 (default) Single space No (Defaults to valu (Defaults to valu (Defaults to valu	ue in pı	rint f	ile,	QPQUPR	FIL)	
Length Width Report start Report end li Report line s Print definit Printer Spooled Spool the out Form type Copies Hold Cover Page Print cover p	line	· · · · · · · · · · · · · · · · · · ·	132 6 (default) 60 (default) Single space No (Defaults to valu (Defaults to valu (Defaults to valu	ue in pı	rint f	ile,	QPQUPR	FIL)	
Length Width Report start Report end li Report line s Print definit Printer Spooled Spool the out Form type Copies Nod Cover Page		· · · · · · · · · · · · · · · · · · ·	132 6 (default) 60 (default) Single space No (Defaults to valu (Defaults to valu (Defaults to valu	ue in pı	rint f	ile,	QPQUPR	FIL)	

Figure 88. SDLC\_IOP Query, Part 2

## A.3.2 IOP Query for MFIO Processor

```
Library . . . . . . . . . . . . . . . . . ITSCID03
 Query text . . . . . . . . . . . . . . . SDLC and IOP related performance fields
 Collating sequence . . . . . . . . . Hexadecimal
 Processing options
   Use rounding ..... Yes (default)
Ignore decimal data errors .... No (default)
Ignore substitution warnings .... Yes
   Use collating for all compares . . . Yes
 Special conditions
    *** All records selected by default ***
Selected files
 ID File
                        Library
                                       Member
                                                      Record Format
        OAPMHDLC
                        OPFRDATA
                                      SDLC
                                                      OAPMHDLR
                                   SDLC
        QAPMMIOP
                        QPFRDATA
                                                      QAPMMIOR
 T02
Join tests
 Type of join ..... Matched records
Field Test Field Tol.INTNUM EQ TO2.INTNUM
TOI.IOPRN FO TO2.IOPRN
 T01.IOPRN
                     EQ
                                        T02.IOPRN
Result fields
 Name Expression
LINEUTIL (SHBTRN + SHBRCV) * 800 /
                                                   Column Heading
                                                                             Len Dec
                                                   Line
                                                                               4 1

    COLLINESC / SHLSP
    Util

    substr(TO1.DTETIM,3,2)
    '/' || Date

    substr(TO1.DTETIM,5,2)
    ...

 DATE
              substr(T01.DTETIM,7,2) || ':' || Time
 TIME
              substr(T01.DTETIM,9,2)
SHRNRT / (SHEFFR + SHFRIE +
 LCLNOTR
                                                   Loca1
                                                                               4 1
              SHIFR + SHRRFR + SHRNRR)
                                                   Not
                                                   Ready
 RMTNOTR
              SHRNRR / (SHIFTR + SHIFRT +
                                                   Remote
                                                                               4 1
              SHRRFT + SHRNRT)
                                                   Not
                                                   Ready
 IOPUTIL
              100 - ((MIIDLC * MIIDLT) /
                                                   Pct IOP
                                                                               4 1
              (1000000 * T02.INTSEC))
                                                   Util
Ordering of selected fields
                  Sort Ascending/ Break Field
Priority Descending Level Text
 Field
  Name
 T01.INTNUM
                                                 Interval Number
                                         1
 T01.IOPRN
                                                 IOP Resource Name
 T01.SHTYPE
                                                 IOP Type
 T01.SHLND
                                         2
                                                 Line Description
 DATE
 TIME
 LINEUTIL
  IOPUTIL
 T01.SHBTRN
T01.SHBRCV
                                                 Bytes Transmitted
                                                 Bytes Received
 LCLNOTR
 RMTNOTR
```

Figure 89. SDLC\_MIOP Query, Part 1

Summary funct	ions: 1-Tota	1, 2-Aver	age, 3-Minimum, 4-Maxi	mum, 5-	Count			0verr	ides
Field Name T01.INTNUM	Summary Functions	Column Spacing O	Column Headings	Len 5	Dec Pos 0	Null Cap			Numeri Editin
101.101000		0	Interval	5	0				
			Number						
T01.IOPRN		2	IOP Resource	10					
TA1 AUTVD5			Name						
T01.SHTYPE		2	TOP	4					
			Туре						
T01.SHLND		2		10					
			Line						
DATE		2	Description Date	5					
TIME		2	Time	5					
LINEUTIL	2 4	2	Line	4	1		4	1	
			Util						
IOPUTIL	24	2	Pct IOP Util	4	1		4	1	
T01.SHBTRN	1	2	0.11	11	0		8	0	
			Bytes		-		2	-	
			Transmitted						
T01.SHBRCV	1	2	Dutas	11	0		8	0	
			Bytes Received						
LCLNOTR	2 4	2	Local	4	1		4	1	
			Not						
			Ready						
RMTNOTR	2 4	2	Remote Not	4	1		4	1	
			Readv						
Report breaks			Reduy						
	Suppress Br	eak							
Level Page	Summaries Te	xt							
0 110	Yes								
1 110	Yes No								
2 No	NO								
Selected output	attributes		Durintau						
Selected output Output type .			Printer						
Output type . Form of outpu	 t		Detail						
	 t		Detail						
Output type . Form of outpu Line wrapping	 t		Detail						
Output type . Form of outpu Line wrapping Printer Output	 t		Detail No						
Output type . Form of outpu Line wrapping Printer Output Printer devic	 t		Detail No						
Output type . Form of outpu Line wrapping Printer Output Printer devic Report size	t	· · · · · ·	Detail No						
Output type . Form of outpu Line wrapping Printer Output Printer devicc Report size Length Width		· · · · · ·	Detail No *PRINT 66 (default) 132						
Output type . Form of outpu Line wrapping Printer Output Printer devic Report size Length Width Report start	e	· · · · · ·	Detail No *PRINT 66 (default) 132 6 (default)						
Output type . Form of outpu Line wrapping Printer Output Printer devic Report size Length . Width . Report start Report end lin	e	· · · · · · ·	Detail No *PRINT 66 (default) . 132 6 (default) 60 (default)						
Output type . Form of outpu Line wrapping Printer Output Printer devic Report size Length . Width . Report start Report end lin Report line sj	e	· · · · · · · · · · · · · · · · · · ·	Detail No *PRINT 66 (default) 132 6 (default) 60 (default) Single space						
Output type . Form of outpu Line wrapping Printer Output Printer devic Report size Length . Width . Report start Report end lin	e	· · · · · · · · · · · · · · · · · · ·	Detail No *PRINT 66 (default) 132 6 (default) 60 (default) Single space						
Output type . Form of outpu Line wrapping Printer Output Printer devic Report size Length Width Report start Report start Report ine sy Print definit Printer Spooled		· · · · · · · · · · · · · · · · · · ·	Detail No *PRINT 66 (default) 132 6 (default) 60 (default) Single space No						
Output type . Form of outpu Line wrapping Printer Output Printer devic Report size Length Width Report start Report end lin Report line sy Printer Spooled Spool the out	e	· · · · · · · · · · · · · · · · · · ·	Detail No *PRINT 66 (default) 132 60 (default) 60 (default) Single space No (Defaults to valu						
Output type . Form of outpu Line wrapping Printer Output Printer device Report size Length Width Report start Report end lin Report line sy Print definit Printer Spooled Spool the outp	e		Detail No *PRINT 66 (default) 132 60 (default) Single space No (Defaults to valu (Defaults to valu						
Output type . Form of outpu Line wrapping Printer Output Printer devic Report size Length Width Report start Report start Report start Report line sy Print definit Printer Spooled Spool the out; Form type	e		<ul> <li>. Detail</li> <li>. No</li> <li>. *PRINT</li> <li>. 66 (default)</li> <li>. 132</li> <li>. 6 (default)</li> <li>. 60 (default)</li> <li>. Single space</li> <li>. No</li> <li>. (Defaults to valu</li> <li>. 10 faults to valu</li> <li>. 10 faults to valu</li> </ul>	ue in pi	rint f	ile,	QPQUPR	FIL)	
Output type . Form of outpu Line wrapping Printer Output Printer devic Report size Length Width Report start Report line sy Printer Spooled Spool the out Form type Copies	e		Detail No *PRINT 66 (default) 132 60 (default) Single space No (Defaults to valu (Defaults to valu	ue in pi	rint f	ile,	QPQUPR	FIL)	
Form of outpu Line wrapping Printer Output Report size Length Width Report start Report end lin Report line sy Print definit Printer Spool the out Form type Copies Hold Cover Page	e		<ul> <li>. Detail</li> <li>. No</li> <li>. *PRINT</li> <li>. 66 (default)</li> <li>. 132</li> <li>. 6 (default)</li> <li>. 5ingle space</li> <li>. No</li> <li>. (Defaults to valution of the second s</li></ul>	ue in pi	rint f	ile,	QPQUPR	FIL)	
Output type . Form of outpu Line wrapping Printer Output Printer devic Report size Length Width Report start Report line sy Printer Spooled Spool the out Form type Copies	e		<ul> <li>. Detail</li> <li>. No</li> <li>. *PRINT</li> <li>. 66 (default)</li> <li>. 132</li> <li>. 6 (default)</li> <li>. 5ingle space</li> <li>. No</li> <li>. (Defaults to valution of the second s</li></ul>	ue in pi	rint f	ile,	QPQUPR	FIL)	
Output type . Form of outpu Line wrapping Printer Output Report size Length Width Report start Report line sy Print edfinit Printer Spoold Spool the out Form type Copies Kodd Cover Page Print cover page Page headings a	e		<ul> <li>. Detail</li> <li>. No</li> <li>. *PRINT</li> <li>. 66 (default)</li> <li>. 132</li> <li>. 6 (default)</li> <li>. 5ingle space</li> <li>. No</li> <li>. (Defaults to valu</li> <li>. (Defaults to valu</li> <li>. (Defaults to valu</li> <li>. (Defaults to valu</li> <li>. Yes</li> </ul>	ue in pi	rint f	ile,	QPQUPR	FIL)	
Output type . Form of outpu Line wrapping Printer Output Printer devic Report size Length Width Report start Report line sy Print definit Printer Spooled Spool the out Form type Copies Hold Cover Page Print cover page	e		<ul> <li>. Detail</li> <li>. No</li> <li>. *PRINT</li> <li>. 66 (default)</li> <li>. 132</li> <li>. 6 (default)</li> <li>. 5ingle space</li> <li>. No</li> <li>. (Defaults to valu</li> <li>. (Defaults to valu</li> <li>. (Defaults to valu</li> <li>. (Defaults to valu</li> <li>. Yes</li> </ul>	ue in pi	rint f	ile,	QPQUPR	FIL)	

Figure 90. SDLC\_MIOP Query, Part 2

## A.4 SDLC\_JOB

```
Query language id . . . . . . . . . . . . . US
Query country id . . . . . . . . . . US
*** . is the decimal separator character for this query ***
 Collating sequence . . . . . . . . . Hexadecimal
 Processing options
  Special conditions
*** All records selected by default ***
Selected files
 ID File
TO1 QAPMHI
                     Library
                                  Member
                                               Record Format
 T01 QAPMHDLC
T02 QAPMJOBS
                                               QAPMHDLR
QAPMJOBR
                     QPFRDATA
                                  SDLC
                     QPFRDATA
                                 SDLC
Join tests
 Type of join . . . . . . . . . . . Matched records
             Test Field
EQ TO2.JBLND
 Field
 T01.SHLND
 T01.INTNUM
                  EQ
                                   T02.INTNUM
Result fields
            Expression
(SHBRCV + SHBTRN) * 800 /
 Name
                                            Column Heading
                                                                  Len Dec
 LINEUTIL
                                            Total
                                                                    Δ
                                                                        1
            T01.INTSEC / SHLSP
                                            Line
                                            Util
            substr(TO1.DTETIM,3,2) || '/' ||
 DATE
                                            Date
            substr(T01.DTETIM,5,2)
            substr(TO1.DTETIM,7,2) || ':' ||
 TIME
                                            Time
            substr(T01.DTETIM,9,2)
 AVGJOBRSP JBRSP / (JBNTR + 0000.1)
                                            Job avg
                                             response
                                             time
            ((JBCPU / 1000) * 100) /
 PCTCPU
                                             Pct
                                                                    4 1
            T01.INTSEC
                                            CPU
                                            Usage
Ordering of selected fields
 Field
                Sort
                        Ascending/ Break Field
                Priority Descending Level Text
 Name
 T02.JBNAME
                        A
A
                                1
                10
                                           Job Name
 T02.JBUSER
                                    1
                20
                                           Job User
 T02.JBNBR
                30
                         А
                                    1
                                           Job Number
 T01.SHLND
                                           Line Description
                                           IOP Resource Name
IOP Type
 T01.IOPRN
 T01.SHTYPE
 DATE
 TIME
 AVGJOBRSP
 PCTCPU
 LINEUTIL
```

Figure 91. SDLC\_JOB Query, Part 1

	y func	tions: 1-T	otal, 2-Aver	age, 3-Minimum, 4-Max	imum, 5-	Count			0verr	ides
Field		Summary	Column			Dec	Null		Dec	Numeric
Name		Functio		Column Headings	Len	Pos		Len		Editing
T02.JB	NAME		0		10					5
				Job						
				Name						
T02.JB	USER		2		10					
				Job						
				User						
T02.JB	NBR		2		6					
				Job						
				Number						
T01.SH	LND		2		10					
				Line						
				Description						
T01.I0	PRN		2	IOP	10					
				Resource						
				Name						
T01.SH	ТҮРЕ		2		4					
				IOP						
				Туре						
DATE			2	Date	5					
TIME			2	Time	5					
AVGJOBI	RSP	2 4	2	Job avg	16	3				
				response						
				time						
РСТСРИ		2 4	2	Pct	4	1				
				CPU						
				Usage						
LINEUT	IL		2	Total	4	1				
				Line						
				Util						
port b	reaks									
Break	New	Suppress	Break							
Level	Page	Summaries	Text							
0	No	Yes								
1	No	No	Summary for	job &JBNAME &JBUSER	&JBNBR					
lected		t attribute								
0++				Printer						
				Detail						
Form o										
Form o <sup>.</sup> Line wi	rapping									
Form o Line wi inter (	rapping Output			No						
Form o Line wi inter ( Printer	rapping Output r devi			No						
Form o Line wi inter ( Printer Report	rapping Output r devi size			No *PRINT						
Form o Line wi inter ( Printer Report Lengi	rapping Output r devi size th		· · · · · · · ·	No *PRINT 66 (default)						
Form o Line wi inter ( Printer Report Leng Width	rapping Output r devi size th		· · · · · · · · · · · · · · · · · · ·	<ul> <li>. No</li> <li>. *PRINT</li> <li>. 66 (default)</li> <li>. 152</li> </ul>						
Form o Line wi inter ( Printer Report Leng Width Report	rapping Output r devi size th . start	g ce   line	· · · · · · · · · · · · · · · · · · ·	<ul> <li>. No</li> <li>. *PRINT</li> <li>. 66 (default)</li> <li>. 152</li> <li>. 6</li> </ul>						
Form o Line wi inter ( Printer Report Leng Width Report Report	rapping Output r devin size th h start end li	9	· · · · · · · · · · · · · · · · · · ·	No *PRINT 66 (default) 152 6 60						
Form o' Line wi inter ( Printer Report Leng: Width Report Report Report	rapping Output r devic size th h start end li line	g	· · · · · · · · · · · · · · · · · · ·	No *PRINT 66 (default) 152 6 60 Single space						
Form o' Line wi inter ( Printer Report Leng: Width Report Report Report	rapping Output r devic size th h start end li line	g	· · · · · · · · · · · · · · · · · · ·	No *PRINT 66 (default) 152 6 60 Single space						
Form o' Line wi inter ( Printer Report Leng: Width Report Report Report Print (	rapping Output r devin size th start end li line defini	g	· · · · · · · · · · · · · · · · · · ·	No *PRINT 66 (default) 152 6 60 Single space						
Form o' Line wu inter ( Printer Report Leng Width Report Report Report Print (	rapping Output r devin size th start end li line s defini Spoolee	J	· · · · · · · · · · · · · · · · · · ·	No *PRINT 66 (default) 152 6 60 Single space No						
Form of Line wi inter ( Printer Report Leng Width Report Report Print ( inter 1 Spool 1	rapping Output r devic size th start end li line s defini Spooled the out	g	· · · · · · · · · · · · · · · · · · ·	No *PRINT 66 (default) 152 6 60 Single space No (Defaults to val						
Form of Line wi inter ( Printer Report Leng Width Report Report Print ( Spool 1 Form ty	rapping Output r devin size th start end li line s defini Spoole the out ype	g	· · · · · · · · · · · · · · · · · · ·	No *PRINT 						
Form of Line wi inter ( Printer Report Leng Width Report Report Print of Spool 1 Form ty Copies	rapping Output r devin size th start end li line defini Spoole the out ype	J	· · · · · · · · · · · · · · · · · · ·	No *PRINT 66 (default) 152 6 60 Single space No (Defaults to val (Defaults to val 1	lue in pr	int f	ile, (	QPQUPI	RFIL)	
Form of Line wi inter ( Printer Report Leng Width Report Report Print ( Spool 1 Form ty Copies Hold	rapping Output r devin size th start end li line defini Spoole the out ype	J	· · · · · · · · · · · · · · · · · · ·	No *PRINT 	lue in pr	int f	ile, (	QPQUPI	RFIL)	
Form of Line wi inter ( Printer Report Leng Width Report Report Print ( Spool 1 Form ty Copies Hold ver Pag	rapping Output r devin size th start end li line defini Spooled the out ype	1		<ul> <li>. No</li> <li>*PRINT</li> <li>. 152</li> <li>. 6</li> <li>. 60</li> <li>. Single space</li> <li>. No</li> <li>. (Defaults to val</li> <li>. (Defaults to val</li> </ul>	lue in pr	int f	ile, (	QPQUPI	RFIL)	
Form of Line within the construction Printer ( Printer ( Report Leng) Width Report Report Report Print ( Spool of Form ty Copies Hold Ver Pag Print (	rapping Output r devin size th start end li line s defini Spooled the out ype . ge cover	J	· · · · · · · · · · · · · · · · · · ·	<ul> <li>. No</li> <li>*PRINT</li> <li>. 152</li> <li>. 6</li> <li>. 60</li> <li>. Single space</li> <li>. No</li> <li>. (Defaults to val</li> <li>. (Defaults to val</li> </ul>	lue in pr	int f	ile, (	QPQUPI	RFIL)	
Form of Line within terms Printer ( Printer ( Report Report Report Report Print of Spool if Form ty Copies Hold Viver Page Print of Cover	rapping Output r devid size th start end li line s defini Spooled the out ype  ge cover p r page	<pre></pre>		<ul> <li>. No</li> <li>*PRINT</li> <li>. 152</li> <li>. 6</li> <li>. 60</li> <li>. Single space</li> <li>. No</li> <li>. (Defaults to val</li> <li>. (Defaults to val</li> </ul>	lue in pr	int f	ile, (	QPQUPI	RFIL)	
Form of Line within the second Printer ( Printer ( Report Report Report Report Print of Spool of Form ty Copies Hold ver Page Print of Cover ge head	rapping Output r devid size th start end li line defini Spooled the out ype	J	· · · · · · · · · · · · · · · · · · ·	<ul> <li>. No</li> <li>*PRINT</li> <li>. 152</li> <li>. 6</li> <li>. 60</li> <li>. Single space</li> <li>. No</li> <li>. (Defaults to val</li> <li>. (Defaults to val</li> <li>. (Defaults to val</li> <li>. No</li> </ul>	lue in pr	int f	ile, (	QPQUPI	RFIL)	
Form of Line wi inter ( Printer Report Leng Width Report Print of Spool if Form ty Copies Hold ver Pag Print of Cover ge heaa Print s	rapping Output r devid size th start end li line s defini Spooled the out ype   ge cover µ ge cover µ standam	ce		<ul> <li>. No</li> <li>*PRINT</li> <li>. 152</li> <li>. 6</li> <li>. 60</li> <li>. Single space</li> <li>. No</li> <li>. (Defaults to val</li> <li>. (Defaults to val</li> <li>. (Defaults to val</li> <li>. No</li> </ul>	lue in pr	int f	ile, (	QPQUPI	RFIL)	
Form o' Line winiter I Printel Report Lengy WidtH Report Print ( Cove ge head Print ( Cove ge head Print 2 Print 2 Pri	rapping Output r devid size th start end li line defini Spooled the out ype	J	· · · · · · · · · · · · · · · · · · ·	<ul> <li>. No</li> <li>*PRINT</li> <li>. 152</li> <li>. 6</li> <li>. 60</li> <li>. Single space</li> <li>. No</li> <li>. (Defaults to val</li> <li>. (Defaults to val</li> <li>. (Defaults to val</li> <li>. No</li> </ul>	lue in pr	int f	ile, (	QPQUPI	RFIL)	

Figure 92. SDLC\_JOB Query, Part 2

### Appendix B. Local Area Network Queries

This appendix contains query examples to help you measure your LAN performance. Queries for both token-ring networks and Ethernet networks are provided. These queries make use of the performance data collected by the OS/400 Performance Monitor. Basically, the files used in these queries are:

QAPMCIOP	Communications Controller IOP Data File
QAPMECL	Token-Ring Network/Statistics File
QAPMSTNL	Token-Ring Station File
QAPMETH	Ethernet Network/Statistics File
QAPMSTNE	Ethernet Station File

#### **B.1 Token-Ring LAN Query**

Three examples of queries you can use to identify performance bottlenecks in token-ring LANs are discussed here:

1. TRNQRY

This query, which prints the Token-Ring LAN Performance Indicators Report, shows you the values of the main performance indicators that were discussed in Chapter 6, "Communications I/O Processor (IOP)" on page 89. Use this report to compare with the threshold values of the performance indicators to obtain an overview of the performance on your token-ring LAN. The information that is provided in this report is shown in the following list:

- · Line utilization
- IOP utilization
- Overrun indicators
  - Local Not Ready
  - Local Sequence Error
  - Remote Not Ready
  - Remote Sequence Error
- T1 Timers time-outs
- MAC errors rate
- Retransmission rate

The query definition is shown in Section B.1.4, "Token-Ring LAN Performance Indicators Query" on page 244.

2. TRNMACQRYx (x = 1,2 and 3 representing Reports 1,2 and 3 respectively)

This query prints three reports showing all of the MAC error counters contained in the Token-Ring Performance Data File. A high value in any of these counters should be investigated. The query definition is shown in Section B.1.5, "Token-Ring LAN MAC Error Counters Query" on page 248.

Run query 1 and 2 in sequence starting from the query TRNQRY followed by the queries TRNMACQRYx. Alternatively, you can run both queries consecutively from a CL program. The detailed listing of this CL program is shown in Figure 95 on page 242. This program first generates the Token-Ring Performance Indicators Report and prints the detailed MAC Error Counters Report if the average MAC error rate exceeds 1% of the total frames transmitted and received. The output of both queries is in Figure 93 on page 241 and Figure 94 on page 241.

3. TRNUSAGE

This query analyzes the overhead generated in a token-ring LAN against the total frames transmitted and received in each time interval. The listing of this query definition is shown in Section B.1.6, "Token-Ring LAN Overhead Query" on page 254.

### **B.1.1 Sample Report Output**

28/96 16:57:											
IOP		IOP		Line	Local Not	Local Seq	Remote	Remote Seq	T1 timer	MAC	Retransmission
Resource	Line	Uti	lization	Utilization		Error	Not Ready		time-out	Errors	Rate
Name	Descriptior	1	(%)	(%)	(%)	(%)	(%)	(%)	rate(%)	(%)	
CC01	TRNLINE1										
		Summ	ary for	TRNLINE1							
		AVG	1.2	.0	.0	.0	.0	.0	2.7	.0	.(
		МАХ	1.5	.1	.0	.0	.0	.0	16.7	.0	
CC02	TRNLINE2										
		Summ	ary for	TRNLINE2							
		AVG	1.1	.1	.0	.0	.0	.0	.0	.0	
		МАХ	5.7	1.5	.0	.0	.0	.0	.0	.0	
CC03	TRNLINE3										
		Summ	ary for	TRNLINE3							
		AVG	3.9	1.7	.0	.0	.0	.0	.0	.0	
		МАХ	5.2	2.6	.0	.0	.0	.0	.0	.0	
CC04	TRNLINE5										
		Summ	ary for	TRNLINE5							
		AVG	2.2	.1	.0	.0	.0	.0	2.1	.0	
		МАХ	3.4	.2	.0	.0	.0	.0	13.6	.0	
		Summ	ary for a	all Token-ri	ng LANs						
		AVG	1.5	.1	.0	.0	.0	.0	1.4	.0	
		MAX	5.7	2.6	.0	.0	.0	.0	16.7	.0	

Figure 93. Sample Token-Ring LAN Performance Indicators Report

10/25/96	09:43:28				To	ken-Ring L	AN MAC Errors	Counters Repo	rt 3	PAGE 1
IOP		MAC	MAC					IOA		
Resource	Line	Err	Err	Unauth	Unauth	SOFR	Transmit	Status	Frames	Spurious
Name	Desc	Avg%	Max%	AP	MF	Error	Beacon	Overrun	Discarded	Interrupt
CC01	LINTRN	1.3	3.6							
			Summary	for Token-r	ing: LINTRN					
			TOTAL	0	0	0	0	0	2,695	
			Summary	for all Tok	en-Ring LANs					
			TOTAL	0	0	0	0	0	2,695	

Figure 94. Sample Token-Ring LAN MAC Error Counters Report

# B.1.2 CL Program to Execute the Token-Ring LAN Queries

763PW1 V3R1M0 94090		03/31/96 11:33:47	PAGE
OURCE FILE			
	1 UKENURY 2+ 3+ 4+ 5+ 6+	7 + 8 + 9 + 0	
100 /************	*******	/	03/31/96
400 /*		-	03/31/96
500 /* Program name	: TOKENQRY *	*/	03/31/96
600 /* PURPOSE	: THIS CL PROGRAM WILL GENERATE A TOKEN RING	*/	03/31/96
700 /*	LAN PERFORMANCE INDICATORS REPORT SHOWING *	*/	03/31/96
800 /*	- IOP UTILIZATION *	•/	03/31/96
900 /*	- LINE UTILIZATION *	1	03/31/96
1000 /*	- IOA OVERRUN STATISTICS *	*/	03/31/96
1100 /*	- T1 TIMER TIME-OUT RATE *	*/	03/31/96
1200 /*		*/	03/31/96
1500 /*		s/	03/31/96
1600 /*		*/	03/31/96
1700 /*		*/	03/31/96
1900 /*			03/31/96
	***************************************	/	03/31/96
2100 PGM PARM(&			03/31/96
2200 DCL &MEM *CHAR			03/31/96
	R 100 VALUE('RUNQRY QRY(MYLIB/SAPQRY) +		03/31/96
2400 2500 DCL &STRNC2 *CH	QRYFILE((*RUNOPT/QAPMSAP MMMMMMMMM))')		03/31/96 03/31/96
2500 DCL &SIRNG2 *CH 2600	AR 200 VALUE('RUNQRY QRY(MYLIB/TRNQRY2) + QRYFILE((*RUNOPT/QAPMECL MMMMMMMMMM) +		03/31/96 03/31/96
2700	(*RUNOPT/QAPMCIOP MMMMMMMMMM) +		03/31/96
2800	(*RUNOPT/*SAME))')		03/31/96
	AR 200 VALUE('RUNQRY QRY(MYLIB/TRNQRY2) +		03/31/96
3000 DEL ASTRINGS CII	QRYFILE((*RUNOPT/QAPMECL MMMMMMMMM) +		03/31/96
3100	(*RUNOPT/QAPMCIOP MMMMMMMMM) +		03/31/96
3200	(*RUNOPT/*SAME)) +		03/31/96
3300	OUTTYPE(*OUTFILE) OUTFILE(MYLIB/TRNPFRIND)')		03/31/96
3400 DCL &STRNG4 *CH	AR 100 VALUE('RUNQRY QRY(MYLIB/TRNMACQRY1) +		03/31/96
3500	QRYFILE((*RUNOPT/*SAME) +		03/31/96
3600	(*RUNOPT/QAPMECL MMMMMMMMMM))')		03/31/96
3700 DCL &STRNG5 *CH	AR 100 VALUE('RUNQRY QRY(MYLIB/TRNMACQRY2) +		03/31/96
3800	QRYFILE((*RUNOPT/*SAME) +		03/31/96
3900	(*RUNOPT/QAPMECL MMMMMMMMMM))')		03/31/96
	AR 100 VALUE('RUNQRY QRY(MYLIB/TRNMACQRY3) +		03/31/96
4100	QRYFILE((*RUNOPT/*SAME) +		03/31/96
4200	(*RUNOPT/QAPMECL MMMMMMMMMM))')		03/31/96
4300 DCLF FILE(MYLIB			03/31/96
	JNORY COMMAND STRING */		03/31/96
4500 /* PUT THE MEM 4600 CHGVAR	3ER NAME FROM THE PARAM  */ VAR(%SST(&STRNG 51 10)) VALUE(&MEM)		03/31/96 03/31/96
4800 /* RUNQRY QRY(			03/31/96
	CMDEXC) PARM(&STRNG 100)		03/31/96
	ECOND RUNQRY COMMAND STRING */		03/31/96
5200 /* SET MEMBER			03/31/96
5300 CHGVAR	VAR(%SST(&STRNG2 52 10)) VALUE(&MEM)		03/31/96
5600 CHGVAR	VAR(%SST(&STRNG2 82 10)) VALUE(&MEM)		03/31/96
5900 /* RUNORY ORY	(MYLIB/TRNQRY) */		03/31/96
	CMDEXC) PARM(&STRNG2 200)		03/31/96
	YLIB/TRNPFRIND)		03/31/96
6200 MONMSG MSG			03/31/96
5200 /* SET MEMBER	NAME FIELDS */		03/31/96
6400 CHGVAR	VAR(%SST(&STRNG3 52 10)) VALUE(&MEM)		03/31/96
6700 CHGVAR	VAR(%SST(&STRNG3 82 10)) VALUE(&MEM)		03/31/96
	(MYLIB/TRNQRY) OUTTYPE(*OUTFILE) OUTFILE(MYLIB/TRNPFR	-	03/31/96
7100 IND) */			03/31/96
	CMDEXC) PARM(&STRNG3 200)		03/31/96
7300 START: RCVF			03/31/96
	ID (CPF0864) EXEC (RETURN)		03/31/96
	ACERRRA02 *GT 0.01) THEN(DO)		03/31/96
	SER NAME FROM THE PARAM */		03/31/96
7800 CHGVAR	VAR(%SST(&STRNG4 71 10)) VALUE(&MEM)		03/31/96
	(MYLIB/TRNMACQRY1) */		03/31/96
	CMDEXC) PARM(&STRNG4 100)		03/31/96 03/31/96
8300 /* PUT THE MEMI 8400 CHGVAR	3ER NAME FROM THE PARAM  *∕ VAR(%SST(&STRNG5 71 10)) VALUE(&MEM)		03/31/96 03/31/96
	(MYLIB/TRNMACQRY2) */		03/31/96
	CMDEXC) PARM(&STRNG5 100)		03/31/96
	SER NAME FROM THE PARAM */		03/31/96
9000 /* PUT THE MEMI 9000 CHGVAR	VAR(%SST(&STRNG6 71 10)) VALUE(&MEM)		03/31/96
	(MYLIB/TRNMACQRY3) */		03/31/96
	CMDEXC) PARM(&STRNG6 100)		03/31/96
9500 ENDDO	,		03/31/96
9600 ENDPGM			03/31/96

Figure 95. Program to Generate the Token-Ring LAN Performance Report

# B.1.3 Token-Ring LAN SAP Counter Query

~												
5716QU1 V3R6M0	950929	IB	M Query/400	SYST	EM05	10/28/96	1	17:29:5	5	Page	1	
Query			SAPQRY									
Library			MYLIB									
Query text .												
Query CCSID .			37									
	e id											
Query country												
			Hexadecim	1								
Processing op			nexadeeim									
			Vac (dafa	.1+)								
			Yes (defa									
			No (defau	t)								
	titution warn											
	ng for all co	ompares .	Yes									
Special condi												
	ords selected	l by defau	lt ***									
Selected files												
ID File	Libr	rary	Member	Record Format								
T01 QAPMSA	P QPFR	RDATA	0961981803	QAPMSAPR								
Ordering of sel												
Field		Ascending	/ Break Fiel	1								
Name			g Level Text									
INTNUM		beseenann		val Number								
IOPRN				Resource Name								
SCLND				Description								
SCIRCV				Received								
SCIXMT				ransmitted								
SCBRCV				tes Received								
SCBXMT				tes Transmitt	ed							
Report column f												
Summary funct	ions: 1-Tota	al, 2-Aver	age, 3-Minimum	4-Maximum, 5	-Coun	t		Overri	des			
Field	Summary	Column			Dec	Null		Dec	Numeric			
Name			Column Headin	ıs Len			Len		Editing			
INTNUM		0	Interval	5					-			
			Number	0	0							
Report column f	ormatting and	summary		inued)								
					C			0				
Field			age, 3-Minimum	, 4-Maximum, 5				Overri				
	Summary	Column				Null			Numeric			
Name	Functions		Column Headin		Pos	Cap	Len	Pos	Editing			
IOPRN		2	IOP	10								
			Resource									
			Name									
SCLND		2	Line	10								
			Description									
SCIRCV	1	2	UIs	11	0							
			Received									
SCIXMT	1	2	UIS	11	0							
			Transmitted		-							
SCBRCV	1	2	UI Bytes	11	0							
	-	-	Received									
SCBXMT	1	2	UI Bytes	11	0							
000/111	-	-	Transmitted	11	0							
Report breaks			ansmitteu									
	Suppose 7	a a k										
		reak										
•	Summaries Te	:XI										
	No											
Selected output												
			Database									
			Summary o	11 y								
Line wrapping			No									
Database file c	utput											
File			SAPTOTFIL									
Member			*FILE									
			Replace m	ember								
For a new fil												
			*LIBCRTAU	r								
Text about												
the file			Total num	oer of UT from	ac n^	r I TND						
	ion			ser of of fram	cs he	LIND						
Output file rec			~~									
	length		83									
Field list:												
Field	-		Null Data Ty		Text							
BREAKLVL	1	1	Charact			LEVEL						
OVERFLOW	2	1	Charact		OVERF	LOW FLAG						
INTNUM	3	5 0	Zoned d	ecimal	Inter	val Numb	er					
IOPRN	8	10	Charact	er	IOP R	esource	Name	e				
SCLND		10	Charact			Descript						
SCIRCV01		14 0	Zoned d		SCIRC		TAL					
SCIXMT01		14 0	Zoned d		SCIXM		TAL					
SCBRCV01		14 0	Zoned d		SCBRC		TAL					
SCBXMT01		14 0	Zoned d		SCBXM		TAL					
3CDAMIU1	/U * * * * *			PRINT			1 ML					
		END	DF QUER	PRINI								

Figure 96. Token-Ring LAN SAP Counter Report Query

#### **B.1.4 Token-Ring LAN Performance Indicators Query**

```
5716QU1 V3R6M0 950929
                          IBM Query/400
                                              SYSTEM05 10/28/96 17:30:21
                                                                          Page 1
 Collating sequence . . . . . . . . . Hexadecimal Processing options
  Special conditions
   *** All records selected by default ***
Selected files

ID File Library

TOI QAPMECL QPFRDAT/

TO2 QAPMCIOP QPFRDAT/

TO3 SAPTOTFILE MYLIB
                  Librarv
                                       Record Format
                             Member
                            Q961981803 QAPMECLR
Q961981803 QAPMCIOR
                  QPFRDATA
                 QPFRDATA
                             *FIRST
                                       SAPTOTFILE
Join tests
               ..... Matched records
Test Field
EQ TO2.IOPRN
 Type of join . .
            Test
 Field
 T01.IOPRN
 T01.INTNUM
                             T02.INTNUM
               EQ
 T01.INTNUM
                EQ
                             T03.INTNUM
 T01.ELLND
               EQ
                             T03.SCLND
```

Figure 97. Token-Ring LAN Performance Indicator Report Query, Part 1

Describe describe	IBM Query	/400	10/28/96	5 17:30:21	Page	2	
Result fields		Column Hoodi		D			
Name LINEUTIL	Expression	Column Heading 1) Line	Len	nec			
LINEUTIL	<pre>((elict+elicr+scbrcv01+scbxmt0 *8*100)/(ellsp*T01.intsec)</pre>	1) Line Utilization (%)					
Result fields	(continued)	( */					
Name	Expression	Column Heading	Len	Dec			
IOPUTIL	(TO2.intsec-(ciidlc*ciidlt)/	IOP					
	100000000)/T02.intsec*100	Utilization (%)	т				
TOTALFRAME	emftr+emfrv+0.001+	Total frames					
	scixmt01+scircv01	transmitted & received					
MAC ERRO1	emine+embre+emafe+emabt+emlst+						
MAC_ERROT	emrxc+emfce+emfqe+emtke+emdbe+ emdpe						
TOTMAC ERR	mac err01+emanr+emfnc+emtse	Total MAC errors					
	+emuap+emumf+emsft+emtbc+emioa						
	emfdc+emsin						
MACERRRATE	(TOTMAC_err/totalframe)*100	MAC					
		errors					
		(%)					
LOCNRDY	(elrft*100)/(elift+0.001)	Local Not					
		Ready (%)					
LOCSEQERR	(elrjft*100)/(elift+0.001)	Local Seq					
		Error					
		(%)					
RMTNRDY	(elrfr*100)/(elift+0.001)	Remote					
		Not Ready					
DMTSFOEDD	(a] ====================================	(%) Remote Seg					
RMTSEQERR	(elrjfr*100)/(elift+0.001)	Remote Seq Error					
		(%)					
TIMEOUT	(elt1t*100)/(emftr+0.001)	T1 timer					
		time-out					
		rate(%)					
	elected fields						
Field Name	Sort Ascending/ Brea Priority Descending Leve	k Field					
Name TO1.IOPRN	Priority Descending Leve	IOP Resource Name					
T01.ELLND	10 A 1	Line Description					
IOPUTIL	· · · ·						
LINEUTIL							
LOCNRDY							
LOCSEQERR							
RMTNRDY							
RMTSEQERR							
TIMEOUT MACERRRATE							
MUERKKAIE							

1

Figure 98. Token-Ring LAN Performance Indicator Report Query, Part 2

				IBM Query/400		1	0/28/9	96 1	7:30:	21	Page	3	
		ormatting a											
	funct			erage, 3-Minimum, 4-	Maximum, 5-				0verr				
Field		Summary	Column				Null			Numeric			
Name		Function		g Column Headings		Pos	Cap	Len	Pos	Editing			
T01.IOPF	RN		0	IOP	10								
				Resource									
				Name									
T01.ELLM	ND		1		10								
				Line									
			-	Description									
IOPUTIL		2 4	1	IOP	28	2		4	1				
				Utilization									
		24	1	(%) Line	22	2		4	1				
LINEUTII	_	24	1	Utilization	22	2		4	1				
				(%)									
LOCNRDY		24	1	Local Not	14	3		4	1				
LUCINKUT		2 4	1	Ready	14	3		4	1				
				(%)									
LOCSEQEF	ac	24	1	Local Seq	14	3		4	1				
LOCOLQLI	AIX .	2 4	1	Error	14	5		4	1				
				(%)									
RMTNRDY		24	1	Remote	14	3		4	1				
			-	Not Ready		0			-				
				(%)									
RMTSEQEF	RR	24	1	Remote Seq	14	3		4	1				
				Error									
				(%)									
TIMEOUT		2 4	1	T1 timer	14	3		4	1				
				time-out									
				rate(%)									
MACERRR	ATE	2 4	1	MAC	31	3		4	1				
				Errors									
				(%)									
Report bre													
Break 1			Break										
		Summaries											
				or all Token-ring LA	Vs								
				or : &tOl.ellnd									
		attributes											
				Printer									
				Summary only									
Line wra	apping			NO									
Printer Ou	utput												
		•		*PRINT									
Report s				• • • FRINI									
				66 (default)									
		line											
				60 (default)									
				Single space									
		ion		÷ 1									
ut													

Figure 99. Token-Ring LAN Performance Indicators Report Query, Part 3

		I	BM Query/400	10/28/96 17:30:21	Page 4	
Printer Spooled (	Dutput	-				
			(Defaults to value	in print file, QPQUPRFIL)		
				in print file, QPQUPRFIL)		
Copies						
Hold			(Defaults to value	in print file, QPQUPRFIL)		
Cover Page						
Print cover pag	je		Yes			
Cover page ti						
Token-Ring	LAN Perfo	rmance Rep	ort Query			
Page headings and	d footings					
Print standard	page head	ing	Yes			
Page heading						
Token-Ring	LAN Perfo	rmance				
Page footing						
Database file out	tput					
			TRNPFRIND			
Library						
Member						
			Replace member			
For a new file:			.,			
Authority			*LIBCRTAUT			
Text about						
the file .						
Print definitio						
Output file recor Output record 1 Field list:	length .					
Field	Begin	Len Dec	Null Data Type	Text		
BREAKLVL	1	1	Character	BREAK LEVEL		
OVERFLOW	2	1	Character	OVERFLOW FLAG		
IOPRN	3	10	Character	IOP Resource Name		
ELLND	13	10	Character	Line Description		
IOPUTIL02	23	4 1	Zoned decimal	IOPUTIL AVG		
IOPUTIL04	27	4 1	Zoned decimal	IOPUTIL MAX		
LINEUTIL02	31	4 1	Zoned decimal	LINEUTIL AVG		
LINEUTIL04	35	4 1	Zoned decimal	LINEUTIL MAX		
LOCNRDY02	39	4 1	Zoned decimal	LOCNRDY AVG		
LOCNRDY04	43	4 1	Zoned decimal	LOCNRDY MAX		
LOCSEQER02	47	4 1	Zoned decimal	LOCSEQERR AVG		
LOCSEQER04	51	4 1	Zoned decimal	LOCSEQERR MAX		
RMTNRDY02	55	4 1	Zoned decimal	RMTNRDY AVG		
RMTNRDY04	59	4 1	Zoned decimal	RMTNRDY MAX		
RMTSEQER02	63	4 1	Zoned decimal	RMTSEQERR AVG		
RMTSEQER04	67	4 1	Zoned decimal	RMTSEQERR MAX		
TIMEOUT02	71	4 1	Zoned decimal	TIMEOUT AVG		
TIMEOUT04	75	4 1	Zoned decimal	TIMEOUT MAX		
MACERRRA02	79	4 1	Zoned decimal	MACERRRATE AVG		
	83	4 1	Zoned decimal	MACERRRATE MAX N T * * * * *		
MACERRRA04						
MACERRRA04 *	* * * * *	END	OF QUERY PRI	N I * * * * *		
MACERRRA04 *	* * * * *	END	OF QUERY PRI	N I * * * * *		
MACERRRAO4 *	* * * * *	END	OF QUERY PRI	N   * * * * *		

Figure 100. Token-Ring LAN Performance Indicators Report Query, Part 4

# B.1.5 Token-Ring LAN MAC Error Counters Query

5716QU1 V3R6MO 9	50929	IBM	Query/4	400 SYSTEM05 10/28/96 17:30:34 Page 1
Query				
Library			. MYLI	IB
Query text			Toke	en-ring LAN MAC Error Counters Report 1
Query CCSID			. 3	37
Query language i	d			
Query country id				
Collating sequen	ce	• • • • •	. Hexa	adecimal
Processing optio				
Use rounding				
Ignore decimal				
Ignore substit				
Use collating		ompares	. No	
Special conditio				
*** All record	s selecte	d by default	***	
Selected files				
ID File			ember	Record Format
TO1 TRNPFRIND			FIRST	TRNPFRIND
TO2 QAPMECL Join tests	QPF	RDATA C	9619818	803 QAPMECLR
Type of join .			Mate	ahad macanda
Field	 Test		Field	ched records
T01.FLIND	EO		T02.ELL	
			102.111	
Ordering of select	Sort	Ascending/	Broak	Field
Field		Descending		
Field		Descending	1	IOP Resource Name
Name T02.IOPRN		Descending A		IOP Resource Name
Field Name T02.IOPRN	Priority	-	1	
Field Name TO2.IOPRN TO1.ELLND	Priority	-	1 1	IOP Resource Name Line Description
Field Name TO2.IOPRN TO1.ELLND TO1.MACERRRAO2	Priority	-	1 1 1	IOP Resource Name Line Description MACERRRATE AVG
Field Name T02.IOPRN T01.ELLND T01.MACERRRA02 T01.MACERRRA04	Priority	-	1 1 1	IOP Resource Name Line Description MACERRATE AVG MACERRATE MAX

Figure 101. Token-Ring LAN MAC Error Counters Report 1 Query, Part 1

Summary functions:     1-Total, 2-Average, 3-Minimum, 4-Maximum, 5-Count     Overrides       Field     Summary     Column     Dec     Null     Dec     Numeric       Name     Functions     Spacing     Column Headings     Len     Pos     Cap     Len     Pos     Editing       T02.10PRN     0     IOP     10     Resource     Name     Name     Field     Sumary       T01.ELLND     1     Ine     Dec     Name     Name     Field     Sumary       T01.MACERRRA02     1     MAC     4     1     Field     Sumary       T01.MACERRRA02     1     MAC     4     1     Field     Sumary       T01.MACERRRA04     1     MAC     4     1     Field     Sumary       T02.EMINE     1     MAC     4     1     Field     Sumary       T02.EMINE     1     MAC     4     1     Field     Sumary       T02.EMINE     1     MAC     5     0     Field       T02.EMINE     1     1     Sumary     Sumary     Field       T02.EMINE     1     1     Sumary     Sumary     Field       T02.EMINE     1     1     Sumary     Field       T				1 Query/4	00		1	0/28/9	96	17:30:	34	Page	2		
Name         Priority         Descending         Levil         Text           T02_EMART         KAbort Delimiter         Kabort Delimiter         Kabort Delimiter           T02_EMRXC         Frame Copiel Error         RX Congestion         Frame Copiel Error           eport column formatting and summary         Frame Copiel Error         Overrides           summary         for toritons:         1-totil,         2-Average, 3-Minitum, 4-Maximum, 5-Court         Overrides           Field         Summary         Foundinos         Column Headings         Len Pos         Cap Len Pos         Editing           T02_10PRN         Functions         Spacing         Column Headings         Len Pos         Cap Len Pos         Editing           T02_10PRN         O         ToP         ToP         ToP         Err         ToP         ToP </th <th></th>															
T02_EMART       Abort Delimiter         T02_EMART       Last Frame         T02_EMIST       Last Frame Copied Error         eport column formatting and summary functions:       RX Congestion         Summary functions:       1-Total, 2-Average, 3-Mintuum, 4-Maximum, 5-Count       Overrides         Field       Summary functions       Social       Column Hadings       Len       Pos       Cap       Len       Pos       Editing         Name       Functions       Spacing       Column Hadings       Len       Pos       Cap       Len       Pos       Editing         T01_LELLND       0       IoP       10       Resource       Name															
T02. PMAC       Lost Frame RX Congestion         T02. PMAC       RX Congestion         Summary functions:       1-Total, 2-Average, 3-Minimum, 4-Maximum, 5-Court       Overrides         Summary functions:       1-Total, 2-Average, 3-Minimum, 4-Maximum, 5-Court       Overrides         Field       Summary       Colum Headings       Lost       Numeric         Name       Functions       Spacing       Colum Headings       Lost       Numeric         T02.10PRN       0       10       Dec       Numeric         T01.LLLN       1       Internation       Dec       Edition         T01.MACERRRA02       1       Erro       Internation       Internation         T02.EMINE       1       Internation       Internation       I		Priority	Descending	Level											
T02.EMRC       RX Congestion Frame Copied Error         eport column formating and summary functions: 1-10-1 - 2-223 - 3-Minimum, 4-Maximum, 5-Curr       0 errides         Field       Summary functions: 1-10-1 - 2-223 - 3-Minimum, 4-Maximum, 5-Curr       0 errides         Field       Summary functions: 1-10-1 - 2-223 - 3-Minimum, 4-Maximum, 5-Curr       0 errides         Field       Summary functions: 1-10-1 - 2-223 - 3-Minimum, 4-Maximum, 5-Curr       0 errides         T02.IOPRN       O       100       Dec Null       0 errides         T02.IOPRN       0       100       Name       Editing         T01.ELLND       1       Name       Name       Editing         T01.MACERRRA02       1       Incernal       Incernal       Incernal         T01.MACERRRA04       1       Incernal       Incernal       Incernal         T02.EMINE       1       MAC       4       1       Incernal         T02.EMINE       1       Incernal       Incernal       Incernal       Incernal         T02.EMINE       1       Incernal       Incernal       Incernal       Incernal       Incernal         T02.EMINE       1       Incernal       Incernal       Incernal       Incernal       Incernal         T02.EMINE       1 <td></td> <td></td> <td></td> <td></td> <td></td> <td>iter</td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td>						iter									
T02.EMFCE       Frame copied Error         Summary functions: 1-rotal - 2-ver-say: 3-Minimum, 4-Maximum, 5 - Cou       Overrides         Field       Summary       Colum Headings       Len       No         Name       Functions       Spacing       Colum Headings       Len       No       Dec       Numeric         Name       Functions       Spacing       Colum Headings       Len       Pos       Editing         T02.10PRN       0       10P       Len       Pos       Editing         T02.10PRN       1       Eessurce       Name       Editing         T01.ELLND       1       Dec       Len       Pos       Editing         T01.MACERRA02       1       Hea       Pos       Editing       Editing         T01.MACERRA02       1       Hea       Pos       Editing       Editing         T02.EMINE       1       MAC       4       1       Error       <															
					-										
Summary functions:     1-Total, 2-Average, 3-Minimum, 4-Maximum, 5-Count     Overrides       Field     Summary     Column     Dec     Null     Dec     Numeric       Name     Functions     Spacing     Column Headings     Len     Pos     Cap     Len     Pos     Editing       T02.10PRN     0     IOP     10     Resource     Name     Name     Field     Sumary       T01.ELLND     1     Ine     Dec     Name     Name     Field     Sumary       T01.MACERRRA02     1     MAC     4     1     Field     Sumary       T01.MACERRRA02     1     MAC     4     1     Field     Sumary       T01.MACERRRA04     1     MAC     4     1     Field     Sumary       T02.EMINE     1     MAC     4     1     Field     Sumary       T02.EMINE     1     MAC     4     1     Field     Sumary       T02.EMINE     1     MAC     5     0     Field       T02.EMINE     1     1     Sumary     Sumary     Field       T02.EMINE     1     1     Sumary     Sumary     Field       T02.EMINE     1     1     Sumary     Field       T	T02.EMFCE				Frame Copie	d Error									
Summary functions:     1-Total, 2-Average, 3-Minimum, 4-Maximum, 5-Count     Overrides       Field     Summary     Column     Dec     Null     Dec       Name     Functions     Spacing     Column Headings     Len     Pos     Cap     Len     Pos     Editing       T02.IOPRN     0     IOP     10     Resource     Name     Name     For Cap     Len     Pos     Editing       T01.ELLND     1     Ion     Ion     Ion     Ion     Ion     Ion       T01.MACEERRA02     1     MAC     4     1     Ion     Ion       T01.MACEERRA02     1     MAC     4     1     Ion     Ion       T02.EMINE     1     MAC     4     1     Ion       T02.EMINE     1     MAC     4     1       T02.EMINE     1     MAC     4     1       Ionerra     Ion     Ion     Ion     Ion       T02.EMINE     1     MAC     5     0       Ionerra     Ion     Ion     Ion     Ion       T02.EMINE     1     Ion     Ion     Ion       Ion     Ion     5     0       Ion     Ion     Ion     Ion       Ion	eport column for	matting an	d summarv '	functions											
Name T02.10PRNFunctions 9 SpacingSpacing 10PColum Headings 10PLen PosCap Len PosEditingT02.10PRN010P1010101010T01.ELLND11010101010T01.ELLND11010101010T01.ELLND11010101010T01.ELLND11010101010T01.MACERRA0211010101010T01.MACERRA0411010101010T01.MACERRA0411010101010T02.EMINE11010101010T02.EMINE11010101010T02.EMARE11010101010T02.EMARE11010101010T02.EMARE11010101010T02.EMARE11010101010T02.EMARE11010101010T02.EMARE11010101010T02.EMARE11010101010T02.EMARE11010101010T02.EMARE11010101010T02.EMARE110101010 <td< td=""><td></td><td></td><td></td><td></td><td>nimum, 4-Max</td><td>imum, 5-</td><td>Count</td><td></td><td></td><td>0verr</td><td>ides</td><td></td><td></td><td></td><td></td></td<>					nimum, 4-Max	imum, 5-	Count			0verr	ides				
NameFunctionsSpacingColumn HeadingsLenPosCapLenPosEditingT02.10PRN010P10101010101010T01.ELLND1110101010101010T01.ELLND1110101010101010T01.MACERRA021110101010101010T01.MACERRA041110101010101010T01.MACERRA041110101010101010T01.MACERRA04111010101010101010T02.EMINE11101010101010101010T02.EMINE11101010101010101010T02.EMINE1110 <t< td=""><td>Field</td><td>Summary</td><td>Column</td><td></td><td></td><td></td><td>Dec</td><td>Null</td><td></td><td>Dec</td><td>Numeric</td><td></td><td></td><td></td><td></td></t<>	Field	Summary	Column				Dec	Null		Dec	Numeric				
T02.IOPRN     0     IOP     10       Name     Name       T01.ELLND     1     10       Line     Desc       Desc     Desc       T01.MACERRRA02     1     MAC       Avg%     1       T01.MACERRRA04     1       MAC     4       Pr     Avg%       T02.EMINE     1       MAC     4       Image: State	Name		Spacing	Column H	eadings	Len	Pos	Cap	Len	Pos	Editing				
Name       T01.ELLND     1     10       T01.FLLND     1     10       Desc     Desc     10       D01.MACERRRA02     1     MAC     4     1       T01.MACERRRA04     1     10     Avg%       T01.MACERRRA04     1     MAC     4     1       T01.MACERRRA04     1     MAC     5     0       T02.EMINE     1     1     5     0       T02.EMARE     1     1     5     0       T02.EMAFE     1     5     0 <td< td=""><td></td><td></td><td></td><td></td><td>5</td><td></td><td></td><td></td><td></td><td></td><td>5</td><td></td><td></td><td></td><td></td></td<>					5						5				
Name       T01.ELLND     1     10       T01.FLLND     1     10       Desc     Desc     10       D01.MACERRRA02     1     MAC     4     1       T01.MACERRRA04     1     10     Avg%       T01.MACERRRA04     1     MAC     4     1       T01.MACERRRA04     1     MAC     5     0       T02.EMINE     1     1     5     0       T02.EMARE     1     1     5     0       T02.EMAFE     1     5     0 <td< td=""><td></td><td></td><td></td><td>Resource</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></td<>				Resource											
T01.ELLND     1     10       Line     Desc       Desc     Desc       T01.MACERRA02     1       MAC     4       I     MAC       Avg%       T01.MACERRA04     1       MAC     4       Err       MAC     4       I     MAC       Avg%       T01.MACERRA04     1       MAC     4       Err       Max%       T02.EMINE     1       I     1       Burst       Burst       Burst       Burst       Burst       Burst       Desc       T02.EMAFE       I       I       I       I       Desc       Burst       Bu															
T01.MACERRA02     I       T01.MACERRA04     I       Err     Avg%       T01.MACERRA04     I       T01.MACERRA04     I       T02.MACERRA04     I       T01.MACERRA04     I       T02.MACERRA04     I       T02.EMINE     I <tr< td=""><td>T01.ELLND</td><td></td><td>1</td><td></td><td></td><td>10</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr<>	T01.ELLND		1			10									
T01.MACERRRA02     I       T01.MACERRRA04     I       Err     Avg%       T01.MACERRRA04     I       T02.EMINE     I       I     I       Max%     I       T02.EMINE     I       I     I				Line											
T01.MACERRA04 - Frame															
$ \begin{array}{cccccccccccccccccccccccccccccccccccc$	T01.MACERRRA02		1	MAC		4	1								
T01.MACERRRA04     1       T02.EMINE     1       T02.EMINE     1       T02.EMBRE     1       T02.EMAFE     5       T02.EMAFE<				Err											
$ \begin{array}{ccccccccccccc} & & & & & & & & & & & & &$				Avg%											
$\begin{array}{cccccccccccccccccccccccccccccccccccc$	T01.MACERRRA04		1	MAC		4	1								
T02.EMINE     1     1     5     0       T02.EMBRE     1     Errors     0       T02.EMAFE     1     5     0       T02.EMAFE     1     6     0       T02.EMAFE     1     6     0       T02.EMAFE     1     5     0       T02.EMAFE     1     6     0       T02.EMAFE     1     7     0       T02.EMAFE     1     7     0       T02.EMAFE     1     1     1       T02.EMAFE     1     1     1       T02.EMAFE     1     1     5     0       T02.EMAFE     1     1     5     0				Err											
Internal Errors T02.EMBRE I I I I I I I I I I I I I I I I I I I				Max%											
$\begin{array}{cccccccccccccccccccccccccccccccccccc$	T02.EMINE	1	1			5	0								
T02.EMBRE       1       1       5       0         Burst       Error       6         T02.EMAFE       1       1       5       0         T02.EMAFE       1       1       6       6         T02.EMAFT       1       1       6       6         T02.EMABT       1       1       5       0         T02.EMABT       1       1       5       0         T02.EMAST       1       1       5       0         T02.EMRXC       1       1       5       0         T02.EMRXC       1       1       5       0				Internal											
Burst       T02.EMAFE     1       T02.EMAFE     1       ARI/FCI       Error       T02.EMABT       1       Abort       Delimiter       T02.EMLST       1       1       Cost       Frame       T02.EMRXC       1       1       RX       Congestion				Errors											
$\begin{array}{cccccccccccccccccccccccccccccccccccc$	T02.EMBRE	1	1			5	0								
T02.EMAFE       1       1       5       0         ARI/FCI       Error       From       1         T02.EMABT       1       1       5       0         T02.EMLST       1       1       5       0         T02.EMLST       1       1       5       0         T02.EMLST       1       1       5       0         T02.EMRXC       1       1       5       0         T02.EMRXC       1       1       5       0         RX       Congestion       5       0				Burst											
ARI/FCI Error T02.EMABT 1 1 5 0 Abort Delimiter T02.EMLST 1 1 6 5 0 Lost Frame T02.EMRXC 1 1 1 5 0 RX Congestion				Error											
$\begin{array}{cccccccccccccccccccccccccccccccccccc$	T02.EMAFE	1	1			5	0								
T02.EMABT     1     1     5     0       Abort     Delimiter     0       T02.EMLST     1     1     5     0       Erame     Frame     0       T02.EMRXC     1     1     5     0       RX     Congestion     5     0															
Abort Delimiter T02.EMLST 1 1 5 0 Lost Frame T02.EMRXC 1 1 1 5 0 RX Congestion				Error											
Delimiter           T02.EMLST         1         1         5         0           Frame           T02.EMRXC         1         1         5         0           RX         Congestion         5         0	T02.EMABT	1	1			5	0								
T02.EMLST 1 1 5 0 Lost Frame T02.EMRXC 1 1 5 0 RX Congestion				Abort											
Lost Frame T02.EMRXC 1 1 5 0 RX Congestion				Delimite	r										
Frame T02.EMRXC 1 1 5 0 RX Congestion	T02.EMLST	1	1			5	0								
T02.EMRXC 1 1 5 0 RX Congestion				Lost											
RX Congestion				Frame											
Congestion	T02.EMRXC	1	1			5	0								
				RX											
T02.EMFCE 1 1 Frame 5 0				Congesti	on										
	T02.EMFCE	1	1	Frame		5	0								
Copied				Copied											
Error				Error											

Figure 102. Token-Ring LAN MAC Error Counters Report 1 Query, Part 2

			IBM Query/400	10/28/96	17:30:34	Page	3	
Report br	eaks							
Break	New Suppress	Break						
Level	Page Summaries	Text						
0	No No	Summary	for all Token-Ring LANs					
1	No No	Summary	for Token-ring: &TO1.ELLND					
Selected	output attribut	es						
Output	type		Printer					
Form of	output		Summary only					
Line wr	apping		No					
Printer (	utput							
Printer	device		*PRINT					
Report	size							
Lengt	h		66 (default)					
			6 (default)					
			60 (default)					
			Single space					
	efinition		No					
	pooled Output							
			(Defaults to value					
•			(Defaults to value	in print file, QPQl	JPRFIL)			
			(Defaults to value	in print file, QPQU	JPRFIL)			
Cover Pag			N					
	over page		res					
	page title Error Counters	Descut						
MAU	Error counters	Report						
-								

Figure 103. Token-Ring LAN MAC Error Counters Report 1 Query, Part 3

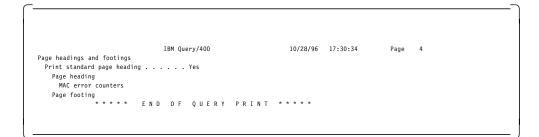


Figure 104. Token-Ring LAN MAC Error Counters Report 1 Query, Part 4

716QU1 V3R6M0 950929			SYSTEM05 10/28/96	17:30:34	Page 1	
Query						
Query text			MAC Error Counters Ren	ort 2		
Query CCSID		37	ine Error counters kep	010 2		
Query language id						
Query country id						
Collating sequence	He	adecimal				
Processing options						
Use rounding						
Ignore decimal data erron						
Ignore substitution warn						
Use collating for all co	mpares No					
Special conditions						
*** All records selected	by default ***					
Selected files						
ID File Libra	arv Member	Record	Format			
TO1 TRNPERIND MYLTE		TRNPFR				
TO2 OAPMECL OPFRI	DATA 0961981					
Join tests						
Type of join	Ma	ched records				
Field Test	Field					
T01.ELLND EQ	T02.EL	LND				
Ordering of selected fields						
	Ascending/ Break					
Name Priority I	Descending Level					
T02.IOPRN	1	IOP Resourc	e Name			
T01.ELLND 10	A 1	Line Descri	ption			
T01.MACERRRA02	1	MACERRRATE				
	1	MACERRRATE				
T01.MACERRRA04		Frequency E	rror			
T02.EMFQE						
		Token Error	ry Access Bus Error			

Figure 105. Token-Ring LAN MAC Error Counters Report 2 Query, Part 1

		10	1 Query/4	50		1	0/20/3	. 00	17:30:	54	Page	2		
rdering of sele	cted fields	(continue)	i)											
Field	Sort	Ascending,												
Name	Priority	Descending	g Level	Text										
T02.EMDPE				Direct Memo	ry Acces	s Par	ity En	ror						
T02.EMANR				Address Not	Recogni	zed								
T02.EMFNC				Frame Not C	opied Er	ror								
T02.EMTSE				Transmit St	rip Erro	r								
eport column fo	rmatting and	d summary '	functions											
Summary functi	ons: 1-Tota	al, 2-Avera	age, 3-Mi	nimum, 4-Max	imum, 5-	Count			0verr	ides				
Field	Summary	Column	5.7				Null			Numeric				
Name		Spacing	Column He	eadings	Len	Pos	Cap	Len	Pos	Editing				
T02.IOPRN		0	IOP	5	10					5				
			Resource											
			Name											
T01.ELLND		1			10									
			Line											
			Desc											
T01.MACERRRA02		1	MAC		4	1								
10111110211111102			Err			-								
			Avg%											
T01.MACERRRA04		1	MAC		4	1								
TOTTMACERRRAD		1	Err		4	1								
			Max%											
T02.EMFQE	1	1	nax.		5	0								
102.EMPQE	1	1	Frequenc		5	0								
			Error	y										
T02.EMTKE	1	1	ELLOI.		5	0								
IUZ.EMIKE	1	1	Token		5	0								
			Error											
T02.EMDBE	1	1	Direct		5	0								
IU2.EMDBE	1	1			5	0								
			Memory A											
T00 50005			Bus Erro	r	-									
T02.EMDPE	1	1	Direct		5	0								
			Memory A											
			Parity E	rror										
T02.EMANR	1	1	Address		5	0								
			Not											
			Recogniz	ed										
T02.EMFNC	1	1	Frame		5	0								
			Not Copi	ed										
			Error											
T02.EMTSE	1	1	Transmit		5	0								
			Strip											
			Error											

Figure 106. Token-Ring LAN MAC Error Counters Report 2 Query, Part 2

				IBM Q	uery/400			1	0/28/96	17:30:34	Page	3	
Report b	reaks												
Break	New	Suppress	Break										
Leve1	Page	Summaries											
0	No	No	Summary										
1	No	No	Summary	for To	ken-ring	: &T01.E	ELLND						
		attribute											
Form o	f outpu	t			. Summar	y only							
Line w	rapping				. No								
rinter					+00707								
		e		• • •	. *PRINI								
Report					<i>cc</i> ( )								
						erauit)							
		1ine											
		ne											
		pacing											
		ion				space							
FIIIC	uernin				. NO								
rinter	Spooled	Output											
Spool	the out	put			. (Defau	lts to v	value in	print	file, QPQ	UPRFIL)			
Form t	уре				. (Defau	lts to v	value in	print :	file, QPQ	UPRFIL)			
Copies					. 1								
Hold					. (Defau	lts to	value in	print '	file, QPQ	UPRFIL)			
Cover Pa													
		age	• • • •	· · ·	. Yes								
	r page												
MA	C Error	Counters	кеport										

Figure 107. Token-Ring LAN MAC Error Counters Report 2 Query, Part 3

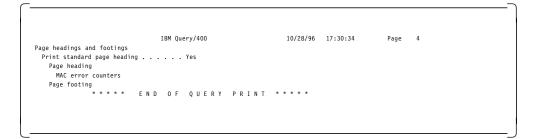


Figure 108. Token-Ring LAN MAC Error Counters Report 2 Query, Part 4

5716QU1 V3R6M0 950929	IBM	Query/40	0 SYSTEM05 10/28/96 17:30:34 Page 1
Query		. MYLIB	
			n-ring LAN MAC Error Counters Report 3
Query CCSID			
Query language id Query country id			
Collating sequence			
contacting sequence		. nexau	lee man
Processing options			
Use rounding		Yes (	(default)
Ignore decimal data e	rrors	. No (d	lefault)
Ignore substitution w	arnings	. Yes	
Use collating for all	compares	. No	
Special conditions			
*** All records selec	ted by default	***	
Selected files			
	5	lember FIRST	Record Format TRNPFRIND
		96198180	
Join tests		190190100	J WATHECER
Type of join		. Match	ed records
Field Test		Field	
T01.ELLND EQ		T02.ELLN	D
Ordering of selected fiel	ds		
Field Sort	Ascending/	Break	Field
Name Priorit	y Descending	Leve1	Text
T02.IOPRN		1	IOP Resource Name
T01.ELLND 10	Α		Line Description
T01.MACERRRA02			MACERRRATE AVG
T01.MACERRRA04		-	MACERRRATE MAX
T02.EMUAP			Unauthorized AP
T02.EMUMF			Unauthorized MF
TO2.EMONF TO2.EMSET			SOFR Error

Figure 109. Token-Ring LAN MAC Error Counters Report 3 Query, Part 1

			1 Query/4	00		1	0/28/9	96	17:30:	34	Page	2		
ordering of select														
Field		Ascending,												
Name	Priority	Descending	g Level											
T02.EMTBC				Transmit	Beacon									
T02.EMI0A				IOA Statu	s Overrun									
T02.EMFDC				Frames Di	scarded									
T02.EMSIN				Spurious	Interrupts									
Report column for														
Summary functio			age, 3-Mi	nimum, 4-M	aximum, 5-				Overr					
Field	Summary	Column					Null			Numeric				
Name	Functions	Spacing		eadings	Len	Pos	Cap	Len	Pos	Editing				
T02.IOPRN		0	IOP		10									
			Resource											
			Name											
T01.ELLND		1			10			8						
			Line											
			Desc											
T01.MACERRRA02		1	MAC		4	1								
			Err											
			Avg%											
T01.MACERRRA04		1	MAC		4	1								
			Err											
			Max%											
T02.EMUAP	1	1			5	0								
			Unauth											
			AP											
T02.EMUMF	1	1			5	0								
			Unauth											
			MF		_									
T02.EMSFT	1	1			5	0								
			SOFR											
			Error		_									
T02.EMTBC	1	1			5	0								
			Transmit											
			Beacon		_									
T02.EMIOA	1	1	IOA		5	0								
			Status											
T00 54500			Overrun											
T02.EMFDC	1	1	-		11	0								
			Frames											
T00 54078			Discarde	D										
T02.EMSIN	1	1			11	0								
			Spurious											
			Interrup	τs										

Figure 110. Token-Ring LAN MAC Error Counters Report 3 Query, Part 2

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				ΙBΜ	Query/400	10/28/96	17:30:34	Page	3
Report b									
Break			Break						
Level		Summaries							
0		No			all Token-Ring LANs				
1		No	-	for	Token-ring: &TO1.ELLND				
		attribute							
					Printer				
					Summary only				
Line w	rapping			• •	No				
Printer	Output								
Printe	r device	e			*PRINT				
Report	size								
Leng	th				66 (default)				
Widt	h				132				
Report	start 1	line			6 (default)				
Report	end lir	ne			60 (default)				
Report	line sp	bacing			Single space				
Print	definit	ion		•••	No				
Printer	Spooled	Output							
Spool	the outp	out			(Defaults to value in	print file, QPQI	JPRFIL)		
Form t	ype				(Defaults to value in	print file, QPQI	JPRFIL)		
Copies					1				
Hold				• •	(Defaults to value in	print file, QPQ	JPRFIL)		
Cover Pa	qe								
	•	age			Yes				
	r page 1	-							
		Counters	Report						

Figure 111. Token-Ring LAN MAC Error Counters Report 3 Query, Part 3

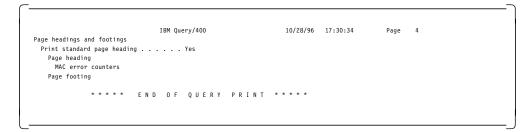


Figure 112. Token-Ring LAN MAC Error Counters Report 3 Query, Part 4

### B.1.6 Token-Ring LAN Overhead Query

	MO 950929 IBM Quei	ry/400	SYSTEM05 10/28/96	17:32:14	Page 1	
Query	· · · · · · · · · · · · · · · · · · ·	TRNUSAGE				
-						
			nead Query			
		37				
	ageid					
	the decimal separator characte	er for this query *	**			
	equence					
Processing						
	ing					
	cimal data errors !					
	bstitution warnings					
Use colla Special con	ting for all compares !	NO				
	ecords selected by default ***					
	condi senered by dendance					
Selected file	s					
ID File	Library Membe	er Record Fo	rmat			
TO1 QAPM	ECL QPFRDATA Q9619	981803 QAPMECLR				
Result fields						
Name	Expression	Column Headi	ng Len D	ec		
LINEUTIL	((elict+elicr)*8*100)/	Line				
	(ellsp*intsec)	Utilization				
TOTAL EDAME	emftr+emfrv+0.001	(%) Total frames				
TOTALI KARL	emitti (emitiv)0.001	transmitted a	e			
		received	•			
MAC ERRO1	emine+embre+emafe+emabt+emlst	t+ MAC errors1				
-	emrxc+emfce+emfqe+emtke+emdbe	2+				
	emdpe	T . 1				
TOTULO 500	<pre>mac_err01+emanr+emfnc+emtse +emuap+emumf+emsft+emtbc+emic</pre>	Total MAC er	rors			
TOTMAC_ERR	emfdc+emsin	Ja+				
TOTMAC_ERR		MAC	31	4		
TOTMAC_ERR MACERR	(TOTMAC_err/totalframe)*100	1110				
-		errors (%)				

Figure 113. Token-Ring LAN Overhead Query, Part 1

		IBM	Query/4	100	10/28/96	17:32:14	Page	2	
Result fields	(continued)								
Name	Expression			Column Heading	Len [	)ec			
RNR	(elrft+elrfr)	*100/totalfr	ame	Receive Not Ready Frames (%)	15	4			
REJ	(elrjft+elrjf	r)*100/total	frame	Reject Frames (%)	15	4			
FRREJ	(elfft+elffr)	*100/totalfr	ame	Frame-Rejects Frames (%)	15	4			
SABM	(elsft+elsfr)	*100/totalfr	ame	SABM Frames (%)	15	4			
DISCNT	(eldft+eldfr)	*100/totalfr	ame	Disconnect Frames (%)	15	4			
DISCNTMODE	(eldmt+eldmr)	*100/totalfr	ame	Disconnect Mode Frames (%)	15	4			
MAC	(emmft+emmfr)	*100/totalfr	ame	MAC Frames (%)	20	4			
ROUTE	(emrit+emrir)	*100/totalfr	ame	Routing Frames (%)	15	4			
Ordering of s	elected fields								
Field	Sort	Ascending/	Break	Field					
Name	Priority	Descending							
IOPRN			1	IOP Resource Name					
ELLND	10	A	1	Line Description					
INTNUM				Interval Number					
DTETIM LINEUTIL TOTALFRAME MACERR RNR				Interval Date and Tim	ie				
REJ									
FRREJ									
SABM									
DISCNT									
DISCNTMODE									
MAC									
ROUTE									

Figure 114. Token-Ring LAN Overhead Query, Part 2

Summary functions:1-10tal, 2-Average, 3-Minimum, 4-Maximum, 5-CourtOverridesFieldSummary ColumColum HeadingsLen Pos CapLen Pos Editing10PN0101010PN01010ResourceName110PN101010PN101010PN101010PN101010PN101010PN101010P10P1010P10P1010P10P1010P10P1010P10P1010P10P1010P10P1010P10P10 <trr></trr>	eport column form	atting and		M Query/400 functions			10/28/9	10 1	17:32:	14	Page	3		
Field Name Function Spacing 10PRNColum 					4-Maximum	5-Coun			Overr	ides				
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MACERR         iccived         iccived <thiccived< th="">         iccived         <th< td=""><td>TO THE TOTAL</td><td></td><td></td><td></td><td>-</td><td>0 0</td><td></td><td>1.</td><td></td><td></td><td></td><td></td><td></td><td></td></th<></thiccived<>	TO THE TOTAL				-	0 0		1.						
MAC errors     31     4     7     2       errors     (%)     15     4     5     2       RNA     1     Receive Not Ready Frames     15     4     5     2       REJ     1     Reject     15     4     5     2       FREJ     1     Reject     15     4     5     2       FREJ     1     Rady Frames     15     4     5     2       FREJ     1     Rady Frames     15     4     5     2       FREJ     1     Rady Frames     15     4     5     2       Frames     (%)     15     4     5     2       SABM     15     5     4     5     2       DISCNT     1     SABM     15     4     5     2       DISCNTMODE     1     Disconnect     15     4     5     2       MAC     1     Disconnect     15     4     5     2       MAC     1     Sisconnect     15     4     5     2       MAC     1     MAC     20     4     5     2       RUTE     MAC     20     4     5     2 <td></td>														
RNR       1       Receive Not Ready Frames       15       4       5       2         REJ       1       Reject       15       4       5       2         FREJ       1       Reject       15       4       5       2         FRREJ       1       Frame-Rejects       15       4       5       2         SABM       1       Frames       5       2       2         V       Frames       7       5       2         V       Frames       7       2       7         V       SABM       15       4       5       2         DISCNT       1       Disconnect       15       4       5       2         MAC       1       Disconnect       15       4       5       2         MAC       1       MAC       2       2       2         R0UTE       1       MAC       2       2       2         R0UTE       1       Routing       15       4       5       2         R0UTE       1       Routing       15       4       5       2         R0UTE       1       Routing       15 <td< td=""><td>MACERR</td><td></td><td>1</td><td></td><td>3</td><td>1 4</td><td></td><td>7</td><td>2</td><td></td><td></td><td></td><td></td><td></td></td<>	MACERR		1		3	1 4		7	2					
$\begin{array}{cccccccccccccccccccccccccccccccccccc$	ThroEntr							,	-					
RNR I Receive Not 15 4 5 2 Redy Frames (3) REJ 1 Reject 15 4 5 2 Frames (3) FREJ 1 Rejects 15 4 5 2 Frames (3) SABM 15 4 5 2 Frames (3) SABM 15 4 5 2 Frames (3) DISCNT 1 DISCONDECT 15 4 5 2 Tomes (3) DISCNTMODE 1 DISCONDECT 15 4 5 2 (3) DISCNTMODE 1 DISCONDECT 15 4 5 2 (3) DISCNTMODE 1 DISCONDECT 15 4 5 2 (3) ROUTE 1 RACE 10 10 10 10 10 10 10 10 10 10 10 10 10														
REJ 18 Reject 15 4 5 2 FAREJ 1 Reject 15 4 5 2 FAREJ 1 Frame-Rejects 15 4 5 2 FAREJ 1 Frame-Rejects 15 4 5 2 FAREJ 1 Frame-Rejects 15 4 5 2 FAREJ 1 SABM 15 4 5 2 TO SCONCE 15 4 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5	RNR		1		1	5 4		5	2					
(%)         (%)           REJ         1         Reject         15         4         5         2           FRREJ         1         Frame-Rejects         15         4         5         2           FRREJ         1         Frame-Rejects         15         4         5         2           SABM         1         Frame-Rejects         15         4         5         2           SABM         1         SABM         15         4         5         2           DISCNT         1         State         7         2         2           MAC         15         4         5         2           MAC         15         4         5         2           R0UTE         1         NaC         2         2           R0UTE         1         NaC         2         2					-			0	-					
REJ     1     Reject     15     4     5     2       Frames     (%)     5     2       FREJ     1     Frame-Rejects     15     4     5     2       SABM     15     SABM     15     4     5     2       SABM     15     SABM     15     4     5     2       DISCNT     1     Disconnect     15     4     5     2       DISCNTMODE     1     Disconnect     15     4     5     2       MAC     1     Disconnect     15     4     5     2       R0UTE     1     Disconnect     15     4     5     2														
FRREJ 1 Frames (%) FRREJ 1 Frame-Rejects 15 4 5 2 Frames (%) SABM 15 4 5 2 Frames (%) DISCNT 1 DISCONNECT 15 4 5 2 (%) DISCNTMODE 1 DISCONNECT 15 4 5 2 (%) MAC Frames (%) MAC 1 MOC Frames (%) MAC 1 MOC Frames (%) ROUTE 1 ROUTING 15 4 5 2 (%) ROUTE 1 ROUTING 15 4 5 2	RFJ		1		1	5 4		5	2					
$ \begin{array}{cccccccccccccccccccccccccccccccccccc$			-		-			-	-					
FRREJ     1     Frame-Rejects Frames     15     4     5     2       SABM     1     SABM     15     4     5     2       SABM     1     SABM     15     4     5     2       DISCNT     1     Sisconnect     15     4     5     2       DISCNTMODE     1     Disconnect     15     4     5     2       MAC     1     MAC     15     4     5     2       ROUTE     1     Routing     15     4     5     2														
$ \begin{array}{cccccccccccccccccccccccccccccccccccc$	ERRE.1		1		1	5 4		5	2					
SABM         (%)           SABM         15         4         5         2           Frames         (%)         5         2           DISCNT         1         Disconnect         15         4         5         2           DISCNTMODE         1         Disconnect         15         4         5         2           MAC         (%)         15         4         5         2           Frames         (%)         2         2         2           MAC         (%)         2         2         2           ROUTE         1         Routing         15         4         5         2           ROUTE         1         Routing         15         4         5         2	T MALEO				-			0	-					
SABM     1     SABM     15     4     5     2       Frames     (%)     15     4     5     2       DISCNT     1     Disconnect     15     4     5     2       DISCNTMODE     1     Disconnect     15     4     5     2       MAC     1     MAC     20     4     5     2       ROUTE     1     Routing     15     4     5     2														
Frames       (%)       DISCNT     1     Disconnect     15     4     5     2       Image: Connect in the second	SARM		1		1	5 4		5	2					
(%)           DISCNT         1         Disconnect         15         4         5         2           Frames         (%)         (%)         5         2           DISCNTMODE         1         Disconnect         15         4         5         2           MAC         1         MAC         20         4         5         2           ROUTE         1         Mac         20         4         5         2           Frames         (%)         7         7         7         7	0/10/1				-			0	-					
DISCNT 1 Disconnect 15 4 5 2 Frames (%) DISCNTMODE 1 Disconnect 15 4 5 2 Mode Frames (%) MAC 1 MAC 20 4 5 2 Frames (%) ROUTE 1 Routing 15 4 5 2														
Frames     (%)       DISCNTMODE     1     Disconnect     15     4     5     2       Mode     Frames     (%)     -     -     -       MAC     1     MAC     20     4     5     2       Frames     -     -     -     -     -       ROUTE     1     Routing     15     4     5     2	DISCNT		1		1	5 4		5	2					
(私) DISCNTMODE 1 Disconnect 15 4 5 2 Mode Frames (私) MAC 1 MAC 20 4 5 2 Frames (私) ROUTE 1 Routing 15 4 5 2	515500				-			0	-					
DISCNTMODE 1 Disconnect 15 4 5 2 Mode Frames (%) MAC 1 MAC 20 4 5 2 Frames (%) ROUTE 1 Routing 15 4 5 2 Frames														
Mode Frames (%)           MAC         1         MAC         20         4         5         2           Frames (%)         -	DISCNTMODE		1		1	5 4		5	2					
(%) MAC 1 MAC 20 4 5 2 Frames (%) ROUTE 1 Routing 15 4 5 2 Frames	DISCHINGE				-			0	-					
MAC 1 MAC 20 4 5 2 Frames (%) ROUTE 1 Routing 15 4 5 2 Frames														
Frames (%) ROUTE 1 Routing 15 4 5 2 Frames	MAC		1		2	0 4		5	2					
(%) ROUTE 1 Routing 15 4 5 2 Frames			-		-			5	-					
ROUTE 1 Routing 15 4 5 2 Frames														
Frames	ROUTE		1		1	5 /		5	2					
			-		-			5	-					
(*)														
				x - /										

Figure 115. Token-Ring LAN Overhead Query, Part 3

				IBM Query/400		10/28/96	17:32:14	Page	4	
Report b	reaks									
Break	New	Suppress	Break							
Leve1	Page	Summaries	Text							
0	No	No	Summary	for all Token-rin	ng LANs					
1	No	No	Summary	for : &t01.ellnd						
Selected	outpu	t attribute	es .							
Output	type			Database	file					
Form o	f outp	ut		Detail						
Line w	rapping			No						
Printer	Output									
Printe	r devi	ce		*PRINT						
Report	size									
Leng	th .			66 (defa	ault)					
Widt	h			132						
Report	start	line		6 (defa	ault)					
				60 (defa						
				Single sp	pace					
Print	defini	tion		No						
Printer	Spoole	d Output								
Spool	the ou	tput		(Default:	s to value i	n print file, QP	QUPRFIL)			
Form t	ype .			(Default	s to value i	n print file, QP	QUPRFIL)			
Copies				1						
Hold				(Default	s to value i	n print file, QP	QUPRFIL)			
Cover Pa	ge									
Print	cover	page		No						
	r page									
		ng LAN Over								

Figure 116. Token-Ring LAN Overhead Query, Part 4

File	5
Page heading         Token-Ring LAN Overhead Report         Page footing         Database file output         File	
Token-Ring LAN Overhead Report         Page footing         Database file output         File	
Page footing           Database file output           File	
Database file output         File	
File	
Library	
Member	
Data in file	
For a new file: Authority *LIBCRTAUT Text about the file	
Authority	
Text about the filePrint definitionNo Output file record format Output record length 210 Field list: Field Begin Len Dec Null Data Type Text IOPRN 1 10 Character IOP Resource Name ELLND 11 10 Character Line Description INTNUM 21 5 0 Packed decimal Interval Number DTETIM 24 12 Character Interval Number DTETIM 24 12 Character Interval Number DTETIM 24 12 Character Interval Packed and Time LINEUTIL 36 18 2 Packed decimal (elict+elicr)*8*100)/ (ellsp TOTALFRAME 46 16 3 Packed decimal emftr+emfrv+0.001 MACERR 55 31 4 Zoned decimal (elift+elifr)*100/totalframe REJ 101 15 4 Zoned decimal (elift+eliffr)*100/totalframe	
the filePrint definitionNo Output file record format Output record length210 Field list: Field Begin Len Dec Null Data Type Text IOPRN 1 10 Character IOP Resource Name ELLND 11 10 Character Line Description INTNUM 21 5 0 Packed decimal Interval Number DTETIM 24 12 Character Interval Number IDTETIM 24 12 Character Interval Date and Time LINEUTIL 36 18 2 Packed decimal ((elict+elicr)*8*100)/ (ellsp) TOTALFRAME 46 16 3 Packed decimal ((elict+elicr)*8100)/ (ellsp) MACERR 55 31 4 Zoned decimal (elift+elfr)*100/totalframe REJ 101 15 4 Zoned decimal (elift+elifr)*100/totalframe FRREJ 116 15 4 Zoned decimal (elift+elifr)*100/totalframe	
Print definition	
Output file record length	
Output record length	
IOPRN         1         10         Character         IOP Resource Name           ELLND         11         10         Character         Line Description           INTNUM         21         5         0         Packed decimal         Interval Number           DTETIM         24         12         Character         Interval Date and Time           LINEUTIL         36         18         2         Packed decimal         ((elict+elicr)*8*100)/ (ellsp)           TOTALFRAME         46         16         3         Packed decimal         (mTr+emfr+0.001)           MACERR         55         31         4         Zoned decimal         (TOTMAC_err/totalframe)*100           RNR         86         15         4         Zoned decimal         (elrft+elrfr)*100/totalframe           REJ         101         15         4         Zoned decimal         (elrft+elffr)*100/totalframe	
ELLND         11         10         Character         Line Description           INTNUM         21         5         0         Packed decimal         Interval Number           DTETIM         24         12         Character         Interval Date and Time           LINEUTIL         36         18         2         Packed decimal         (elit+elicr)*8*100) / (ellsp'           TOTALFRAME         46         16         3         Packed decimal         emftr+emfrv+0.001           MACERR         55         31         4         Zoned decimal         (lotft+elifr)*100/totalframe)*100           RNR         86         15         4         Zoned decimal         (elrft+elrfr)*100/totalframe           REJ         101         15         4         Zoned decimal         (elrft+elffr)*100/totalframe           FRREJ         116         15         4         Zoned decimal         (elfft+elffr)*100/totalframe	
INTNUM         21         5         0         Packed decimal         Interval Number           DTETIM         24         12         Character         Interval Date and Time           LINEUTIL         36         18         2         Packed decimal         ((elict+elicr)*8*100)/ (ellsp)           TOTALFRAME         46         16         3         Packed decimal         emftr+emfrv+0.001           MACERR         55         31         4         Zoned decimal         (TOTMAC_err/totalframe)*100           RNR         86         15         4         Zoned decimal         (elrft+elrf)*100/totalframe           REJ         101         15         4         Zoned decimal         (elrft+elrfr)*100/totalframe           FRREJ         116         15         4         Zoned decimal         (elrft+elffr)*100/totalframe	
DTETIM         24         12         Character         Interval Date and Time           LINEUTIL         36         18         2         Packed decimal         ((elict+elicr)*8*100)/         (ellsp)           TOTALFRAME         46         16         3         Packed decimal         emftr+emfry+0.001         (ellsp)           MACERR         55         31         4         Zoned decimal         (TOTMAC_err/totalframe)*100           RNR         86         15         4         Zoned decimal         (elrft+elrfr)*100/totalframe           REJ         101         15         4         Zoned decimal         (elrft+elfrfr)*100/totalframe           FRREJ         116         15         4         Zoned decimal         (elrft+elfrfr)*100/totalframe	
LINEUTIL         36         18         2         Packed decimal         ((elict+elicr)*8*100)/         (ellsp)           TOTALFRAME         46         16         3         Packed decimal         emftr+emfrv+0.001           MACERR         55         31         4         Zoned decimal         (TOTMAC_err/totalframe)*100           RNR         86         15         4         Zoned decimal         (elrft+elrfr)*100/totalframe           REJ         101         15         4         Zoned decimal         (elrft+elrfr)*100/totalframe           FRREJ         116         15         4         Zoned decimal         (elrft+elffr)*100/totalframe	
TOTALFRAME         46         16         3         Packed decimal         emftr+emfrv+0.001           MACERR         55         31         4         Zoned decimal         (TOTMAC_err/totalframe)*100           RNR         86         15         4         Zoned decimal         (elrft+elrfr)*100/totalframe)           REJ         101         15         4         Zoned decimal         (elrft+elrfr)*100/totalframe)           FRREJ         116         15         4         Zoned decimal         (elrft+elrffr)*100/totalframe)	p*intsec)
RNR 86 15 4 Zoned decimal (elrft+elrfr)*100/totalframe REJ 101 15 4 Zoned decimal (elrjft+elrjfr)*100/totalframe FRREJ 116 15 4 Zoned decimal (elfft+elffr)*100/totalframe	,
RNR 86 15 4 Zoned decimal (elrft+elrfr)*100/totalframe REJ 101 15 4 Zoned decimal (elrjft+elrjfr)*100/totalframe FRREJ 116 15 4 Zoned decimal (elfft+elffr)*100/totalframe	
FRREJ 116 15 4 Zoned decimal (elfft+elffr)*100/totalframe	
SABM 131 15 4 Zoned decimal (elsft+elsfr)*100/totalframe	
DISCNT 146 15 4 Zoned decimal (eldft+eldfr)*100/totalframe	
DISCNTMODE 161 15 4 Zoned decimal (eldmt+eldmr)*100/totalframe	
MAC 176 20 4 Zoned decimal (emmft+emmfr)*100/totalframe	
ROUTE 196 15 4 Zoned decimal (emrit+emrir)*100/totalframe	
* * * * * END OF QUERY PRINT * * * * *	

Figure 117. Token-Ring LAN Overhead Query, Part 5

#### **B.2 Ethernet LAN Query**

Two queries are provided in this section:

1. ELANQRY

This query prints the main performance indicators that are often bottlenecks in an Ethernet LAN. Use the result of this query to compare with the threshold values of these indicators that has already been discussed in Chapter 6, "Communications I/O Processor (IOP)" on page 89 to obtain an evaluation of performance on your LAN. This query provides information on the following areas:

- · Line utilization
- · IOP utilization
- · Overrun indicators
  - Local Not Ready
  - Local Sequence Error
  - Remote Not Ready
  - Remote Sequence Error
- T1 Timers time-outs
- · MAC errors rate
- Retransmission rate

The query definition is found in Section B.2.4, "Ethernet LAN Performance Indicator Report Query" on page 263.

2. ETHMACQRYx (x = 1,2 and 3 representing Reports 1,2 and 3 respectively)

This query prints three reports showing all of the MAC error counters in the Ethernet performance data file. A high value in any of these counters should be investigated. The query definition is found in Section B.2.5, "Ethernet LAN MAC Error Counters Query" on page 267.

Run the queries in sequence starting from query ETHQRY followed by the queries, ETHMACQRYx. A CL program has been provided for you to execute this automatically. This is listed in Figure 120 on page 261. This program first generates the Ethernet LAN Performance Indicators Report and prints the detailed MAC Error Counters Report if the average MAC error rate exceeds 1% of the total frames transmitted and received.

The output of both queries is shown in Figure 118 on page 260 and Figure 119 on page 260.

#### Notes:

- 1. The MAC Error % column of the Ethernet LAN Performance Indicators Report counts the number of MAC errors different from that of the Advisor in the Performance Tools/400. These are due to two reasons:
  - Certain fields have been excluded from the total MAC error counts in the query definition because they represent more statistical counters rather than error counters. These fields are:

**ETMM1R** More than 1 retry to transmit

**ETM1R** Exactly 1 retry to transmit

**ETMDCN** Deferred conditions due to a busy channel.

- The MAC error % calculation shown in the Advisor tends to cap the maximum percentage displayed at 100%. The query, ETHQRY, provides the actual results of the MAC error % calculation based on the formula defined in the query definition.
- 2. The report shows MAC error % of up to 10 significant places. A overflow of the figure is shown on the report as '+++++++++'. This situation is unlikely to happen. If it does, consider modifying the field definition of the query, ETHQRY. Erase the length definition of the MAC Error % field, MACERRRATE, for both the result field definition and the report column formatting field definition. This allows Query/400 to decide on the length of the result field. Then run the query from the start again.
- 3. Take note of the Congestion statistics that are listed in the Ethernet MAC Error Counters report in the following columns:
  - More than 16 retries that count the number of frames unsuccessfully transmitted due to excessive retries.
  - Receive overruns due to receiver being unable to accept incoming frames.
  - More than one retry to transmit.
  - Exactly one retry to transmit.
  - Deferred conditions represent the number of times the adapter deferred transmission due to a busy channel.

This should provide you with useful statistics about your Ethernet LAN congestion.

### **B.2.1 Sample Report Output**

10/28/96	16:57:31			Ethern	et LAN P	erforman	ce Indica	tors Report		PAGE 1	
IOP		IOP	Line	Local	Local	Remote	Remote	T1-timer	Retrans	MAC	
Resource	Line	Util	Util	Not Rdy	Seq Err	Not Rdy	Seq Err	time-out	Rate	Error	
Name	Desc	(%)	(%)	(%)	(%)	(%)	(%)	rate		(%)	
CC03	ETHLINE1										
	Summ	nary for	Ether	net LAN:	ETHLINE	1					
	AVG	6.8	.0	.0	.0	.0	.0	.2	.0	214.4	
	MAX	8.2	.0	.0	1.1	.0	.0	.9	.0	431.7	
	Summ	nary for	all E	thernet	LANs						
	AVG	6.8	.0	.0	.0	.0	.0	.2	.0	214.4	
	MAX	8.2	.0	.0	1.1	.0	.0	.9	.0	431.7	

Figure 118. Sample Ethernet LAN Performance Indicators Report

10/28/96	16:57:32		Etherr	net LAN MAC Er	ror Counter	s Report 3			PAGE 1
IOP		MAC	MAC			Signal	More Than	Exactly	
Resource	Line	Err	Err	Transmit	Babble	Quality	1 Retry to	1 Retry to	Deferred
Name	Desc	Avg%	Max%	Underflow	Errors	Error	Transmit	Transmit	Conditions
CC03	ETHLINE1	214.4	431.7						
			Summary	/ for Ethernet	ETHLINE1				
			TOTAL	0	0	0	307	286	957
			Summary	/ for all Ethe	rnet LANs				
			TOTAL	0	0	0	307	286	957

Figure 119. Sample Ethernet LAN MAC Error Counters Report

# B.2.2 CL Program to Execute the Ethernet LAN Queries

738PW1 V2R2MO 920615 SEU SOURCE LISTING	09/17/93 15:34:45	PAGE
763PW1 V3R1M0 940909 SEU SOURCE LISTING	03/31/96 11:30:22	PAGE
OURCE FILE MYLIB/QCLSRC		
IEMBER ELANQRY		
EQNBR*+ 1+ 2+ 3+ 4+ 5+ 6		
100 /***********************************		03/29/96
200 /*	*/	03/29/96
400 /* PROGRAM NAME : ELANQRY 500 /* PURPOSE : THIS CL PROGRAM WILL GENERATE AN ETHERNET	*/ */	03/29/96
		03/29/96
600 /* LAN PERFORMANCE INDICATORS REPORT SHOWING	*/ */	03/29/96
700 /* - IOP UTILIZATION	~/ */	03/29/96
800 /* - LINE UTILIZATION 900 /* - IOA OVERRUN STATISTICS	*/	03/29/96
····	*/	03/29/96
	*/	03/29/96
1100 /* - MAC ERRORS 1200 /* - RETRANSMISSION RATE	*/	03/29/96 03/29/96
1300 /*	*/	03/29/96
1500 /* IF THE MAC ERRORS ARE SIGNIFICANT, A REPOR	-	03/29/96
1600 /* SHOWING ALL THE MAC ERRORS WILL BE GENERAT		03/29/96
1900 /*	*/	03/29/96
2000 /**********************************		03/29/96
2100 PGM PARM(&MEM)		03/29/96
2200 DCL &MEM *CHAR 10		03/29/96
2300 DCL &STRNG *CHAR 10 VALUE('RUNQRY QRY(MYLIB/SAPQRY) +		03/29/96
2400 QRYFILE((*RUNOPT/QAPMSAP MMMMMMMM	(MM) ) ( )	03/29/96
2500 DCL &STRNG2 *CHAR 200 VALUE('RUNQRY QRY(MYLIB/ETHQRY2) +		03/29/96
2600 QRYFILE((*RUNOPT/QAPMETH MMMMMMMM	MM) +	03/29/96
2700 (*RUNOPT/QAPMCIOP MMMMMMMMM) +		03/29/96
2800 (*RUNOPT/*SAME))')		03/29/96
2900 DCL &STRNG3 *CHAR 200 VALUE('RUNQRY QRY(MYLIB/ETHQRY2) +		03/29/96
3000 QRYFILE((*RUNOPT/QAPMETH MMMMMMMM	IMM) +	03/29/96
3100 (*RUNOPT/QAPMCIOP MMMMMMMMM) +		03/29/96
3200 (*RUNOPT/*SAME)) +		03/29/96
3300 OUTTYPE(*OUTFILE) OUTFILE(MYLIB/ETHPFRIND	J')	03/29/96
3400 DCL &STRNG4 *CHAR 100 VALUE('RUNQRY QRY(MYLIB/ETHMACQRY1) +		03/29/96
3500 QRYFILE((*RUNOPT/*SAME) +		03/29/96
3600 (*RUNOPT/QAPMETH MMMMMMMMMM))')		03/29/96
3700 DCL &STRNG5 *CHAR 100 VALUE('RUNQRY QRY(MYLIB/ETHMACQRY2) +		03/29/96
3800 QRYFILE((*RUNOPT/*SAME) +		03/29/96
3900 (*RUNOPT/QAPMETH MMMMMMMMM))')		03/29/96
4000 DCL &STRNG6 *CHAR 100 VALUE('RUNQRY QRY(MYLIB/ETHMACQRY3) +		03/29/96
4100 QRYFILE((*RUNOPT/*SAME) +		03/29/96
4200 (*RUNOPT/QAPMETH MMMMMMMMMM))')		03/29/96
4300 DCLF FILE(MYLIB/ETHPFRIND)		03/29/96
4500 /* PUT THE MEMBER NAME FROM THE PARAM */		03/29/96
4600 CHGVAR VAR(%SST(&STRNG 51 10)) VALUE(&MEM)		03/29/96
4800 /* RUNQRY QRY(MYLIB/SAPQRY) */		03/29/96
5000 CALL PGM(QCMDEXC) PARM(&STRNG 100)		03/29/96
5100 /* SETUP THE SECOND RUNQRY COMMAND STRING */		03/29/96
5300 CHGVAR VAR(%SST(&STRNG2 52 10)) VALUE(&MEM)		03/29/96
5500 /* SET 2ND MEMBER NAME FIELD */		03/29/96
5600 CHGVAR VAR(%SST(&STRNG2 82 10)) VALUE(&MEM)		03/29/96
5900 /* RUNQRY QRY(MYLIB/ETHQRY2) */		03/29/96
6000 CALL PGM(QCMDEXC) PARM(&STRNG2 200)		03/29/96
6100 DLTF FILE(MYLIB/ETHPFRIND)		03/29/96
6200 MONMSG MSGID(CPF2105)		03/29/96
6300 /* SET MEMBER NAME FIELDS */		03/29/96
6400 CHGVAR VAR(%SST(&STRNG3 52 10)) VALUE(&MEM)		03/29/96
6700 CHGVAR VAR(%SST(&STRNG3 82 10)) VALUE(&MEM)		03/29/96
6900 /* PUT THE OUTPUT IN THE FILE */	0 (571050	03/29/96
7000 /* RUNQRY QRY(MYLIB/ETHQRY) OUTTYPE(*OUTFILE) OUTFILE(MYLI	B/EIHPFR-	03/29/96
7100 IND) */		03/29/96
7200 CALL PGM(QCMDEXC) PARM(&STRNG3 200)		03/29/96
7300 START: RCVF		03/29/96
7500 MONMSG MSGID(CPF0864) EXEC(RETURN)		03/29/96
7600 IF COND(&MACERRRA02 *GT 0.01) THEN(DO)		03/29/96
7700 /* PUT THE MEMBER NAME FROM THE PARAM */		03/29/96
7800 CHGVAR VAR(%SST(&STRNG4 71 10)) VALUE(&MEM)		03/29/96
8100 /* RUNQRY QRY(MYLIB/ETHMACQRY1) */		03/29/96
8200 CALL PGM(QCMDEXC) PARM(&STRNG4 100)		03/29/96
8300 /* PUT THE MEMBER NAME FROM THE PARAM */		03/29/96
8400 CHGVAR VAR(%SST(&STRNG5 71 10)) VALUE(&MEM)		03/29/96
8700 /* RUNQRY QRY(MYLIB/ETHMACQRY2) */		03/29/96
8800 CALL PGM(QCMDEXC) PARM(&STRNG5 100)		03/29/96
8900 /* PUT THE MEMBER NAME FROM THE PARAM */		03/29/96
9000 CHGVAR VAR(%SST(&STRNG6 71 10)) VALUE(&MEM)		03/29/96
9300 /* RUNQRY QRY(MYLIB/ETHMACQRY3) */		03/29/96
9400 CALL PGM(QCMDEXC) PARM(&STRNG6 100)		03/29/96
9500 ENDDO		03/29/96
9600 ENDPGM		03/29/96

Figure 120. Program to Generate the Ethernet LAN Performance Report

# B.2.3 Ethernet LAN SAP Counter Query

-													 	-
5716QU1 V3R6M0			M Query/40		SYSTE	M05	10/28/9	5	17:29:	55	Page	1		
Query														
Query text .														
Query CCSID . Query language														
Query country														
Collating sequ				lecimal										
Processing opt														
			Yes	(default)										
	nal data erro													
Ignore subst	titution warr	ings	Yes											
	ng for all co	ompares .	Yes											
Special condi														
	ords selected	by defau	lt ***											
Selected files ID File	Liby		Member	Record										
TO1 QAPMSAI	Libr OPER	ary DATA	Q96198180											
Ordering of sele		DATA	Q30130100	G QAFIISAFI	ĸ									
Field		Ascending,	/ Break	Field										
Name	Priority													
INTNUM			1	Interval Num	ber									
IOPRN			1	IOP Resource	Name									
SCLND				Line Descrip	tion									
SCIRCV				UIs Received										
SCIXMT				UIs Transmit										
SCBRCV				UI Bytes Rec		. d								
SCBXMT Report column fo	ormatting and	SUmmany		UI Bytes Tra	nsmitte	ed.								
Summary functi				imum. 4-Mavi	mum 5-	Cour	t		Overr	ides				
Field	Summary	Column		, i iiuxii	, 5-		Null			Numeric				
Name	Functions		Column He	adings	Len			Len		Editing				
INTNUM		0	Interval		5	0								
			Number											
Report column fo	-	-												
Summary functi			age, 3-Min	iimum, 4-Maxir	mum, 5-				0verr					
Field Name	Summary Functions	Column Spacing	Column !!?	adings	Lor		Null Cap	Lor		Numeric Editing				
IOPRN	runctions	Spacing 2	IOP		Len 10	rUS	cap	ren	r U S	curcing				
201.001		-	Resource		10									
			Name											
SCLND		2	Line		10									
			Descripti	on										
SCIRCV	1	2	UIS		11	0								
SCIXMT	1	2	Received UIs		11	0								
SCINHI	1	2	Transmitt	he	11	0								
SCBRCV	1	2	UI Bytes	cu	11	0								
			Received											
SCBXMT	1	2	UI Bytes		11	0								
			Transmitt	ed										
Report breaks														
Break New S Level Page S		reak												
	Vo													
Selected output														
Output type .			Datab	ase file										
Form of output														
Line wrapping			No											
Database file ou														
File														
			MYLIE											
Member			*FILE											
Data in file For a new file			керla	ice member										
	••		*ITR/	RTAUT										
Text about														
			Total	number of U	I frame	es pe	r LIND							
Print definiti			No											
Output file reco														
Output record	length		83											
Field list: Field	Begin L	.en Dec	Null Dat	a Type	-	ext								
BREAKLVL	Begin L	.en Dec		a Type racter			LEVEL							
OVERFLOW	2	1		racter			LOW FLAG	3						
INTNUM	3	5 0		ed decimal			val Numi							
IOPRN	8	10	Cha	racter			esource		e					
SCLND		10		racter			Descrip							
SCIRCV01		14 0		ed decimal		CIRC		DTAL						
SCIXMT01		14 0		ed decimal		CIXM		DTAL						
SCBRCV01		14 0		ed decimal		CBRC		DTAL						
SCBXMT01	70 * * * * *	14 0 END (		ed decimal ERY PR:	S INT	* *	( ***	DTAL						
			vu		- 11 1									
						-							 	

Figure 121. Ethernet LAN SAP Counter Report Query

#### **B.2.4 Ethernet LAN Performance Indicator Report Query**

```
5716QU1 V3R6M0 950929
                                 IBM Query/400
                                                           SYSTEM05 10/28/96 17:31:34
                                                                                                Page
                                                                                                      1

      Query s.....
      LIMUNTZ

      Library ....
      MYLIB

      Query text .....
      Ethernet LAN Performance Indicators Report

      Query CCSID .....
      37

      Query language id .....
      90

 Collating sequence . . . . . . . . . Hexadecimal
 Processing options
   Selected files
 TO1 CT
                                                  Record Format
                      Librarv
                                    Member
       QAPMETH
                       QPFRDATA
                                     Q961981803
                                                  QAPMETHR
        OAPMCIOP
                       QPFRDATA
                                                  OAPMCIOR
 T02
                                    Q961981803
 T03
      SAPTOTFILE
                                     *FIRST
                                                  SAPTOTFILE
                      MYLIB
Join tests
                     .... Matched records
Fest Field
EQ TO2.IOPRN
 Type of join . .
                Test
 Field
 T01.IOPRN
                   EO
 T01.INTNUM
                                     T02.INTNUM
                   EQ
 T01.INTNUM
                    EQ
                                     T03.INTNUM
 T01.ETLLND
                   EQ
                                     T03.SCLND
Result fields
 Name
             Expression
                                               Column Heading
                                                                       Len Dec
 LINEUTIL ((etlict+etlicr+scbxmt01+
                                                  Line
                                                                        6 4
             scbrcv01)*8*100)/
                                               Utilization
             (etllsp*T01.intsec)
(T02.intsec-(ciidlc*ciidlt)/
                                               (%)
IOP
 IOPUTIL
                                                                         4 1
             100000000)/T02.intsec*100
                                               Utilization
```

Figure 122. Ethernet LAN Performance Indicators Report Query, Part 1

		IBM	Query/4	00	10/28/96	5 17:31:34	Page	2	
Result fields									
Name Total EDAME	Expression etltft+etltfr			Column Heading Total frames	Len	Dec			
TUTALFRAME				transmitted &					
	scixmt01+scir	·cv01+0.001							
MAC 50001	etmifm+etmcre			received MAC errors1					
MAC_ERR01	etmirm+etmcre etmowc+etmale		d.c.r	MAC errorsi					
	etmowc+etmare etmrbe+etmspi		ar+						
TOTMAC FRR	mac err01+etm		tmioul	Total MAC errors					
TOTMAC_ERK			LIIIIOVŦ	TOLAT MAC errors					
MACEDDDATE	etmtun+etmbbe (TOTMAC err/t		00	MAC	10	1			
MACERRRATE	(TOTMAC_err/t	.ocarrame) ~1	00	errors	10	1			
				(%)					
LOCNRDY	(etlrft*100)/	(o+1;f++0 00	1)	Local Not	4	1			
LOCINDI	(etilit 100)/	(etilitio.00	1)	Ready	4	1			
				(%)					
LOCSEQERR	(etlrjt*100)/	/(a+1;f++0 00	1)	Local Seq	4	1			
LUCSLQLKK	(ernjr 100)/	(etilitio.00	1)	Error	4	1			
				(%)					
RMTNRDY	(etlrfr*100)/	/(etlift+0_00	1)	Remote	4	1			
NTT NILD I	(cciiii 100)/	(201112-0.00	1)	Not Ready	-	1			
				(%)					
RMTSEQERR	(etlrjr*100)/	(etlift+0.00	1)	Remote Seq	4	1			
in ordering	(221131 200))	(	-)	Error		-			
				(%)					
TIMEOUT	(etlt1t*100)/	(et1tft+0.00	1)	T1 timer	4	1			
	(,,	(	-,	time-out					
				rate(%)					
RETRANS	etlfrt/t01.ir	ntsec		Retransmission	4	1			
				Rate					
Ordering of s	elected fields	5							
Field	Sort	Ascending/	Break	Field					
Name	Priority	Descending	Leve1	Text					
T01.IOPRN			1	IOP Resource Name					
T01.ETLLND	10	A	1	Line Description					
IOPUTIL									
LINEUTIL									
LOCNRDY									
LOCSEQERR									
RMTNRDY									
RMTSEQERR									
TIMEOUT									
RETRANS									
MACERRRATE									
TOTALFRAME									
MAC_ERR01									
TOTMAC_ERR									

Figure 123. Ethernet LAN Performance Indicators Report Query, Part 2

			M Query/400		1	0/28/9	6 1	17:31:	34	Page	3	
eport column f												
			age, 3-Minimum, 4-Ma	ximum, 5-				Overr				
Field	Summary	Column				Null			Numeric			
Name	Functions		Column Headings		Pos	Cap	Len	Pos	Editing			
T01.IOPRN		0	IOP	10								
			Resource									
			Name									
T01.ETLLND		1		10			8					
			Line									
			Desc									
IOPUTIL	2 4	1	IOP	4	1							
			Util									
LINEUTIL	24	1	(%) Line	6	4							
LINCOIIL	2 4	1	Util	0	4							
			(%)									
LOCNRDY	24	1	(*) Local	4	1							
LUCINDI	2 4	1	Not Rdy	4	1							
			(%)									
LOCSEQERR	2 4	1	Local	4	1							
		-	Seq Err		-							
			(%)									
RMTNRDY	2 4	1	Remote	4	1							
			Not Rdy									
			(%)									
RMTSEQERR	2 4	1	Remote	4	1							
			Seq Err									
			(%)									
TIMEOUT	2 4	1	Τ1	4	1							
			end									
			rate									
RETRANS	2 4	1	Retrans	4	1		10	1				
			Rate									
MACERRRATE	2 4	1	MAC	10	1		10	1				
			Error									
			(%)									
TOTALFRAME		2	Total frames	20	3							
			transmitted &									
			received									
MAC_ERR01		2	MAC errors1	14	0							
TOTMAC_ERR		2	Total MAC errors	20	0							

Figure 124. Ethernet LAN Performance Indicators Report Query, Part 3

			IBM Query/400	10/28/96	17:31:34	Page	4	
Report break	s							
Break New	Suppress	Break						
Level Pag	e Summaries	Text						
0 No	No	Summary	for all Ethernet LANs					
1 No	No	Summary	for Ethernet LAN: &T01.et1	lnd				
	put attribute							
Output type	· · · · · ·		Printer					
Form of ou	tput		Summary only					
Line wrapp	ing		No					
Printer Outp	ut							
Printer de	vice		*PRINT					
Report siz	e							
Length			66 (default)					
Width .			132					
	rt line							
			60 (default)					
Report line	e spacing		Single space					
Print defi	nition		No					
Printer Spoo	led Output							
Spool the	output		(Defaults to value	in print file, QPQ	UPRFIL)			
Form type			(Defaults to value	in print file, QPQ	UPRFIL)			
Copies .			1					
Hold			(Defaults to value	in print file, QPQ	UPRFIL)			
Cover Page								
Print cove	rpage		Yes					
Cover pa	ge title							
Ethern	et LAN Perfor	mance In	dicators Report Query					
Page heading	s and footing	IS						
Print stan	dard page hea	ding	Yes					
Page hea	ding							
	et LAN Perfor	mance In	dicators Report					
Etherne								

Figure 125. Ethernet LAN Performance Indicators Report Query, Part 4

			I	BM Quer	•y/400	10/28	/96	17:31:34	Page	5
Database file ou	tput									
File					ETHPFRIND					
Library										
Member				'	*FILE					
Data in file					Replace member					
For a new file										
Authority .				'	*LIBCRTAUT					
Text about										
the file										
Print definiti	on	• • •	•••	!	۱o					
Output file reco	ad format									
Output record					120					
Field list:	iengen .	• • •	• •	•••	120					
Field	Begin	Len	Dec	Null	Data Type	Text				
BREAKLVL	1	1			Character	BREAK LEVE	1			
OVERFLOW	2	1			Character	OVERFLOW F				
IOPRN	3	10			Character	IOP Resour		ame		
ETLLND	13	8			Character	Line Descr	iptic	on		
IOPUTIL02	21	4	1		Zoned decimal	IOPUTIL	AVG			
IOPUTIL04	25	4	1		Zoned decimal	IOPUTIL	MAX			
LINEUTIL02	29	6	4		Zoned decimal	LINEUTIL	AVG			
LINEUTIL04	35	6	4		Zoned decimal	LINEUTIL	MAX			
LOCNRDY02	41	4	1		Zoned decimal	LOCNRDY	AVG			
LOCNRDY04	45	4	1		Zoned decimal	LOCNRDY	MAX			
LOCSEQER02	49	4	1		Zoned decimal	LOCSEQERR	AVG			
LOCSEQER04	53	4	1		Zoned decimal	LOCSEQERR	MAX			
RMTNRDY02	57	4	1		Zoned decimal	RMTNRDY	AVG			
RMTNRDY04	61	4	1		Zoned decimal	RMTNRDY	MAX			
RMTSEQER02	65	4	1		Zoned decimal	RMTSEQERR				
RMTSEQER04	69	4	1		Zoned decimal	RMTSEQERR				
TIMEOUT02	73	4	1		Zoned decimal	TIMEOUT	AVG			
TIMEOUT04	77	4	1		Zoned decimal	TIMEOUT	MAX			
RETRANS02	81	10	1		Zoned decimal	RETRANS	AVG			
RETRANS04	91	10	1		Zoned decimal	RETRANS	MAX			
MACERRRA02	101	10	1		Zoned decimal	MACERRRATE				
MACERRRA04	111	10	1		Zoned decimal	MACERRRATE				
,	* * * * *	ΕI	ND	0 F	QUERY PRIN	T * * * *	×			

Figure 126. Ethernet LAN Performance Indicators Report Query, Part 5

6

# B.2.5 Ethernet LAN MAC Error Counters Query

Library . Query text	· · · · · ·		MYLI Ethe	MACQRY1
				57
				adecimal
Ignore dec Ignore sub	ng imal data stitution ing for al	 errors warnings 1 compares .	No ( Yes	
		cted by defau	1+ ***	
	.corus scre	cica by aciaa		
Selected files				
ID File		Library	Member	Record Format
T01 ETHPP	RIND	MYLIB	ETHPFRIN	ND ETHPFRIND
TO2 QAPME	TH	QPFRDATA	Q9619818	803 QAPMETHR
Join tests				
			Mato	ched records
Field	Tes		Field	
T01.ETLLND	EQ		T02.ETL	LLND
Ordering of se	elected fie	lds		
Field	Sort	Ascending,		
Name	Priori	ty Descending		
T01.IOPRN			1	IOP Resource Name
T01.ETLLND	10	A	1	Line Description
T01.MACERRRA			1	MACERRRATE AVG
T01.MACERRRA	.04		1	MACERRRATE MAX
T02.ETMIFM				Inbound Frames Missed
T02.ETMCRE				CRC Error
T02.ETMEXR				More Than 16 Retries
T02.ETMOWC				Out of Window Collisions
T02.ETMALE T02.ETMCRL				Alignment Error Carrier Loss
IUZ.EIMUKL				Carrier Loss

Figure 127. Ethernet LAN MAC Error Counters Report 1 Query, Part 1

port column for	matting and	lsummary	functions								
Summary functio	ns: 1-Tota	1 2-Aver	age, 3-Minimum, 4-Ma	ximum 5-	Count			Overn	ides		
Field	Summary	Column		, ,		Null			Numeric		
Name	Functions	Spacing	Column Headings	Len	Pos	Cap	Len	Pos	Editing		
T01.IOPRN		0	IOP Resource	10							
			Name								
T01.ETLLND		1	Hume	8							
		-	Line	-							
			Desc								
T01.MACERRRA02		1	MAC	10	1						
			Err								
			Avg%								
T01.MACERRRA04		1	MAC	10	1						
			Err								
			Max%								
T02.ETMIFM	1	1	Inbound	5	0						
			Frames Missed								
T02.ETMCRE	1		Missed	5	0						
IUZ.EIMCKE	1	1	CRC	5	0						
			Error								
T02.ETMEXR	1	1	21101	5	0						
10212111230		•	More Than	0	Ŭ						
			16 Retries								
T02.ETMOWC	1	1	Out of	5	0						
			Window								
			Collisions								
T02.ETMALE	1	1		5	0						
			Alignment								
			Error								
T02.ETMCRL	1	1		5	0						
			Carrier								
			Loss								

Figure 128. Ethernet LAN MAC Error Counters Report 1 Query, Part 2

```
IBM Query/400
                                                                            3/31/96 11:30:00
                                                                                                   Page 5
Selected output attributes
 Printer Output
  Printer device . . . . . . . . . . . *PRINT
  Report size

        Report size
        66 (default)

        Width
        132

        Report start line
        6 (default)

        Report and line
        6 (default)

        Report line spacing
        50 (default)

        Print definition
        No

Printer Spooled Output
 Cover Page
 Print cover page . . . . . . . . . . Yes
Cover page title
      Ethernet LAN MAC Error Counters Report 1
Page headings and footings
 Print standard page heading . . . . . Yes
   Page heading
      Ethernet LAN MAC Error Counters Report 1
   Page footing
              **** END OF QUERY PRINT ****
```

Figure 129. Ethernet LAN MAC Error Counters Report 1 Query, Part 3

	950929	IBM	Query/40	00 SYSTEM05 10/28/96 17:31:48 Page 1
Query			. ETHM	IACQRY2
Library			. MYLIE	В
Query text .			. Ethe	ernet LAN MAC Error Counters Report 2
Query CCSID .			. 37	7
Query language	eid			
Query country	id			
Collating sequ	uence		. Hexa	decimal
Processing opt	tions			
Use rounding	g		. Yes	(default)
Ignore decir	nal data err	ors	. No (	default)
Ignore subst	titution war	nings	. Yes	
Use collatir	ng for all c	ompares	. No	
Special condit	tions			
*** All reco	ords selecte	d by default	***	
Selected files				
ID File		5	ember	
TO1 ETHPFR			THPFRING	
TO2 QAPMETH	H OPF	RDATA C	96198180	03 QAPMETHR
	. q.,	NDATA 9	50150100	US QAFFELIIK
loin tests			50150100	us çarmellik
Join tests Type of join	×.	·		
	×.			
Type of join			. Matcl	hed records
Type of join Field			. Matcl Field	hed records
Type of join Field TO1.ETLLND Ordering of sele			. Matcl Field TO2.ETLI	hed records
Type of join Field TO1.ETLLND Ordering of sele Field	 Test EQ ected fields Sort	Ascending/	. Matcl Field TO2.ETLI Break	hed records LND Field
Type of join Field TO1.ETLLND Ordering of sele Field Name	 Test EQ ected fields Sort		. Matcl Field TO2.ETLI Break Level	hed records LND Field Text
Type of join Field TO1.ETLLND Ordering of sele Field Name TO1.IOPRN	 Test EQ ected fields Sort Priority	Ascending/ Descending	. Matcl Field TO2.ETLI Break Level 1	hed records LND Field Text IOP Resource Name
Type of join Field T01.ETLLND Drdering of sele Field Name T01.IOPRN T01.ETLLND	Test EQ ected fields Sort Priority 10	Ascending/	. Matcl Field TO2.ETLI Break Level 1 1	hed records LND Field Text JOP Resource Name Line Description
Type of join Field TO1.ETLLND Ordering of seld Field Name TO1.IOPRN TO1.ETLLND TO1.MACERRRA02	EQ Ected fields Sort Priority 10	Ascending/ Descending	Field Field TO2.ETLI Break Level 1 1 1	hed records LND Field Text IOP Resource Name Line Description MACERRATE AVG
Type of join Field T01.ETLLND Ordering of seld Field Name T01.IOPRN T01.ETLLND T01.MACERRRA02 T01.MACERRRA04	EQ Ected fields Sort Priority 10	Ascending/ Descending	. Matcl Field TO2.ETLI Break Level 1 1	hed records LND Field Text IOP Resource Name Line Description MACERRATE AVG
Type of join Field TOI.ETLLND Ordering of seld Field Name TOI.IOPRN TOI.ETLLND TOI.MACERRA02 TOI.MACERRA02 TOI.MACERRA04 TOI.MACERRA04	EQ Ected fields Sort Priority 10	Ascending/ Descending	Field Field TO2.ETLI Break Level 1 1 1	hed records LND Field Text IOP Resource Name Line Description MACERRATE AVG MACERRATE AVA Receive Buffer Errors
Type of join Field TO1.ETLLND Ordering of sele Field Name TO1.IOPRN TO1.ETLLND TO1.MACERRRA02 TO1.MACERRRA02 TO1.MACERRRA02 TO2.ETMBBE TO2.ETMBBE	EQ Ected fields Sort Priority 10	Ascending/ Descending	Field Field TO2.ETLI Break Level 1 1 1	hed records LND Field Text IOP Resource Name Line Description MACERRATE AVG MACERRATE MAX Receive Buffer Errors Spurious Interrupts
Type of join Field TO1.ETLLND Prdering of seld Field Name TO1.IOPRN TO1.HCERRRAOJ TO1.MACERRRAOJ TO1.MACERRRAOJ TO2.ETMSPI TO2.ETMSPI	EQ Ected fields Sort Priority 10	Ascending/ Descending	Field Field TO2.ETLI Break Level 1 1 1	hed records LND Field Text IOP Resource Name Line Description MACERRATE AVG MACERRATE MAX Receive Buffer Errors Spurious Interrupts Discarded Inbound Frames
Type of join Field TO1.ETLLND Ordering of sele Field Name TO1.IOPRN TO1.ETLLND TO1.MACERRRAO2 TO1.MACERRRAO2 TO2.ETMSPI TO2.ETMSPI TO2.ETMSPI TO2.ETMSPI	EQ Ected fields Sort Priority 10	Ascending/ Descending	Field Field TO2.ETLI Break Level 1 1 1	hed records LND Field Text IOP Resource Name Line Description MACERRATE AVG MACERRATE MAX Receive Buffer Errors Spurious Interrupts Discarded Inbound Frames Receive Overruns
Type of join Field TO1.ETLLND Prdering of seld Field Name TO1.IOPRN TO1.HCERRRAOJ TO1.MACERRRAOJ TO1.MACERRRAOJ TO2.ETMSPI TO2.ETMSPI	EQ Ected fields Sort Priority 10	Ascending/ Descending	Field Field TO2.ETLI Break Level 1 1 1	hed records LND Field Text IOP Resource Name Line Description MACERRATE AVG MACERRATE MAX Receive Buffer Errors Spurious Interrupts Discarded Inbound Frames

Figure 130. Ethernet LAN MAC Error Counters Report 2 Query, Part 1

r

		IB	M Query/400		1	0/28/9	96	17:31:	48	Page	2	
eport column for	matting and	summary	functions									
Summary functio	ns: 1-Tota	1, 2-Aver	age, 3-Minimum, 4-Ma	ximum, 5-	Count			0verr	ides			
Field Name	Summary Functions	Column Spacing	Column Headings	Len		Null Cap	Len		Numeric Editing			
T01.IOPRN		0	IOP Resource Name	10								
T01.ETLLND		1	Line Desc	8								
T01.MACERRRA02		1	MAC Err Avg%	10	1							
T01.MACERRRA04		1	MAC Err Max%	10	1							
T02.ETMRBE	1	1	Rec Buffer Errors	5	0							
T02.ETMSPI	1	1	Spurious Interrupts	5	0							
T02.ETMDIF	1	1	Discarded Inbound Frames	5	0							
T02.ETMROV	1	1	Receive Overruns	5	0							
T02.ETMMEE	1	1	Memory Error	5	0							
T02.ETMIOV	1	1	Interrupt Overrun	5	0							

Figure 131. Ethernet LAN MAC Error Counters Report 2 Query, Part 2

			IBM Query/400	10/28/96	17:31:48	Page	3
Report brea	ks						
Break Ne	w Suppress	Break					
Level Pa	ge Summaries	Text					
0 No	No	Summary	for all Ethernet LANs				
1 No	No	Summary	for Ethernet: &T01.ETLLND				
Selected ou	tput attribut	es					
Output ty	pe		Printer				
Form of o	utput		Summary only				
Line wrap	ping		No				
Printer Out	nut						
			*PRINT				
Report si	ze						
Length			66 (default)				
Width .			132				
Report st	art line		6 (default)				
Report en	d line		60 (default)				
Report li	ne spacing .		Single space				
Print def	inition		No				
Printer Spo	oled Output						
			(Defaults to value	in print file, QPQU	JPRFIL)		
			(Defaults to value				
Copies .			1				
Hold			(Defaults to value	in print file, QPQU	JPRFIL)		
Cover Page							
•	er page		Yes				
Cover p	age title						
Ether	net LAN MAC E	rror Count	ers Report 2				
Page headin	gs and footin	ıs					
÷	ndard page hea		Yes				
Page he		J					
-	net LAN MAC E	rror Count	ers Report 2				
Page fo	oting						
-	* * * *	* ENI	OF QUERY PRIM	IT * * * * *			

Figure 132. Ethernet LAN MAC Error Counters Report 2 Query, Part 3

```
5716QU1 V3R6M0 950929
                                  IBM Query/400
                                                                 SYSTEM05 10/28/96 17:31:48
                                                                                                    Page 1
 Processing options
   Use collating for all compares . . . No
 Special conditions
*** All records selected by default ***
Selected files
 TID File Library Member Record Format
TO1 ETHPFRIND MYLIB ETHPFRIND ETHPFRIND
TO2 QAPMETH QPFRDATA Q961981803 QAPMETHR
Join tests
 Ordering of selected fields
 Field Sort Ascending/ Break Field
              Priority Descending Level Text
 Name

        T01.10PRN
        1
        IOP Resource Name

        T01.ETLLND
        10
        A
        1
        Line Description

        T01.MACERRRA02
        1
        MACERRATE AVG
        MACERRATE AVG

        T01.MACERRRA04
        1
        MACERRATE MAX
        Transmit Underflow

        T02.ETMBBE
        Database
        Database
        Database

                                                  Transmit Underflow
  T02.ETMBBE
                                                  Babble Errors
                                                  Signal Quality Error
More Than 1 Retry to Transmit
  T02.FTMSOF
  T02.ETMM1R
  T02.ETM1R
                                                  Exactly 1 Retry to Transmit
  T02.ETMDCN
                                                  Deferred Conditions
```

Figure 133. Ethernet LAN MAC Error Counters Report 3 Query, Part 1

		11	3M Query/400		1	0/28/9	100	17:31:	40	Page	2	
port column fo	rmatting and	l summary	functions									
Summary functi	ons: 1-Tota	il, 2-Aver	rage, 3-Minimum, 4-Ma	ximum, 5-	Count			0verr	ides			
Field	Summary	Column				Null			Numeric			
Name	Functions	Spacing	Column Headings	Len	Pos	Cap	Len	Pos	Editing			
T01.IOPRN		0	IOP	10								
			Resource									
T01.ETLLND		1	Name	8								
			Line									
			Desc									
T01.MACERRRA02		1	MAC Err	10	1							
			Avg%									
T01.MACERRRA04		1	MAC	10	1							
			Err									
T00 574744			Max%	-								
T02.ETMTUN	1	1	Transmit	5	0							
			Underflow									
T02.ETMBBE	1	1		5	0							
			Babble									
T02.ETMSQE	1	1	Errors Signal	5	0							
102.010300	1	1	Quality	5	0							
			Error									
T02.ETMM1R	1	1	More Than	5	0							
			1 Retry to									
T02.ETM1R	1	1	Transmit Exactly	5	0							
102.1111	1	1	1 Retry to	5	0							
			Transmit									
T02.ETMDCN	1	1		5	0							
			Deferred									
			Conditions									

Figure 134. Ethernet LAN MAC Error Counters Report 3 Query, Part 2

				IBM Query/400	10/28/96	17:31:48	Page	3	
Report b	reaks								
Break	New	Suppress	Break						
Level	Page	Summaries	Text						
0	No	No	Summary	for all Ethernet LANs					
1	No	No	Summary	for Ethernet: &T01.ETLLN	D				
Selected	outpu	t attribute	s						
				Printer					
Form o	f outp	ut		Summary only					
Line w	rappin	9		No					
Printer	Output								
Printe	r devi	ce		*PRINT					
Report	size								
Leng	th .			66 (default)					
Widt	h			132					
				6 (default)					
				60 (default)					
				Single space					
Print	defini	tion		No					
Printer	Spoole	d Output							
Spool	the ou	tput		(Defaults to val	ue in print file, QPQ	UPRFIL)			
Form t	ype .			(Defaults to val	ue in print file, QPQ	UPRFIL)			
Copies				1					
Hold				(Defaults to val	ue in print file, QPQ	UPRFIL)			
Cover Pa	ge								
Print	cover	page		Yes					
		title							
Et	hernet	LAN MAC Er	ror Coun	ters Report 3					
Page hea	dings	and footing	s						
Print	standa	rd page hea	ding	Yes					
Page	headi	ng							
Et	hernet	LAN MAC Er	ror Coun	ters Report 3					
Page	footi	ng							
		ه به به به به	EN	D OF QUERY PR					

Figure 135. Ethernet LAN MAC Error Counters Report 3 Query, Part 3

## Appendix C. X.25 Queries

This appendix provides query definitions that can be used to examine X.25 environments. All of the queries use input from the OS/400 Performance Monitor and run with trace options. There are six queries defined:

- X25\_ALL
- X25\_HDLC
- X25\_PLC
- X25\_LLC
- X25\_IOP
- X25\_JOB

The X25\_ALL query is simple. It shows you all of the values in the QAPMX25 file. The only thing you have to define is the file name and member name that contains the performance data. The rest are defaults so it takes you only a few minutes to create the query.

The X25\_HDLC query shows you the most important performance values for the X25 environment on the HDLC level.

The X25\_PLC query shows you the most important performance values for the X25 environment on the PLC level.

The X25\_LLC query shows you the most important performance values for the X25 environment on the LLC level.

The X25\_IOP query shows you performance values of the IOP to which the line is connected.

The X25\_JOB query shows you performance values of the JOBS that are running on the X25 line.

# C.1 X25\_ALL

					X.25 performance fields	
	CCSID					
	language id				•	
	country id					
	ing sequence				decimal	
	sing options					
	rounding .					
	re decimal d				default)	
	re substitut					
	collating fo	r all c	compares .	Yes		
	l conditions All records	selecte	d by defau	1+ ***		
	the records	5010000	u by ucruu			
Selected	files					
	File		rary	Member	Record Format	
T01	QAPMX25	QPF	RDATA	X25B	QAPMX25R	
Ordering	of selected	fiolds				
ordering	or screeted	TICIUS				
Field	So		Ascending			
Name	Pr	iority	Descendin	g Level		
INTNUM					Interval Number	
DTETIM					Interval Date and Time	
INTSEC					Elapsed Interval Seconds	
IOPRN XITYPE					IOP Resource Name IOP Type	
XLLND					Line Description	
XLLSP					Line Speed	
XHBTRN					Bytes Transmitted	
XHBRCV					Bytes Received	
XHPRCL					Protocol	
XHFTRN					Frames Transmitted	
XHIFTR					I Frames Transmitted	
XHIFRT					I Frames Retransmitted	
XHFRT					Frames Retransmitted	
XHEFFR					Error Free Frames Received	
XHEFIR					Error Free I Frames Received	
XHFRIE					Frames Received in Error Invalid Frames Received	
XHIFR XHRRFT					RR Frames Transmitted	
XHRRFR					RR Frames Received	
XHRNRT					RNR Frames Transmitted	
XHRNRR					RNR Frames Received	
XHLNKR					Link Resets	
XLITR					IPDU Transmitted	
XLIRC					IPDU Received	
XLIRT					IPDU Retransmitted	
XLIRE					IPDU Received in Error	
XLLXTR					XID Transmitted	
XLXRC					XID Received	
XLTT					Tests Transmitted Tests Received	
XLTR XLLJT					LLC Rejects Transmitted	
XLLJR					LLC Rejects Received	
XLRLD					Received LLC PDU Discarded	
XLTO					Timeouts	
XLCED					Checksum Errors Detected	
XLSRA					Successful Recovery Attempts	
XLRA					Recovery Attempts	
XLRSI					Reset Indications	
XLCLS					Close Station	
XLRNR					LLC RNR Received	
XPTPT					Total Packets Transmitted	
XPTPR					Total Packets Received	
XPDPT					Data Packets Transmitted	
X PD PR X PR PT					Data Packets Received	
YERE					Reset Packets Transmitted	
XPROR					Reset Packets Received	

Figure 136. X25\_ALL Query, Part 1

Summary funct	ions: 1-Tota	1, 2-Aver	age, 3-Minimum, 4-Ma	ximum, 5-	Count			Overr	ides	
				, -						
Field Name	Summary	Column	Column Hondings	Lon		Null	Lon		Numeric	
INTNUM	Functions	0	Column Headings	5	Pos 0	cap	Len	PUS	Editing	
11111011		Ŭ	Interval		0					
			Number							
DTETIM		2	Interval	12						
			Date							
INTSEC			Time	-						
INISEC		2	Elapsed Interval	7	0					
			Seconds							
IOPRN		2	IOP	10						
			Resource							
V.T.V.D.C			Name							
XITYPE		2	IOP	4						
			Туре							
XLLND		2		10						
			Line							
			Description							
XLLSP		2	1 days	11	0					
			Line Speed							
XHBTRN		2	speed	11	0					
		-	Bytes		Ŭ					
			Transmitted							
XHBRCV		2		11	0					
			Bytes							
XHPRCL		2	Received	1						
AIII KCE		2	Protocol	1						
XHFTRN		2		11	0					
			Frames							
			Transmitted							
XHIFTR		2	I Frames	11	0					
			Transmitted							
XHIFRT		2	i anomi e e e e	11	0					
			I Frames							
			Retransmitted							
XHFRT		2	-	11	0					
			Frames Retransmitted							
XHEFFR		2	Error Free	11	0					
			Frames							
			Received							
XHEFIR		2	Error Free	11	0					
			I Frames Received							
XHFRIE		2	Received Frames	11	0					
		-	Received		Ŭ					
			in Error							
XHIFR		2	Invalid	11	0					
			Frames							
XHRRFT		2	Received RR	11	0					
AUMAN (		2	Frames	11	v					
			Transmitted							
XHRRFR		2	RR	11	0					
			Frames							
VUDNDT		2	Received		0					
XHRNRT		۷	RNR Frames	11	0					
			Transmitted							
XHRNRR		2	RNR	11	0					
			Frames							
VIII NIZE		0	Received		~					
XHLNKR		2	Link	11	0					
			Resets							
XLITR		2		11	0					
			IPDU							
			Transmitted							

Figure 137. X25\_ALL Query, Part 2

		IPDU				
	-	Received				
XLIRT	2	1000	11	0		
		IPDU				
VITOC	2	Retransmitted IPDU	11	0		
XLIRE	2	Received	11	0		
		in Error				
XLLXTR	2	IN Error	11	0		
ALLAIN	2	XID	11	0		
		Transmitted				
XLXRC	2	i i di sin i ceca	11	0		
		XID				
		Received				
XLTT	2		11	0		
		Tests				
		Transmitted				
XLTR	2		11	0		
		Tests				
		Received				
XLLJT	2	LLC	11	0		
		Rejects				
		Transmitted				
XLLJR	2	LLC	11	0		
		Rejects				
VIDID	0	Received Received		0		
XLRLD	2	LLC PDU	11	0		
		Discarded				
XLT0	2	DISCAFUEU	11	0		
XLIO	2	Timeouts	11	0		
XLCED	2	Checksum	11	0		
XECED	-	Errors		0		
		Detected				
XLSRA	2	Successful	11	0		
		Recovery				
		Attempts				
XLRA	2		11	0		
		Recovery				
		Attempts				
XLRSI	2		11	0		
		Reset				
		Indications				
XLCLS	2		11	0		
		Close Station				
XLRNR	2	LLC	11	0		
ALKINK	2	RNR	11	U		
		Received				
XPTPT	2	Total	11	0		
	L	Packets	**			
		Transmitted				
XPTPR	2	Total	11	0		
	-	Packets				
		Received				
XPDPT	2	Data	11	0		
		Packets				
		Transmitted				
XPDPR	2	Data	11	0		
		Packets				
		Received				
XPRPT	2	Reset	11	0		
		Packets				
		Transmitted				
XPROR	2	Reset	11	0		
		Packets				
VARNA		Received				
XPRNR	2	RNR	11	0		
		Packets				
		Received				

Figure 138. X25\_ALL Query, Part 3

Figure 139. X25\_ALL Query, Part 4

# C.2 X25\_HDLC

Query			. X25_	HDLC			
Library .			. ITSC	ID03			
				HDLC related perfor	rmance field	is	
	age id			/			
	ryid						
	the decimal sep equence			or this query *** decimal			
Processing							
Use round	ling cimal data erro		. Yes	(default)			
	bstitution warr			derault)			
	ting for all co						
Special cor			***				
	records selected	i by detault	***				
Selected file ID File			ember	Record Format			
			ember 25B	0APMX25R			
101 ().11	,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,		200	Qui in Esti			
Result fields				Column Headda		Dec	
Name IINFIITTI T	Expression XHBTRN * 800 /	INTSEC /XI	ISP	Column Heading Transmit	Len 4		
LINCOTILI	,	111020 / 12	201	Line		-	
				Util			
LINEUTILR	XHBRCV * 800 /	/ INTSEC /XL	LSP	Receive	4	1	
				line Util			
PCERRTR	(XHFRT * 100)	/ (XHFRT +	XHFTRN)	Pct Frames	4	1	
				Trnsmitd			
00150070	(201555 + 100)	( ()))		in Error			
PCIERRTR	(XHIFRT * 100) XHIFTR)	/ (XHIFRI ·	+	Pct I Frames Trnsmitd	4	1	
	AITT IK)			in Error			
PCERRRCV	((XHIFR + XHFR	IE) * 100)	/	Pct Frames	4	1	
	(XHEFFR + XHIF	FR + XHFRIE)		Recd			
DATE	substr(DTETIM,	3 2)    //	П	in Error Date			
DATE	substr(DTETIM,			bate			
TIME	substr(DTETIM,		11	Time			
	substr(DTETIM,						
LCLNOTR	XHRNRT / (XHEF XHIFR + XHRRFF		+	Local Not	4	1	
				Ready			
RMTNOTR	XHRNRR / (XHIF		+	Remote	4	1	
	XHRRFT + XHRNF	tΤ)		Not			
				Ready			
	elected fields						
Field		Ascending/					
Name XLLND		Descending A		Text Line Description			
IOPRN	10	^	1	IOP Resource Name			
DATE							
TIME							
LINEUTILT LINEUTILR							
PCERRTR							
PCIERRTR							
PCERRRCV							
LCLNOTR RMTNOTR							
XHLNKR				Link Resets			

Figure 140. X25\_HDLC Query, Part 1

Summary functi	ons: 1-Tota	al, 2-Aver	age, 3-Minimum, 4-Maxi	imum, 5-	Count			Overr	ides
Field	Summary	Column			Dec	Null		Dec	Numeric
Name XLLND			Column Headings	Len 10			Len		Editing
			Line						
IOPRN		2	Description IOP Resource	10					
			Name						
DATE		2	Date	5					
TIME LINEUTILT	2 4	2 2	Time Transmit Line	5 4	1				
LINEUTILR	2 4	2	Util Receive line	4	1				
			Util						
PCERRTR	2 4	2	Pct Frames Trnsmitd in Error	4	1				
PCIERRTR	2 4	2	Pct I Frames Trnsmitd in Error	4	1				
PCERRRCV	2 4	2	Pct Frames Recd	4	1				
LCLNOTR	2 4	2	in Error Local	4	1				
Locioni	2 1	-	Not Ready		-				
RMTNOTR	2 4	2	Remote Not	4	1				
XHLNKR		2	Ready	11	0				
AITENAA		2	Link Resets	11	0				
Level Page S O No Y		reak ext							
1 No N	o Si	ummary for	line &XLLND						
Selected output	attributes								
Output type .									
Form of output Line wrapping									
Printer Output Printer device Report size			*PRINT						
			66 (default)						
Width			132						
			6 (default)						
			60 (default) Single space						
Print definiti	Output								
Printer Spooled			(Defaults to val						
Printer Spooled Spool the outp	ut								
Printer Spooled Spool the outp Form type Copies	ut  			ue in pi	rint 1	file,	QPQUPI	RFIL)	
Printer Spooled Spool the outp Form type Copies Hold Cover Page	ut  		1 (Defaults to val	ue in pi	rint 1	file,	QPQUPI	RFIL)	
Printer Spooled Spool the outp Form type Copies Hold Cover Page Print cover pa Cover page t	ut   ge itle		1 (Defaults to val	ue in pi	rint 1	file,	QPQUPI	RFIL)	
Printer Spooled Spool the outp Form type Copies Hold Cover Page Print cover pa	ut    ge itle d footings		. 1 (Defaults to val	ue in pi	rint 1	file,	QPQUPI	RFIL)	

Figure 141. X25\_HDLC Query, Part 2

### C.3 X25\_PLC

```
        Query CCSID
        37

        Query language id
        ENU

        Query country id
        US

        ***. is the decimal separator character for this query ***

  Collating sequence . . . . . . . . . Hexadecimal
  Processing options
   Use rounding . . . . . . . . . Yes (default)
Ignore decimal data errors . . . . No (default)
Ignore substitution warnings . . . . Yes
   Use collating for all compares . . . Yes
  Special conditions
    *** All records selected by default ***
Selected files
 ID File
TO1 QAPMX25
                       Library
QPFRDATA
                                         Member
                                                        Record Format
                                      X25B
                                                       QAPMX25R
Result fields
              Expression
                                                    Column Heading
                                                                              Len Dec
  Name
               substr(DTETIM,3,2) || '/' ||
 DATE
                                                    Date
               substr(DTETIM,5,2)
 TIME
               substr(DTETIM,7,2) || ':' ||
                                                    Time
substr(DTETIM,9,2)
Ordering of selected fields
                   Sort Ascending/ Break Field
Priority Descending Level Text
  Field
                   Sort
  Name
  XLLND
                   10
                                          1
                                                  Line Description
                            Α
  DATE
  TIME
  XPTPT
                                                   Total Packets Transmitted
  XPRPT
                                                   Reset Packets Transmitted
  XPROR
                                                   Reset Packets Received
 XPRNR
                                                   RNR Packets Received
Report column formatting and summary functions
 Summary functions: 1-Total, 2-Average, 3-Minimum, 4-Maximum, 5-Count
                                                                                        Overrides
                                                                        Dec Null
 Field
                   Summarv Column
                                                                                        Dec Numeric
                   Functions Spacing Column Headings
                                                                   Len Pos Cap Len Pos Editing
  Name
  XLLND
                               0
                                                                    10
                                         Line
                                         Description
 DATE
                               2
                                                                     5
                                         Date
  TIME
                               2
                                         Time
                                                                     5
  ХРТРТ
                   1
                               2
                                         Total
                                                                    11 0
                                         Packets
                                         Transmitted
                                                                   11 0
 XPRPT
                   1
                              2
                                         Reset
                                         Packets
                                         Transmitted
 XPROR
                                                                   11 0
                   1
                               2
                                         Reset
                                         Packets
                                         Received
 XPRNR
                               2
                                         RNR
                                                                   11 0
                   1
                                         Packets
                                         Received
```

Figure 142. X25\_PLC Query, Part 1

Figure 143. X25\_PLC Query, Part 2

## C.4 X25\_LLC

```
        Query (CSID
        37

        Query (CSID
        37

        Query (CSID
        100

        Query (CSID
        100

        William
        100

        Wery country id
        100

        ***
        is the decimal separator character for this query ***

  Collating sequence . . . . . . . . . Hexadecimal
  Processing options
    Use rounding . . . . . . . . . Yes (default)
Ignore decimal data errors . . . . No (default)
Ignore substitution warnings . . . . Yes
    Use collating for all compares . . . Yes
  Special conditions
     *** All records selected by default ***
Selected files
  ID File
TO1 QAPMX25
                               Library
                                                  Member
                                                                     Record Format
                                                                   QAPMX25R
                             QPFRDATA
                                               X25B
Result fields
                                                                Column Heading
                  Expression
  Name
                                                                                                Len Dec
                  substr(DTETIM,3,2) || '/' ||
  DATE
                                                                Date
                  substr(DTETIM,5,2)
substr(DTETIM,7,2) || ':' ||
  TIME
                                                                Time
  substr(DTETIM,9,2)
PCTERRDUR (XLIRE * 100) / XLIRC
                                                                Pct DU
                                                                                                   4 1
                                                                 received
                                                                in Error
Pct DU
  PCTERRDUT (XLIRT * 100) / XLITR
                                                                                                   4 1
                                                                Transmitted
                                                                in Error
Ordering of selected fields
Field Sort Ascending/ Break Field
Name Priority Descending Level Text
                                                             Line Description
  XIIND
                       10
                                   А
                                                   1
  DATE
  TIME
  PCTERRDUT
  PCTERRDUR
                                                              LLC Rejects Transmitted
  XLLJT
  XLLJR
                                                              LLC Rejects Received
                                                              Received LLC PDU Discarded
  XLRLD
  XLTO
                                                              Timeouts
  XLCED
                                                              Checksum Errors Detected
                                                             Reset Indications
LLC RNR Received
  XLRSI
  XLRNR
```

Figure 144. X25\_LLC Query, Part 1

	y func	tions: 1-T	otal, 2-Aver	age, 3-Minimum, 4-Max	imum, 5-	Count			0verr	ides
Field		Summary	Column			Dec	Null		Dec	Numeric
Name				Column Headings	Len					Editing
XLLND			0		10					
				Line						
				Description	_					
DATE TIME			2 2	Date Time	5 5					
PCTERR	пит	24	2	Pct DU	4	1				
TOTERR	501	2 4	L	Transmitted in Error	-	1				
PCTERR	DUR	24	2	Pct DU	4	1				
			-	received		-				
				in Error						
XLLJT		1	2	LLC	11	0				
				Rejects						
				Transmitted		-				
XLLJR		1	2	LLC	11	0				
				Rejects Received						
XLRLD		1	2	Received	11	0				
ALALD		-	-	LLC PDU	11	U				
				Discarded						
XLT0		1	2		11	0				
				Timeouts						
XLCED		1	2	Checksum	11	0				
				Errors						
XLRSI		1	2	Detected	11	0				
XLK21		1	2	Reset	11	U				
				Indications						
XLRNR		1	2	LLC	11	0				
				RNR						
				Received						
leport b Break		Suppress	Break							
		Summaries								
0	No	Yes								
1	No	No	Summary for	line &XLLND						
		t attribute								
				Printer						
Erne w	i app ing									
rinter	Output									
Printe	r devi			*PRINT						
Report				66 (default)						
Report Leng	h									
Report Leng Widtl		11ne		b						
Report Leng Widtl Report	start			00						
Report Leng Widtl Report Report	start end li			Single space						
Report Leng Width Report Report Report	start end li line s	spacing		Single space						
Report Leng Width Report Report Report	start end li line s	spacing								
Report Leng Width Report Report Print	start end li line s definis	spacing tion d Output		No						
Report Leng Widtl Report Report Print Spool	start end li line s defini Spoole the out	spacing tion d Output sput		No (Defaults to val	ue in pr	int f	ile,	QPQUPF	RFIL)	
Report Leng Widtl Report Report Print Spool Form t	start end li line s defini Spoole the out ype .	spacing tion d Output sput		No (Defaults to val (Defaults to val	ue in pr ue in pr	int f	ile, ile,	QPQUPF QPQUPF	RFIL) RFIL)	
Report Leng Width Report Report Print Print Spool Form t Copies	start end li line s defini Spoole the out ype .	spacing tion d Output cput	· · · · · · · ·	No (Defaults to val (Defaults to val 1	ue in pr	int f	ile,	QPQUPI	RFIL)	
Report Leng Widtl Report Report Print Spool Form t Copies Hold	start end li line s defini Spoole the out ype . 	spacing tion d Output cput	· · · · · · · ·	No (Defaults to val (Defaults to val	ue in pr	int f	ile,	QPQUPI	RFIL)	
Report Leng Widtl Report Report Print Spool Form t Copies Hold Cover Pag	start end li line s definin Spooled the out ype . ge	spacing tion d Output sput 		No (Defaults to val (Defaults to val 1 (Defaults to val	ue in pr	int f	ile,	QPQUPI	RFIL)	
Report Leng Widtl Report Report Printer Spool Form t Copies Hold Cover Pau Print	start end li line s definin Spooled the out ype . ge	spacing tion d Output sput   	· · · · · · · ·	No (Defaults to val (Defaults to val 1 (Defaults to val	ue in pr	int f	ile,	QPQUPI	RFIL)	
Report Leng Widtl Report Report Print Spool Form t Copies Hold Cover Par	start end li line s defini Spooler the out ype ge cover p r page	spacing tion d Output sput   	· · · · · · · · · · · · · · · · · · ·	No (Defaults to val (Defaults to val 1 (Defaults to val	ue in pr	int f	ile,	QPQUPI	RFIL)	
Report Leng Widtl Report Report Print Spool Form t Copies Hold Cover Pag Drint Cover Page hea	start end li line s defini Spooler the out ype ge cover   r page dings a	spacing tion d Output cput   	· · · · · · · · · · · · · · · · · · ·	No (Defaults to val (Defaults to val 1 (Defaults to val Yes	ue in pr	int f	ile,	QPQUPI	RFIL)	

Figure 145. X25\_LLC Query, Part 2

C

# C.5 X25\_IOP

## C.5.1 IOP Query for a Communications Processor

Query			X25	IOP			
				5 and IOP related perfo	ormance fi	elds	
	D			7			
	uage id						
	ntry id						
				or this query ***			
	sequence .						
Processing							
	nding						
	decimal data			default)			
	substitution						
	lating for al	1 compares	Yes				
Special co							
*** A11	records sele	cted by def	ault ***				
Selected fil	es						
ID Fil	e	Library	Member	Record Format			
TO1 QAF	PMX25	QPFRDATA	X25B	QAPMX25R			
TO2 QAF	PMCIOP	QPFRDATA	X25B	QAPMCIOR			
Join tests							
Type of jo	in		Mate	ched records			
Field	Tes		Field	neu recorus			
T01.INTNUM			TO2.INT	NUM			
TO1.INTNUM	n EQ EQ		T02.IN				
101.10PKN	EQ		102.108	KN			
Result field	is						
Name	Expression	I III		Column Heading	Len	Dec	
DATE	substr(TO1	.DTETIM,3,2	)    '/'	Date			
	substr(TO1	.DTETIM,5,2	:)				
TIME	substr(TO1	.DTETIM,7,2	)    ':'	Time			
	substr(TO1	.DTETIM,9,2	:)				
LCLNOTR	XHRNRT / (	XHEFFR + XH	IFRIE +	Local	4	1	
		IRRER + XHRN	IRR)	Not			
	XHIFR + XH						
	XHIFR + XH			Ready			
RMTNOTR		XHIFTR + XH	IIFRT +	Ready Remote	4	1	
RMTNOTR		XHIFTR + XH	IIFRT +		4	1	
RMTNOTR	XHRNRR / (	XHIFTR + XH	IIFRT +	Remote	4	1	
RMTNOTR	XHRNRR / ( XHRRFT + X	XHIFTR + XH		Remote Not	4	1	
	XHRNRR / ( XHRRFT + X 100 - ((CI	XHIFTR + XH (HRNRT)	LT) /	Remote Not Ready			
IOPUTIL	XHRNRR / ( XHRRFT + X 100 - ((CI (1000000 *	XHIFTR + XH (HRNRT) IDLC * CIID TO2.INTSEC	LT) /	Remote Not Ready Pct IOP			
IOPUTIL Drdering of	XHRNRR / ( XHRRFT + X 100 - ((CI (1000000 * selected fie	(XHIFTR + XH (HRNRT) (IDLC * CIID (TO2.INTSEC (Ids	ULT) /	Remote Not Ready Pct IOP Util			
IOPUTIL Drdering of Field	XHRNRR / ( XHRRFT + X 100 - ((CI (1000000 * selected fie Sort	(XHIFTR + XH (HRNRT) IDLC * CIID 7 TO2.INTSEC Plds Ascendi	ILT) / ;)) ng/ Break	Remote Not Ready Pct IOP Util Field			
IOPUTIL Ordering of Field Name	XHRNRR / ( XHRRFT + X 100 - ((CI (1000000 * selected fie Sort	(XHIFTR + XH (HRNRT) (IDLC * CIID (TO2.INTSEC (1ds	ILT) / ;)) ng/ Break	Remote Not Ready Pct IOP Util Field Text			
IOPUTIL Ordering of Field Name TO1.IOPRN	XHRNRR / ( XHRRFT + X 100 - ((CI (1000000 * selected fie Sort Priori	(XHIFTR + XH (HRNRT) (IDLC * CIID (TO2.INTSEC (Ids Ascendi ty Descend	nLT) / :)) ng/ Break ling Level	Remote Not Ready Pct IOP Util Field Text IOP Resource Name			
IOPUTIL Ordering of Field Name TO1.IOPRN TO2.CITYPE	XHRNRR / ( XHRRFT + X 100 - ((CI (1000000 * selected fie Sort Priori	(XHIFTR + XH (HRNRT) IDLC * CIID 7 TO2.INTSEC Plds Ascendi	ILT) / ;)) ng/ Break	Remote Not Ready Pct IOP Util Field Text IOP Resource Name IOP Type			
IOPUTIL Drdering of Field Name TO1.IOPRN TO2.CITYPE TO1.XLLND	XHRNRR / ( XHRRFT + X 100 - ((CI (1000000 * selected fie Sort Priori	(XHIFTR + XH (HRNRT) (IDLC * CIID (TO2.INTSEC (Ids Ascendi ty Descend	nLT) / :)) ng/ Break ling Level	Remote Not Ready Pct IOP Util Field Text IOP Resource Name			
IOPUTIL Drdering of Field Name TO1.IOPRN TO2.CITYPE TO1.XLLND DATE	XHRNRR / ( XHRRFT + X 100 - ((CI (1000000 * selected fie Sort Priori	(XHIFTR + XH (HRNRT) (IDLC * CIID (TO2.INTSEC (Ids Ascendi ty Descend	nLT) / :)) ng/ Break ling Level	Remote Not Ready Pct IOP Util Field Text IOP Resource Name IOP Type			
IOPUTIL Drdering of Field Name T01.IOPRN T02.CITYPE T01.XLLND DATE TIME	XHRNRR / ( XHRRFT + X 100 - ((CI (1000000 * selected fie Sort Priori	(XHIFTR + XH (HRNRT) (IDLC * CIID (TO2.INTSEC (Ids Ascendi ty Descend	nLT) / :)) ng/ Break ling Level	Remote Not Ready Pct IOP Util Field Text IOP Resource Name IOP Type			
IOPUTIL Drdering of Field Name T01.IOPRN T02.CITYPE T01.XLLND DATE TIME IOPUTIL	XHRNRR / ( XHRRFT + X 100 - ((CI (1000000 * selected fie Sort Priori	(XHIFTR + XH (HRNRT) (IDLC * CIID (TO2.INTSEC (Ids Ascendi ty Descend	nLT) / :)) ng/ Break ling Level	Remote Not Ready Pct IOP Util Field Text IOP Resource Name IOP Type			
IOPUTIL Ordering of Field Name TOI.IOPRN TO2.CITYPE TO1.XLLND DATE TIME IOPUTIL LCLNOTR	XHRNRR / ( XHRRFT + X 100 - ((CI (1000000 * selected fie Sort Priori	(XHIFTR + XH (HRNRT) (IDLC * CIID (TO2.INTSEC (Ids Ascendi ty Descend	nLT) / :)) ng/ Break ling Level	Remote Not Ready Pct IOP Util Field Text IOP Resource Name IOP Type			
IOPUTIL Field Name TOI.IOPRN TO2.CITYPE TO1.XLLND DATE TIME IOPUTIL LCLNOTR RMTNOTR	XHRNRR / ( XHRRFT + X 100 - ((CI (1000000 * selected fie Sort Priori	(XHIFTR + XH (HRNRT) (IDLC * CIID (TO2.INTSEC (Ids Ascendi ty Descend	nLT) / :)) ng/ Break ling Level	Remote Not Ready Pct IOP Util Field Text IOP Resource Name IOP Type Line Description			
IOPUTIL Ordering of Field Name TOI.IOPRN TO2.CITYPE TO1.XLLND DATE TIME IOPUTIL LCLNOTR	XHRNRR / ( XHRRFT + X 100 - ((CI (1000000 * selected fie Sort Priori	(XHIFTR + XH (HRNRT) (IDLC * CIID (TO2.INTSEC (Ids Ascendi ty Descend	nLT) / :)) ng/ Break ling Level	Remote Not Ready Pct IOP Util Field Text IOP Resource Name IOP Type			

Figure 146. X25\_IOP Query, Part 1

mmary functi	ons: 1-Tota	1, 2-Aver	age, 3-Minimum, 4-Max	imum, 5-	Count			0verr	ides
eld	Summary	Column			Dec	Null		Dec	Numeric
me	Functions		Column Headings	Len	Pos		Len		Editing
1.IOPRN		0	IOP	10					5
11101101		Ū.	Resource	10					
			Name						
2.CITYPE		2	Wallie	4					
2.011112		-	IOP	-					
1.XLLND		2	Туре	10					
1.ALLND		2	line	10					
TE		2	Description	-					
TE			Date	5					
ME		2	Time	5					
PUTIL	2 4	2	Pct IOP	4	1		4	1	
			Util						
LNOTR	2 4	2	Local	4	1		4	1	
			Not						
			Ready						
ITNOTR	2 4	2	Remote	4	1		4	1	
			Not						
			Ready						
1.XLITR		2		11	0				
			IPDU						
			Transmitted						
1.XLIRC		2		11	0				
			IPDU						
			Received						
No Y	es es		line &TO1.SHLND						
NO N	0 30	ininaly loi	TIME WIGT.SHEND						
cted output	attributor								
tput type .			Printer						
rm of output									
ne wrapping									
ne wrapping			110						
iter Output			*DDINT						
inter device			*PRINT						
inter device port size									
inter device port size Length			66 (default)						
inter device port size Length Width			66 (default) 132						
inter device port size Length Width port start l	 		66 (default) 132 6 (default)						
inter device port size Length Width port start 1 port end lin	  ine e	 	66 (default) 132 6 (default) 60 (default)						
inter device port size Length Width port start 1 port end lin port line sp	 ine e acing	· · · · · ·	<ul> <li>. 66 (default)</li> <li>. 132</li> <li>. 6 (default)</li> <li>. 60 (default)</li> <li>. Single space</li> </ul>						
inter device port size Length Width port start 1 port end lin	 ine e acing	· · · · · ·	<ul> <li>. 66 (default)</li> <li>. 132</li> <li>. 6 (default)</li> <li>. 60 (default)</li> <li>. Single space</li> </ul>						
inter device port size Length Width port start 1 port end lin port line sp int definiti	 ine e acing on	· · · · · ·	<ul> <li>. 66 (default)</li> <li>. 132</li> <li>. 6 (default)</li> <li>. 60 (default)</li> <li>. Single space</li> </ul>						
inter device port size Length Width port start 1 port end lin port line sp int definiti		   	66 (default) 132 6 (default) 60 (default) Single space No						
inter device port size Length Width port start 1 port end lin port line sp int definiti ter Spooled ool the outp		· · · · · · · · · · · · · · · · · · ·	66 (default) . 132 6 (default) 60 (default) Single space No (Defaults to val						
inter device port size Length Width port start 1 port end lin port line sp int definiti ter Spooled ool the outp rm type	ine	· · · · · · · · · · · · · · · · · · ·	66 (default) . 132 . 6 (default) . 60 (default) . Single space . No . (Defaults to val . (Defaults to val						
inter device port size Length port start 1 port end lin port line sp int definiti ter Spooled ool the outp rm type pies	 ine acing on Output ut	· · · · · · · · · · · · · · · · · · ·	<ul> <li>. 66 (default)</li> <li>. 132</li> <li>. 6 (default)</li> <li>. 60 (default)</li> <li>. Single space</li> <li>. No</li> <li>. (Defaults to val</li> <li>. (Defaults to val</li> <li>. 1</li> </ul>	ue in pr	int f	ile, (	PQUPR	FIL)	
inter device port size Length Width port start 1 port end lin port line sp int definiti ter Spooled cool the outp rm type pies	 ine acing on Output ut	· · · · · · · · · · · · · · · · · · ·	66 (default) . 132 . 6 (default) . 60 (default) . Single space . No . (Defaults to val . (Defaults to val	ue in pr	int f	ile, (	PQUPR	FIL)	
inter device port size Length port start 1 port end lin port line sp int definiti ter Spooled ool the outp rm type pies ld			<ul> <li>. 66 (default)</li> <li>. 132</li> <li>. 6 (default)</li> <li>. 60 (default)</li> <li>. Single space</li> <li>. No</li> <li>. (Defaults to val</li> <li>. (Defaults to val</li> <li>. (Defaults to val</li> </ul>	ue in pr	int f	ile, (	PQUPR	FIL)	
inter device port size Length Width port start 1 port end lin port line sp int definiti ter Spooled col the outp rm type pies ld r Page int cover pa			<ul> <li>. 66 (default)</li> <li>. 132</li> <li>. 6 (default)</li> <li>. 60 (default)</li> <li>. Single space</li> <li>. No</li> <li>. (Defaults to val</li> <li>. (Defaults to val</li> <li>. (Defaults to val</li> </ul>	ue in pr	int f	ile, (	PQUPR	FIL)	
inter device port size Length port start 1 port end lin port line sp int definiti ter Spooled cool the outp rm type pies r Page int cover pa Cover page t			<ul> <li>. 66 (default)</li> <li>. 132</li> <li>. 6 (default)</li> <li>. 60 (default)</li> <li>. Single space</li> <li>. No</li> <li>. (Defaults to val</li> <li>. (Defaults to val</li> <li>. (Defaults to val</li> </ul>	ue in pr	int f	ile, (	PQUPR	FIL)	
<pre>inter device port size Length Width port start 1 port end lin port line sp int definiti ter Spooled ool the outp rm type pies ld r Page int cover page t headings an</pre>	ine		<ul> <li>. 66 (default)</li> <li>. 132</li> <li>. 6 (default)</li> <li>. 60 (default)</li> <li>. Single space</li> <li>. No</li> <li>. (Defaults to val</li> <li>. (Defaults to val</li> <li>. (Defaults to val</li> <li>. No</li> </ul>	ue in pr	int f	ile, (	PQUPR	FIL)	
inter device port size Length Width port start 1 port end lin port line sp int definiti ter Spooled cool the outp rm type pies ld r Page int cover page t headings an int standard			<ul> <li>. 66 (default)</li> <li>. 132</li> <li>. 6 (default)</li> <li>. 60 (default)</li> <li>. Single space</li> <li>. No</li> <li>. (Defaults to val</li> <li>. (Defaults to val</li> <li>. (Defaults to val</li> <li>. No</li> </ul>	ue in pr	int f	ile, (	PQUPR	FIL)	
<pre>inter device port size Length Width port start 1 port end lin port line sp int definiti ter Spooled ool the outp rm type pies ld r Page int cover page t headings an</pre>			<ul> <li>. 66 (default)</li> <li>. 132</li> <li>. 6 (default)</li> <li>. 60 (default)</li> <li>. Single space</li> <li>. No</li> <li>. (Defaults to val</li> <li>. (Defaults to val</li> <li>. (Defaults to val</li> <li>. No</li> </ul>	ue in pr	int f	ile, (	PQUPR	FIL)	

Figure 147. X25\_IOP Query, Part 2

### C.5.2 IOP Query for MFIO Processor

```
Collating sequence . . . . . . . . . . Hexadecimal
 Processing options
   Special conditions
   *** All records selected by default ***
Selected files
 ID File
TO1 QAPMX25
                    Library
                                  Member
                                               Record Format
                    OPFRDATA
                                  X25B
                                              0APMX25R
                               X25B
                  QPFRDATA
 TO2 QAPMMIOP
                                              QAPMMIOR
Join tests
 oin tests

Type of join ..... Matched records

Field Test Field

TO1.INTNUM EQ TO2.INTNUM

TO1.IOPRN EQ TO2.IOPRN
Result fields
            Expression
 Name
                                           Column Heading
                                                                 Len Dec
            substr(T01.DTETIM,3,2) || '/' || Date
 DATE
            substr(TO1.DTETIM,7,2) || ':' || Time
substr(TO1.DTETIM,7,2) || ':' || Time
 TIME
                                       Local
            XHRNRT / (XHEFFR + XHFRIE +
XHIFR + XHRRFR + XHRNRR)
 LCLNOTR
                                                                    4 1
                                           Not
                                            Ready
            XHRNRR / (XHIFTR + XHIFRT +
XHRRFT + XHRNRT)
 RMTNOTR
                                           Remote
                                                                    4 1
                                           Not
                                           Ready
            100 - ((mIIDLC * mIIDLT) /
(1000000 * T02.INTSEC))
                                           Pct IOP
                                                                   4 1
 IOPUTIL
                                           Util
Ordering of selected fields
 Field
                Sort
                      Ascending/ Break Field
                Priority Descending Level Text
  Name
 T01.IOPRN
                                          IOP Resource Name
  T01.XLLND
                                          Line Description
 DATE
 TIME
 IOPUTIL
 LCLNOTR
  RMTNOTR
  T01.XLITR
                                          IPDU Transmitted
  T01.XLIRC
                                          IPDU Received
```

Figure 148. X25\_MIOP Query, Part 1

	ns: 1-Tota	1, 2-Aver	age, 3-Minimum, 4-M	1aximum,	5-Coun	t		0verr	rides
Field	Summary	Column				Null		Dec	Numeric
Name	Functions	Spacing	Column Headings	Le	n Pos	Cap	Len	Pos	Editing
T01.IOPRN		0	IOP	1	0				
			Resource						
			Name						
T01.XLLND		2		1	0				
			Line						
0.475			Description		-				
DATE TIME		2 2	Date		5 5				
IOPUTIL	2 4	2	Time Pct IOP		5 4 1		4	1	
IUPUTIL	2 4	2	Util		4 1		4	1	
LCLNOTR	24	2	Local		4 1		4	1	
		-	Not					-	
			Ready						
RMTNOTR	2 4	2	Remote		4 1		4	1	
			Not						
			Ready						
T01.XLITR		2		1	1 0				
			IPDU						
TO1 81 7-7			Transmitted						
T01.XLIRC		2	IPDU	1	1 0				
			Received						
0 No Ye 1 No Ye 2 No No	5	mmary for	line &TO1.SHLND						
Selected output a	tributes								
Output type			Printer						
Form of output									
Line wrapping .			No						
Printer Output			*DDINT						
			*PRINT						
Report size									
Report size			66 (default)						
			66 (default) 132						
Length			132						
Length Width Report start lin Report end line	 	· · · · · ·	132 6 (default) 60 (default)						
Width . Report start lin Report end line Report line space	 .e 	· · · · · ·	. 132 . 6 (default) . 60 (default) . Single space						
Length Width Report start lin Report end line Report line space Print definition	 .e .ing	· · · · · ·	. 132 . 6 (default) . 60 (default) . Single space						
Length Width Report start lin Report end line Report line spac Print definition Printer Spooled O	 e ing ing u	· · · · · · ·	. 132 . 6 (default) . 60 (default) . Single space . No	value ÷-		611-	000005		
Length Width Report start lin Report end line Report line space Print definition Printer Spooled O Spool the output	ie	· · · · · · ·	132 6 (default) 60 (default) Single space No (Defaults to space)						
Length Width Report start lin Report end line sport line space Print definition Printer Spooled O Spool the output Form type	ie	· · · · · · · · · · · · · · · · · · ·	<ul> <li>. 132</li> <li>. 6 (default)</li> <li>. 60 (default)</li> <li>. Single space</li> <li>. No</li> <li>. (Defaults to space)</li> <li>. (Defaults to space)</li> </ul>						
Length Width		· · · · · · · · · · · · · · · · · · ·	132 6 (default) 60 (default) Single space No (Defaults to y 1	value in	print	file,	QPQUPF	RFIL)	
Length Width		· · · · · · · · · · · · · · · · · · ·	<ul> <li>. 132</li> <li>. 6 (default)</li> <li>. 60 (default)</li> <li>. Single space</li> <li>. No</li> <li>. (Defaults to space)</li> <li>. (Defaults to space)</li> </ul>	value in	print	file,	QPQUPF	RFIL)	
Length Width	ing	· · · · · · · · · · · · · · · · · · ·	132 6 (default) 60 (default) Single space No (Defaults to 1 (Defaults to	value in	print	file,	QPQUPF	RFIL)	
Length Width Report start lin Report end line Report line space Print definition Printer Spooled O Spool the output Form type Copies Cover Page		· · · · · · · · · · · · · · · · · · ·	132 6 (default) 60 (default) Single space No (Defaults to 1 (Defaults to	value in	print	file,	QPQUPF	RFIL)	
Length Width Report start lin Report end line Report line space Printer Spooled O Spool the outpur Form type Copies Cover Page Print cover page ti Page headings and			132 . 6 (default) . 60 (default) . Single space . No . (Defaults to . 1 . (Defaults to . No	value in	print	file,	QPQUPF	RFIL)	
Length			132 . 6 (default) . 60 (default) . Single space . No . (Defaults to . 1 . (Defaults to . No	value in	print	file,	QPQUPF	RFIL)	

Figure 149. X25\_MIOP Query, Part 2

#### C.6 X25\_JOB

```
Collating sequence . . . . . . . . . Hexadecimal
 Processing options
   Use rounding ..... Yes (default)
   Ignore decimal data errors . . . No (default)
Ignore substitution warnings . . . Yes
Use collating for all compares . . . Yes
 Special conditions
*** All records selected by default ***
Selected files
 ID File
TO1 QAPMX25
TO2 QAPMJOBS
                     Library
                                   Member
                                                Record Format
                   QPFRDATA
QPFRDATA
                                                QAPMX25R
QAPMJOBR
                                   X25B
                                  X25B
Join tests
Type of join ..... Matched records
          Test Field
EQ TO2.JRI
 Field
 T01.XLLND
                                   T02.JBLND
 T01.INTNUM
                   EQ
                                    T02.INTNUM
Result fields
 Name Expression Column He
LINEUTILT XHBTRN * 800 / TO1.INTSEC / XLLSP Transmit
                                             Column Heading
                                                                   Len Dec
                                                                      Δ
                                                                          1
                                             Line
                                             Util
 DATE
             substr(T01.DTETIM,3,2) || '/' || Date
            substr(TO1.DTETIM,5,2)
substr(TO1.DTETIM,7,2) || ':' || Time
 TIME
             substr(TO1.DTETIM,9,2)
 AVGJOBRSP
            JBRSP / (JBNTR + 0000.1)
                                             Job avg
                                             response
                                             time
             ((JBCPU / 1000) * 100) /
 PCTCPU
                                             Pct
                                                                     4 1
             T01.INTSEC
                                             CPU
                                              Usage
 LINEUTILR XHBRCV * 800 / TO1.INTSEC /XLLSP Receive
                                             line
                                             Util
Ordering of selected fields
                Sort Ascending/ Break Field
 Field
 Name
                Priority Descending Level Text
                            1
 T02.JBNAME
                10
                          А
                                           Job Name
 T02.JBUSER
                         А
                20
                                           Job User
  T02.JBNBR
                30
                         А
                                    1
                                            Job Number
 T01.XLLND
                                           Line Description
 DATE
  TIME
 AVGJOBRSP
  PCTCPU
 LINEUTILT
 LINEUTILR
```

Figure 150. X25\_JOB Query, Part 1

Break New Suppress Break         Level Page Summaries Text         0       No         1       No         No       No         Summary for job &JBNAME &JBUSER &JBNBR         elected output attributes         Output type		tions: 1-Tot	tal, 2-Aver	age, 3-Minimum, 4-M	aximum, 5-	Count			0verr	ides	
T02.JBNAME       0       Job         Job       Job         T02.JBNSR       2       Job         T02.JBNSR       2       6         Job       Job         T01.JLLNO       2       Job         JOB       Job         T01.JLLNO       2       Job         DATE       2       Transmit         DATE       2       Job avg       16         DATE       2       Job avg       16       3         TOS.JUNAGONSP       2.4       2       Pot avg       16       3         TOTOPU       2.4       2       Pot 4       1       1         VUSage       Line       Util       Util       1       1         LINEUTIL       2       Receive       16       2       1       1         Pot break       Summaries Text       4       1	Field					Dec	Null		Dec	Numeric	
Job         T02.JBUSER       2       10         Job       Job         T02.JBUSER       2       0         T02.JBUSER       2       Job         Job       Job       Job         T01.JLLND       2       Toe       D         T01.JLLND       2       Toe       D         DATE       2       Toe       D         TIME       2       Toe       D         TIME       2       Toe       D         TOE.UPU       2.4       2       Pct       4       1         TOULUTIL       2       Job ADMAME AJBUSER AJBUSER       D       Job         PCTCPU       2.4       2       Pct       4       1         USAGE       Job       Job       Job       Job       Job         USAGE       Job       Job       J		Functions		Column Headings		Pos	Cap	Len	Pos	Editing	
T02.JBUSE       2       Job         T01.JLLNO       2       Ine         DAT       2       Date       5         TIME       2       Job Joay       16       3         TIME       2       Pertone       4       1         CEVENT       2       Pertone       4       1         Usage       Util       Util       Util       1         LINEUTILT       2       Receive       16       2         Util       Util       Util       1       1         Pertone       Util       Util       1       1         Pertone       Pertone       1       1       1         Pertone <td>T02.JBNAME</td> <td></td> <td>0</td> <td></td> <td>10</td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td>	T02.JBNAME		0		10						
T02.JBUSER       2       Job         Job       Job         T02.JBUSR       2       Job         T02.JBUSR       2       Job         T02.JBUSR       2       Job         T01.XLLND       2       Job         T01.XLLND       2       Ine         DATE       2       Date       5         TMM       2       Job avg       16         DATE       2       Date       5         AVGJOBISP       2.4       2       Job avg       16         PCTCPU       2.4       2       Job avg       1         response       Time       5       1         LINEUTILT       2       Transmit       4       1         LINEUTILT       2       Transmit       4       1         LINEUTILT       2       Transmit       4       1         LINEUTILT       2       Prescrive       16       2         Bareak       No       Summarres       Teclive         1       No       No       Summarres       Teclive         1       No       No       Sumarres       Teclive         1       No       S											
Job       T02.JBMBR     2     6       T01.XLLND     2     Ine       DATE     2     0       PARONE     1       DESCRIPTION     0       USage     1       LINEUTILR     2     Receive       10     10     0       Parone     16       2     Receive       11     0       0     No       Ves     10       1     No       No     No       Ves     152       Report Start line     10 <t< td=""><td>TO2 IDUSED</td><td></td><td>2</td><td>Name</td><td>10</td><td></td><td></td><td></td><td></td><td></td><td></td></t<>	TO2 IDUSED		2	Name	10						
102.JBM8         2         6           Jab	102.0003LK		2	Job	10						
Job       Number         T01.XLLND       2       Line         DATE       2       Date       5         DATE       2       Date       5         AVGJOBRSP       2.4       2       Job avg       16       3         response       response       -       -       -         DTUTUT       2.4       2       Job avg       16       3         response       -       -       -       -       -         DENT       2       Transmit       4       1       - </td <td></td>											
T01.XLLND       2       Line Description         DATE       2       Line Description         DATE       2       Time       5         TIME       2       Time       5         VGUORDS7       2.4       2.0       Pote       4       1         POTCPU       2.4       2.0       Pote       4       1         POTCPU       2.4       2.0       Pote       4       1         LINEUTILT       2       Transmit       4       1         Line       Uti1       1       1       1         LINEUTILT       2       Receive       16       2         Line       Uti1       1       1       1       1         Uti1       Uti1       1       1       1       1         Voluput type       Summary for job & JBNAME & JBUSER & JBUSER & JBUSER       2       1         Voluput type       Summary for job & JBNAME & JBUSER & JBUSER & JBUSER       2       1         Voluput type       Summary for job & JBNAME & JBUSER & JBUSER       2       1         Voluput type       Summary for job & JBNAME & JBUSER & JBUSER       3       3         Printer Grouput       Summary for job & JBNAME & JBUSER & JBUS	T02.JBNBR		2		6						
T01.XLLND       2       10         Line       Description         DATE       2       Date       5         AGG.008X5P       2.4       2       Job avg       16       3         response       response       response       10       10       10         LINEUTILT       2.4       2       Transmit       4       1       10 <td></td>											
Line Description D				Number							
DATE 2 Date 5 TIME 2 Time 5 ArGJOBRSP 2.4 2 Job avg 16 3 response time PCTCPU 2.4 2 Pct 4 1 CPU Usage LINEUTILT 2 Transmit 4 1 LINEUTILT 2 Transmit 4 1 LINEUTILT 2 Receive 16 2 Util Util Util Util 4 LINEUTILR 2 Receive 16 2 Util 0 eport breaks Break New Suppress Break Level Page Summaries Text 0 No Yes 1 No No Summary for job &JBNAME &JBNSER &JBNSE elected output attributes Output type	T01.XLLND		2		10						
DATE       2       Date       5         TIME       2       Time       5         TAGGOBRSP       2.4       2       Job avg       16       3         response       time       response       time         PCTCPU       2.4       2       Pct       4       1         Usage       Usage       Usage       Usage       1         LINEUTILT       2       Receive       16       2         line       Util       1       1       1         eport breaks       Summaries Text       0       1       1         0       No       Yes       1       1       1         1       No       No       Summary for job &JBNAME &JBUSER &JBNBR       1         elected output attributes       Util       1       1       1         uptu type											
TIME       2       Time       5         AVGJOBRSP       2.4       2       Job avg       16       3         response       time       7       7       7       4       1         CFU       2.4       2       Pct       4       1         CPU       Usage       1       1       1       1         LINEUTILT       2       Transmit       4       1       1         LINEUTILR       2       Receive       16       2       1         util       1       1       1       1       1       1         eport breaks       Break       Level Page Summaries       Fex       1       1       1       No       Summary for job &JBNAME &JBUSER &JBNBR       1       1       No       No       Summary       1       1       1       No       Summary       1	DATE		2		5						
AVGJOBRSP       2       4       2       Job avg       16       3         PCTCPU       2       4       2       Pct       4       1         Usage       Usage       Usage       1       1         LINEUTILT       2       Transmit       4       1         LINEUTILT       2       Transmit       4       1         Uit1       Uit1       1       1       1         LINEUTILR       2       Receive       16       2         Dine       Uit1       Uit1       1       1         Level Page Sumaries Text       Uit1       1       1         O       No       Yes       Yes       1       No         reine wraping       Of yes       1       No       Yes       Yes         I No       No       Summary for job & JBMAME & JBUSER & JBMBR       Yes       Yes         elected output attributes       Output type       Yes       Yes       Yes         I No       No       Summary for Job & JBMAME & JBUSER & JBMBR       Yes       Yes         reform of output       Yes       Yes       Yes       Yes         Line wrapping       Yes       Yes											
PCTCPU         2         2         Pct         4         1           CPU         Usage         1         1         1           LINEUTILT         2         Transmit         4         1           LINEUTILT         2         Transmit         4         1           LINEUTILT         2         Receive         16         2           LINEUTILR         2         Receive         16         2           Line         Util         1         1         1           eport breaks         Break         Image         1         1           eport breaks         Break New Suppress Break         Image         1         1           Level Page Summaries Text         0         No         Yes         1           1         No         No         Summary for job &JBNAME &JBUSER &JBNBR         Image           elected output attributes         0         Output type         Image         Image         Image           1         No         No         Summaries Text         Image         Image           Printer Form of output         Image         Image         Image         Image           Line wrapting         Image         Imag		2 4				3					
PCTCPU       2 4       2       Pct       4       1         CPU       Usage       1       1         LINEUTILT       2       Transmit       4       1         LINEUTILT       2       Receive       16       2         LINEUTILR       2       Receive       16       2         uti1       uti1       1       1       1         eport breaks       Break       Level Page Sumaries Text       0       No         1       No       No       Summary for job &JBNAME &JBUSER &JBNBR       1         elected output attributes       0utput type       No       1         Printer form of output       No       No         report start line											
CPU         Usage           LINEUTILT         2           Transmit         4           Line         Util           LINEUTILR         2           Receive         16           Util         Util           LINEUTILR         2           Receive         16           Break         New Suppress           Dittit         Printer           Form of output         Printer           Printer device         * PRINT           Report start line				time							
Usage           LINEUTILT         2         Trasmit         4         1           Line         Util         Util         1         1           LINEUTILR         2         Receive         16         2           line         Util         1         1         1           eport breaks         Break         New Suppress         Break         16         2           line         Util         1         1         1         1         1         1           eport breaks         Break         New Suppress         Break         1	PCTCPU	2 4	2		4	1					
LINEUTILT 2 Transmit 4 1 Line Line Util LINEUTIR 2 Receive 16 2 line Util eport breaks Break New Suppress Break Level Page Summaries Text 0 No Yes 1 No No Summary for job &JBNAME &JBUSER &JBNBR elected output attributes Output type Printer Form of output Detail Line wrapping											
LINEUTILR       2       Line Util Util         eport breaks       2       Receive       16       2         ine Util       Util       Util       1 <td></td>											
LINEUTIR       2       Util Receive 16 2 line Util         eport breaks       Break New Suppress Break Level Page Summaries Text 0       0         0       No       Yes 1       No         1       No       No         Summary for job &JBNAME &JBUSER &JBNBR       elected output attributes         Output type	LINEUIILI		2		4	1					
LINEUTILR       2       Receive 16 2         line       Util         eport breaks       Break New Suppress Break         Level Page Summaries Text       0         0       No         1       No         No       No         summary for job & JBNAME & JBUSER & JBNBR         elected output attributes         Output type       Printer         Form of output       Detail         Line wrapping       No         rinter Output       Potail         Printer device       *PRINT         Report size       Length											
line Util eport breaks Break New Suppress Break Level Page Summaries Text 0 No Yes 1 No No Summary for job &JBNAME &JBUSER &JBNBR elected output attributes Output type Printer Form of output Detail Line wrapping No rrinter Output Printer device	LINEUTILR		2		16	2					
eport breaks         Break New Suppress Break         Level Page Summaries Text         0 No Yes         1 No No Summary for job &JBNAME &JBUSER &JBNBR         elected output attributes         Output type Printer         Form of output Detail         Line wrapping											
1       No       No       Summary for job & JBNAME & JBUSER & JBNBR         selected output attributes       Output type Detail         form of output	Level Page	Summaries T									
Output type		No S	Summary for	job &JBNAME &JBUSE	R &JBNBR						
Output type	elected outpu	t attributes									
Line wrapping No  rinter Output Printer device *PRINT Report size Length				Printer							
rinter Output         Printer device       *PRINT         Report size       66 (default)         Width       152         Report start line       60         Report end line       60         Report is spacing       60         Print definition       5ingle space         Print definition       No         rinter Spooled Output       (Defaults to value in print file, QPQUPRFIL)         Form type       (Defaults to value in print file, QPQUPRFIL)         Copies       1         Hold       (Defaults to value in print file, QPQUPRFIL)         over Page       Print cover page         Print cover page title       No											
Printer device	Line wrappin	g		No							
Printer device											
Report size         Length       66 (default)         Width       152         Report start line       6         Report end line       60         Report ine spacing       60         Print definition       50         rinter Spooled Output         Spool the output       0         Form type       10         Copies       1         Hold       10         Verfaults to value in print file, QPQUPRFIL)         over Page         Print cover page         Print cover page title				* DD T N T							
Length       66 (default)         Width       152         Report start line       152         Report end line       60         Report line spacing       50         Print definition       No         rinter Spooled Output       No         Form type       (Defaults to value in print file, QPQUPRFIL)         Form type       (Defaults to value in print file, QPQUPRFIL)         Copies       1         Hold       (Defaults to value in print file, QPQUPRFIL)         over Page       Print cover page         Print cover page       No	Printer devi										
Report start line				66 (default)							
Report end line	Report size			152							
Report line spacing	Report size Length .			102							
Print definition       No         rinter Spooled Output	Report size Length . Width . Report start			6							
rinter Spooled Output Spool the output (Defaults to value in print file, QPQUPRFIL) Form type (Defaults to value in print file, QPQUPRFIL) Copies	Report size Length . Width Report start Report end 1	 line ine		6 60							
Spool the output	Report size Length . Width Report start Report end 1 Report line	line		6 60 Single space							
Spool the output	Report size Length . Width Report start Report end 1 Report line	line		6 60 Single space							
Form type (Defaults to value in print file, QPQUPRFIL) Copies	Report size Length . Width . Report start Report end 1 Report line Print defini	line ine spacing tion		6 60 Single space							
Hold (Defaults to value in print file, QPQUPRFIL) Fover Page Print cover page No Cover page title	Report size Length . Width . Report start Report end 1 Report line Print defini			6 60 Single space No	alue in pi	int f	ile,	QPQUP	RFIL)		
over Page Print cover page No Cover page title	Report size Length . Width . Report start Report end 1 Report line Print defini rinter Spoole Spool the ou Form type .		· · · · · · · ·	<ul> <li>. 6</li> <li>. 60</li> <li>. Single space</li> <li>. No</li> <li>. (Defaults to v</li> <li>. (Defaults to v</li> </ul>							
Print cover page No Cover page title	Report size Length . Report start Report start Report line Print defini rinter Spoole Spool the ou Form type . Copies	line		<ul> <li>. 6</li> <li>. 5ingle space</li> <li>. No</li> <li>. (Defaults to v</li> <li>. (Defaults to v</li> <li>. 1</li> </ul>	alue in pr	rint f	ile,	QPQUP	RFIL)		
Cover page title	Report size Length . Width . Report start Report end 1 Report line Print defini rinter Spoole Spool the ou Form type . Hold	line		<ul> <li>. 6</li> <li>. 5ingle space</li> <li>. No</li> <li>. (Defaults to v</li> <li>. (Defaults to v</li> <li>. 1</li> </ul>	alue in pr	rint f	ile,	QPQUP	RFIL)		
	Report size Length . Width . Report start Report end 1 Report line Print defini rinter Spoole Spool the ou Form type . Copies . Hold . Over Page	line		6 60 Single space No (Defaults to v 1 (Defaults to v	alue in pr	rint f	ile,	QPQUP	RFIL)		
	Report size Length . Width . Report start Report end 1 Report line Print defini rinter Spoole Spool the ou Form type . Copies . Hold . Print cover Print cover	line ine tion d Output ttput page		6 60 Single space No (Defaults to v 1 (Defaults to v	alue in pr	rint f	ile,	QPQUP	RFIL)		
Print standard page heading Yes	Report size Length . Width . Report start Report line Print defini rinter Spool the ou Form type . Copies . Hold over Page Print cover Cover page	line		6 60 Single space No (Defaults to v 1 (Defaults to v	alue in pr	rint f	ile,	QPQUP	RFIL)		
Page heading	Report size Length Width Report start Report start Report line Print defini rinter Spoole Spool the ou Form type . Copies Over Page Print cover Cover page age headings	line ine tion ed Output ttput page title and footings		6 60 Single space No (Defaults to v 1 (Defaults to v No	alue in pr	rint f	ile,	QPQUP	RFIL)		

Figure 151. X25\_JOB Query, Part 2

## Appendix D. Queries for APPN Tasks

Use Query to create your own reports.

- · How much CPU does an intermediate APPN session use?
- This set of queries combines performance data to create reports of how much resource APPN tasks are using.

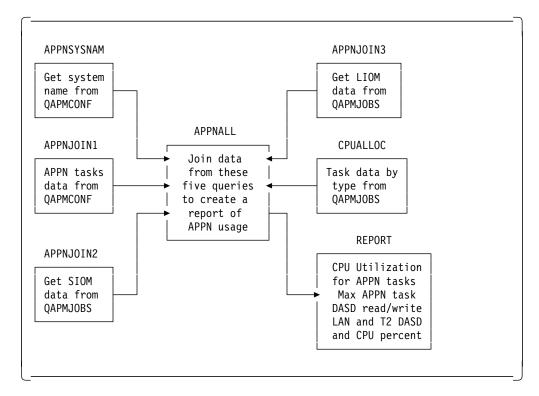


Figure 152. APPN Performance Communications Queries

These queries provide you with an example of creating your own report using the performance monitor data. A copy of each of these queries is provided for you in this appendix.

APPNSYSNAM	Get system name from QAPMCONF config file.
APPNJOIN1	Selects APPN task info from QAPMJOBS and creates APPNTASK1 in file APPNTASKS.
APPNJOIN2	Selects T2 station IOM tasks from QAPMJOBS and creates T2TASK1 in file APPNTASKS.
APPNJOIN3	Selects TRN line IOM tasks from QAPMJOBS and creates LIOMTASK1 in file APPNTASKS.
CPUALLOC	Processor usage by categories, creates member CPUALLOC in file of same name.
APPNALL	Joins the T2TASK1, APPNTASK1, LIOMTASK1.
	SYSNAME and CPUALLOC members for each interval collected. The result is a report of the CPU usage for all of the APPN activity.

Also provided are:

APPNDETAIL	Selects APPN Tasks for Detail Resource Usage report.
APPNT2DTL	Selects T2 station IOM task detail from QAPMJOBS and
	creates a report.

These queries can easily be altered to work on an SDLC line, for example, by changing the APPNJOIN3 query to select tasks whose names begin with #7 instead of #3 for TRN LAN.

The query called APPNDETAIL selects records with information on APPN tasks (CPMGR, LOCMGR, CPPS, DS, and TRS). You can just as easily select on DDM task names, SNADs task names, and others.

### D.1 APPNSYSNAM Query (System Name - Input to Query APPNALL)

57160U1 V3R6M0 950929 IBM Query/400 SYSTEM01 11 25/96 10:33:07 Page 1 Library . . . . . . . . . . . . . . MYLIB 37  $^{\ast\ast\ast}$  . is the decimal separator character for this query  $^{\ast\ast\ast}$ Collating sequence . . . . . . . . . Hexadecimal Processing options Ignore substitution warnings . . . . Yes Use collating for all compares . . . Yes Selected files ID File Library Member Record Fo TOI QAPMCONF QPFRDATA Q963121422 QAPMCONR Record Format Name Expression INTNUM 1 Dicet Result fields Column Heading Len Dec Interval # Select record tests AND/OR Field Test Value (Field, Numbers, or 'Characters') GKEY EQ 'S' Ordering of selected fields Field Sort Ascending/ Break Field Name Priority Descending Level Text INTNUM GKEY GDES IBM Query/400 11/25/96 10:33:07 Page 2 Report column formatting and summary functions Summary functions: 1-Total, 2-Average, 3-Minimum, 4-Maximum, 5-Count Overrides Field Summary Column Summary Column Functions Spacing Column Headings Dec Null Dec Numeric Name Len Pos Cap Len Pos Editing 0 Interval # 2 GKEY 2 GDES 1 0 INTNUM GKEY GDES 10 Selected output attributes Member .....\*FILE Data in file ..... Replace file For a new file: Authority . . . . . . . . . . . . . \*LIBCRTAUT Text about Text about the file . . . . . . . . . . . System name identifier Print definition . . . . . . . . . No . . . . . . . . . . . No Output file record format Field list: Begin Len Dec Null Data Type Field INTNUM Text 1 1 0 Packed decimal 1 2 2 Character GKEY 4 10 Character \* \* \* \* \* END 0F QUERY PRINT \* \* \* \* \* GDES

Figure 153. APPNSYSNAM Query Definition

### D.2 APPNJOIN1 Query (APPN Task - Join Input to Query APPNALL)

5716QU1 V3R6M0 950929 IBM Query/400 SYSTEM01 11/25/96 10:32:52 Page 1 37 Query country id . . . . . . . . . US \*\*\* . is the decimal separator character for this query \*\*\* Collating sequence . . . . . . . . . Hexadecimal Processing options Use rounding . . . . . . . . . Yes (default) Ignore decimal data errors . . . . No (default) Ignore substitution warnings . . . . Yes Use collating for all compares . . . Yes Selected files ID File Library Member Record Fo TOI QAPMJOBS QPFRDATA Q963121422 QAPMJOBR Record Format Result fields JBCPUSEC Expression Column Heading Len Dec jbcpu/1000 cpu secs 6 3 JBCPUCENT (jbcpusec/intsec)\*100 cpu % 5 3 TOSUM jbdbr+jbndb+jbwrt tot i/o 7 0 TOTOPSPSEC iosum/intsec total dasd i/os 6 1 per second READPSEC jbndb/intsec reads per second 6 1 TIME substr(dtetim,7,4) time DATE substr(dtetim,1,6) date IOMSORT substr(jbname,2,2) iom type Select record tests Value (Field, Numbers, or 'Characters') Test AND/OR Field 'LMLOCMGR' JBNAME LIST ' LCCPMGR' ' LCCPPS' 'LCDS' ' LCTRS' IBM Query/400 11/25/96 10:32:52 Page 2 Ordering of selected fields Sort Ascending/ Break Field Field Name Priority Descending Level Text TNTNUM 10 А 1 Interval Number DATE TIME JBNAME Job Name JBPOOL Job Pool JBCPUCENT 20 D JBCPUSEC JBCPU CPU Milliseconds JBNDB Physical Non Database Reads JBWRT Physical Writes READPSEC Job Priority JBPRTY INTSEC Elapsed Interval Seconds Report column formatting and summary functions Summary functions: 1-Total, 2-Average, 3-Minimum, 4-Maximum, 5-Count Overrides Dec Numeric Field Summary Column Dec Null Functions Spacing Column Headings Len Pos Cap Len Pos Editing Name INTNUM 4 0 5 0 Interval Number DATE 6 4 2 date TIME 4 2 time 4 JBNAME 5 1 10 Joh Name JBPOOL 2 2 Joh Poo1 cpu % JBCPUCENT 14 2 5 3 JBCPUSEC 14 1 cpu secs 6 3 JBCPU 2 11 0 CPII Milliseconds Physical .1RNDR 14 1 11 0 Non Database Reads JBWRT 14 1 11 0 Physical Writes READPSEC 14 2 reads per second 6 1 JBPRTY 2 Job Priority

Figure 154. APPNJOIN1 Query Definition, Part 1

		IE	BM Query/400	11/	25/96 10:32	:52 Page	3	
Report column fo	ormatting an	d summarv	functions (continued)			-		
			age, 3-Minimum, 4-Maxi	mum. 5-Count	0ver	rides		
Field	Summary	Column		Dec N	lull Dec	Numeric		
Name	Functions		Column Headings			Editing		
INTSEC		2	Elapsed	7 0		5		
			Interval					
			Seconds					
Report breaks								
	Suppress B	reak						
Level Page S		ext						
1 No 1	No							
Selected output	attributes							
Output type .			Database file					
			Summary only					
Line wrapping			No					
Database file ou								
File			APPNTASKS					
Library			MYLIB					
Member			APPNTASK1					
			Replace member					
For a new file	e:							
Authority .			*LIBCRTAUT					
Text about								
the file			appn tasks - join	input				
Print definit	ion		No					
Output file reco	ord format							
Output record	length		122					
Field list:								
Field	Begin	Len Dec	Null Data Type	Text				
BREAKLVL	1	1	Character	BREAK LE	VEL			
OVERFLOW	2	1	Character	OVERFLOW	FLAG			
INTNUM	3	5 0	Zoned decimal	Interval				
INTNUM04	8	5 0	Zoned decimal	INTNUM	MAX			
DATE04	13	6	Character	DATE	MAX			
			BM Query/400	11/	25/96 10:32	:52 Page	4	
Output file reco	ord format (	continued)	1					
Field list:								
Field		Len Dec	Null Data Type	Text				
TIME04	19	4	Character	TIME	MAX			
JBNAME05	23	7 0	Zoned decimal	JBNAME	COUNT			
JBCPUCEN01	30	8 3	Zoned decimal	JBCPUCEN				
JBCPUCEN04	38	5 3	Zoned decimal	JBCPUCEN				
JBCPUSEC01	43	93	Zoned decimal	JBCPUSEC				
JBCPUSEC04	52	6 3	Zoned decimal	JBCPUSEC				
JBNDB01	58	14 0	Zoned decimal	JBNDB	TOTAL			
JBNDB04	72	11 0	Zoned decimal	JBNDB	MAX			
JBWRT01	83	14 0	Zoned decimal	JBWRT	TOTAL			
JBWRT04	97	11 0	Zoned decimal	JBWRT	MAX			
READPSEC01	108	9 1	Zoned decimal	READPSEC				
READPSEC04	117 * * * * *	6 1	Zoned decimal	READPSEC				
	~ * * * *	END	OF QUERY PR	INT ***				

Figure 155. APPNJOIN1 Query Definition, Part 2

# D.3 APPNJOIN2 Query (T2 Station IOM - Join Input to Query APPNALL)

5716QU1 V3R6			BM Query/400		EMO1 11/25/9	6 10:32:55	Page	1	
				DIN2					
	· · · · · · ·								
	age id								
	ry id								
*** . is	the decimal s	separator c	haracter for	this query ***					
	equence		Hexade	ecimal					
Processing									
	ing cimal data er								
	bstitution wa			erauru)					
	ting for all								
Selected file									
ID File	Li	ibrary	Member	Record Format					
TO1 QAPM		PFRDATA	Q963121422	QAPMJOBR					
Result fields									
Name JBCPUSEC	Expression jbcpu/1000			Column Heading cpu secs	Len 6	Jec 3			
JBCPUCENT	(jbcpu/1000 (jbcpusec/ir	ntsec)*100		cpu %	5	3			
IOSUM	jbdbr+jbndb+			tot i/o	7	0			
	iosum/intsec			total dasd i/os	6	1			
				per second					
READPSEC	jbndb/intsec			reads per second	6	1			
TIME	substr(dteti			time					
DATE IOMSORT	substr(dteti substr(jbnam			date iom type					
Select record		ne,2,2)		тош суре					
	eld	Test	Value (Fie	eld, Numbers, or 'O	Characters')				
	CPUSEC	GT	0		,				
AND JB	NAME	LIKE	′ T2-%′						
			BM Query/400	)	11/25/9	6 10:32:55	Page	2	
Ordering of s									
Field Name	Sort		g/ Break F ng Level 1						
INTNUM	10	A		interval Number					
DATE	10			incerval number					
TIME									
JBNAME				lob Name					
JBPOOL			,	lob Pool					
JBCPUCENT	20	D							
JBCPUSEC JBCPU	20	U	(	CPU Milliseconds					
JBNDB				Physical Non Databa	ase Reads				
JBWRT				Physical Writes					
READPSEC									
JBPRTY				lob Priority					
INTSEC	e			lapsed Interval Se	econds				
Report column				imum, 4-Maximum, 5-	Count	Overrides			
Field	Summary	Column	raye, s-mini	niiuiii, 4-Maxiniuiii, 5-	Dec Null	Dec Numeric			
Name	Function		Column Hea	ıdings Len	Pos Cap	Len Pos Editing			
INTNUM	4	0		5	0				
			Interval						
			Number						
DATE	4	2	date	6					
TIME JBNAME	4 5	2 1	time	4					
JENAME	5	1	Job	10					
			Name						
JBP00L		2		2					
			Job						
			Poo1						
JBCPUCENT	14	2	cpu %	5	3				
JBCPUSEC JBCPU	1 4	1 2	cpu secs	6 11	3 0				
JDUPU		2	CPU	11	U				
			Millisecor	nds					
JBNDB	1 4	1	Physical	11	0				
			Non Databa	ise					
			Reads						
JBWRT	1 4	1		11	0				
			Physical United						
	14	2	Writes reads per	second 6	1				
PEADDSEC		4	reaus per		Ŧ				
READPSEC JBPRTY	14			3					
	14	2	Job	3					
	1 4		Job Priority	3					

Figure 156. APPNJOIN2 Query Definition, Part 1

	IBM Query/400	11/25/96 10:32:55	Page	3
Report column formatting and su				
Summary functions: 1-Total,	2-Average, 3-Minimum, 4-Maximum,	5-Count Overrides		
Field Summary Co	lumn	Dec Null Dec Numeric		
Name Functions Sp	acing Column Headings L	en Pos Cap Len Pos Editing		
INTSEC 2	Elapsed	7 0		
	Interval			
	Seconds			
Report breaks				
Break New Suppress Break	(			
Level Page Summaries Text				
1 No No				
Selected output attributes				
Output type	Database file			
Form of output	Summary only			
Line wrapping	No			
Database file output				
File	APPNTASKS			
Library	MYLIB			
Member	T2TASK1			
Data in file	Replace file			
For a new file:				
Authority	*LIBCRTAUT			
Text about				
the file	t2 station iom tasks	- join input		
Print definition	No			
Output file record format				
Output record length				
Field list:				
Field Begin Len	Dec Null Data Type	Text		
BREAKLVL 1 1	Character	BREAK LEVEL		
OVERFLOW 2 1	Character	OVERFLOW FLAG		
INTNUM 3 5	0 Zoned decimal	Interval Number		
INTNUMO4 8 5	0 Zoned decimal	INTNUM MAX		
DATE04 13 6	Character	DATE MAX		
	IBM Query/400	11/25/96 10:32:55	Page	4
Output file record format (cont	inued)			
Field list:				
Field Begin Len	Dec Null Data Type	Text		
TIME04 19 4	Character	TIME MAX		
JBNAME05 23 7	0 Zoned decimal	JBNAME COUNT		
JBCPUCEN01 30 8	3 Zoned decimal	JBCPUCENT TOTAL		
JBCPUCEN04 38 5	3 Zoned decimal	JBCPUCENT MAX		
JBCPUSEC01 43 9	3 Zoned decimal	JBCPUSEC TOTAL		
JBCPUSEC04 52 6	3 Zoned decimal	JBCPUSEC MAX		
JBNDB01 58 14	0 Zoned decimal	JBNDB TOTAL		
JBNDB04 72 11	0 Zoned decimal	JBNDB MAX		
JBWRT01 83 14	0 Zoned decimal	JBWRT TOTAL		
JBWRT04 97 11	0 Zoned decimal	JBWRT MAX		
READPSEC01 108 9	1 Zoned decimal	READPSEC TOTAL		
READPSEC04 117 6	1 Zoned decimal	READPSEC MAX		
* * * * * E	ND OF QUERY PRIN	T * * * * *		

Figure 157. APPNJOIN2 Query Definition, Part 2

# D.4 APPNJOIN3 Query (Token-Ring IOM - Join Input to Query APPNALL)

STIDUT     1100 00000     1100 00000     Page 1       Unrary     NTMIN     NTMIN       State     NTMIN     NTMIN       Unrary     NTMIN     NTMIN       State     NTMIN     NTMIN       NTMIN     NTMIN     NTMIN       State     State     State       State     State																
Query																
Library										SYSTEMOI	11/25/9	6	10:33:04	Page	1	
Query Last																
Guery (SIDD																
Divery language 16									ioin input	to query	APPNALL					
Overy country 16																
<pre>*** . is the decimal separator character for this guery *** Collating sequence</pre>																
Colling sequence																
Processing options           Use round is at errors		*** . 1	is the	e decima	l separat	or cha	aracter	for th	is query	***						
Up rounding		Collating	j sequ	uence .			Hex	adecim	al							
Ignore decimal data errors No (default) Ignore decimal data errors No (default) Ignore decimal data errors No (default) Use collating for all compres Yes Selected field ID file Library Member Record Format IT No		Processir	ng opt	tions												
Japper substituting for all comparts         * Yes           Selected files         Line / L		Use rou	unding				Yes	(defa	ult)							
Use collating for all compares Yes Selected Tits T0 0 File Library Member Record Forma L T0 0 0444008 0PFRAAD 09631222 0444008 Result Trields MADE SECTION 1000000000000000000000000000000000000		Ignore	decin	nal data	errors		No	(defau	1t)							
Use collating for all compares Yes Selected Tits T0 0 File Library Member Record Forma L T0 0 0444008 0PFRAAD 09631222 0444008 Result Trields MADE SECTION 1000000000000000000000000000000000000		Ignore	subst	titution	warnings		Yes									
Selected files         U         Its         Litzy         Member         Record Format           T0         0APMO005         0PF00A7A         095121422         0APMO081         Len         Dec           Barnet         Expression         Column Heading         Len         Dec         3           3GEVISE         Lippu/1000         cpu sets         5         3         3         Selection         5         3         3         Selection         5         3         Selection         6         1           T000         Selection         Selection         6         1         Selection         6         1           T104         Subtr(fdetim, 7,4)         Time         record         6         1         Selection         8         1           T114         Subtr(fdetim, 7,4)         Time         Tom type         5         1         <																
TOI<         QAPROACES         QPERDATA         <																
Name         Expression         Column Heading         Len         Pec           JBCPUSCE         Jopu/1000         GPU sees         6         3           JBCPUSCE         Jopu/1000         GPU sees         6         3           JBCPUSCE         Jopu/1000         GPU sees         7         0           IDSUM         Jobar-Jobar-Jown         total dasf J/G/S         0         1           JBCPUSCE         Jobar-Jobar-Jown         reade         7         0           JBCPUSCE         Jobar-Jobar-Jown         reade         7         0           JBCPUSCE         Jobar-Jobar-Jown         reade         6         1           JBCPUSCE         Jobar-Jobar-Jown         reade         6         1           JBCPUSCE         Test         Value (Field, Number, or 'Characters')         JBCPUSCE           JBCPUSCE         Test         Value (Field, Number, or 'Characters')         JBCPUSCE         JBCPUSCE         JBCPUSCE           JBCPUSCE         Test         Value (Field, Number, Value (Field, Number, December (Jest)         JBCPUSCE         JBCPUSCE         JBCPUSCE           JBCPUSCE         JBDNM         Labo Namb         JBCPUSCE         JBCPUSCE         JBCPUSCE         JBDNM         JBCPUSCE		ID Fi	ile		Library		Member		Record F	ormat						
Name         Expression         Column Heading         Len         Pec           JBCPUSCE         Jopu/1000         GPU sees         6         3           JBCPUSCE         Jopu/1000         GPU sees         6         3           JBCPUSCE         Jopu/1000         GPU sees         7         0           IDSUM         Jobar-Jobar-Jown         total dasf J/G/S         0         1           JBCPUSCE         Jobar-Jobar-Jown         reade         7         0           JBCPUSCE         Jobar-Jobar-Jown         reade         7         0           JBCPUSCE         Jobar-Jobar-Jown         reade         6         1           JBCPUSCE         Jobar-Jobar-Jown         reade         6         1           JBCPUSCE         Test         Value (Field, Number, or 'Characters')         JBCPUSCE           JBCPUSCE         Test         Value (Field, Number, or 'Characters')         JBCPUSCE         JBCPUSCE         JBCPUSCE           JBCPUSCE         Test         Value (Field, Number, Value (Field, Number, December (Jest)         JBCPUSCE         JBCPUSCE         JBCPUSCE           JBCPUSCE         JBDNM         Labo Namb         JBCPUSCE         JBCPUSCE         JBCPUSCE         JBDNM         JBCPUSCE		T01 04	APMJOE	3S	OPFRDATA		0963121	422	OAPMJOBR							
New         Expression         Colum Heading         Len         Dec           JBCPUREDIT         (Jbcpu/Jood)         cpu sec         5         3           JBCMUEDIT         (Jbcpu/Jood)         rpu second         5         3           JBCMUEDIT         (Jbcpu/Jood)         rpu second         6         1           TIME         substridetim_J.4)         tot 1/0         7         0           JBCMUEDIT         jbsdb/riddet/jbsd/riddetim_J.4)         date         -         -         -           JBCMUEDIT         jbsdb/riddet/jbsd/riddetim_J.4)         date         -<							4		•							
JBCPUSCE JBCPUSC				oressio	n			Co	lumn Head	ina	Len	Dec				
JABCHICKENT         jubbar:Jubbar:/intec         cu k         5         3           IDSUM         Jobbar:Jubbar:/intec         tot 1/0         7         0           IDSUM         Jubbar:Jubbar:/intec         tot 1/0         7         0           IDSUM         Jubbar:Jubbar:/intec         tot 1/0         7         0           IDSUM         Select record         6         1           IDSUM         Time         Substriffettim:,1,6)         date           JUBCHUSEC         GT         0         11/25/96         10:33:04         Page         2           Select record         test         Time         Y         10         1         Interval         Number         11/25/96         10:33:04         Page         2           Ordering of selected         field         Number         Interval		JBCPUSEC								5						
READPSC:       jobd//itketim_7.4)       total dash job       i         TOTOPSS:       jobd//itketim_7.4)       total dash job       i         TIME       substriftetim_7.4)       total dash job       i         Select record       total dash job       i       i         TIME       substriftetim_7.4)       total dash job       i       i         Select record       total dash job       i       i       i       i         MAR       substriftetim_7.4)       total dash job       i       i       i       i         Select record       total dash job       i						100										
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READPSIC         Unit Visual Circle (Interval Visual										i/os						
READPSICJohnaleJohnaleJohnaleJohnaleTTMESubtr(fdet[m],1,6)dateJohnaleJohnaleDMSORSubtr(fdet[m],1,6)JohnaleJohnaleJohnaleSUBTUSCGGJohnaleJohnaleJUTUSCGGJohnaleJohnaleJohnaleJUTUSCGGJohnaleJohnaleJohnaleJUTUSCGGJohnaleJohnaleJohnaleJUTUSCGSizevisoJohnaleJohnaleJohnaleJUTUSCGSizevisoJohnaleJohnaleJohnaleJUTUSCGSizevisoJohnaleJohnaleJohnaleJUTUSCJohnaleJohnaleJohnaleJohnaleJohnaleJUTUSCZCJohnaleJohnaleJohnaleJUTUSCZJohnaleJohnaleJohnaleJohnaleJUTUSCZJohnaleJohnaleJohnaleJohnaleJUTUSCZJohnaleJohnaleJohnaleJohnaleJUTUSCZJohnaleJohnaleJohnaleJohnaleJUTUSCZJohnaleJohnaleJohnaleJohnaleJUTUSCZJohnaleJohnaleJohnaleJohnaleJUTUSCZJohnaleJohnaleJohnaleJohnaleJUTUSCZJohnaleJohnaleJohnaleJohnaleJUTUSCZJohnaleJohnaleJohnaleJohnaleJUTUSCZ <td></td> <td>1010101010</td> <td></td> <td>, s uni, inc</td> <td>500</td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td>-</td> <td></td> <td></td> <td></td> <td></td>		1010101010		, s uni, inc	500							-				
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Instruct Ubana         Job           Select record tests         Value (Field, Numbers, or 'Characters')           AND         JBMME         LIRE         'TRN-4'           Image         Second ing         Berger (Field         'TRN-4'           Nome         Priority         Becanding         Berger (Field         ''''''''''''''''''''''''''''''''''''																
Select record tests     Test     Value (Field, Numbers, or 'Characters') JBCPU3CC     G       AMD /JBNAME     LiKE     'TRA.4''       Dordering of selected fields     IM     JBNAME     LiKE       Field     Sort     Ascending/     Break     Field       Name     Priority     Descending/     Break     Field       Name     Priority     Descending     Leve     Test       JBNAME     Job Name     Job Name     Job Name       JBNAME     Job Priority     Elayed Interval Number       JBNAME     Field     Physical Nrites       JBNAME     Job Priority     Elayed Interval Seconds       READYSC     Soumary     Golumi Headings     Len Pos Editing       INTNUM     10     Interval     Number       Name     Job     Job     South       JBNAME     Job     South     Desc Null       JBNAME     Job     South     Desc Null       JBNAME     Job     South     Desc Null       JBNAME     Job     So     Job <td></td>																
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AND       JBMANE       LLK       'TRL-s'       II/25/6       IO 33:04       Page       Page         Ordering of selected fields       IN       IN       Nome       II/25/6       IO:33:04       Page       2         Intro       Second in the second		AND/ UK				L		rieiu,	Numbers,	UP CHar	acters )					
IP Uncery + UD     11/2 / 25 / 9     10:33:04     Page     2       Ordering Ord		4110				-										
Ordering of selected fields         Ascending Level Text           Field         Sort Ascending Level Text           INTNUM         10         A           JACPUSEC         Job Name           JARDNE         Job Pool           JARDNE         Job Pool           JARDNE         Physical Non Database Reads           JANNS         Physical Nor Database Reads           JARDNE         Physical Nor Database Reads           JARDNE         Physical Nor Database Reads           JARDNE         Physical Nor Database Reads           JANNS         Physical Nor Database Reads           JARDNE         Physical Nor Database Reads           JARDNE         Physical Nor Database Reads           JARDNE         Courner Coure Courner Courner Courner Courner Courner Courner Cou		AND	JBNAP	15	LIK			100			11/05/0	~	10.00.04	D		
FieldSortAscending/ Des		Quedensine ed	1		-1	1 BM	i Query/	400			11/25/9	D	10:33:04	Page	2	
NamePriorityDescendingLevelTextINTUMM10A1Interval NumberDATEJabJabJabJBNMEJabJBRODLJabJBRODLS20D-JBRONSC20D-JBRONSC20D-JBRONSCJBRONSJBRONSJBRONSJBRONSJBRONSJBRONSJBRONSJBRONSJBRONSREADPSECSummary functions:JBRONSSpace-Summary functions:Summary functions:Summary functions:JBRONSSpace-JBRONSJBRONSJBRONSJBRONSJBRONSJBRONSJBRONSJBRONSJBRONSJBRONSJBRONSJBRONSJBRONSJBRONSJBRONSJBRONSJBRONS- </td <td></td> <td></td> <td>Sele</td> <td></td> <td></td> <td></td> <td>Dural</td> <td>54.1</td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td>			Sele				Dural	54.1								
INTUNN       10       A       1       Interval Number         DATE       JANAME       JANAME       JANAME       JANAME         JBROM       JANAME       JANAME       JANAME       JANAME         JBROMC       JANAME       JANAME       JANAME       JANAME         JBROMC       JANAME       JANAME       JANAME       JANAME         JBROT       CPU       CPU Milliseconds       JANAME       JANAME         JBROT       Physical Mirites       Physical Mirites       Physical Mirites         JBROT       Sammary functions       JANAME       Database Reads         JBROT       JANAME       JANAME       Dec Null       Overrides         Sumary functions:       JANAME       Colum       Eapsed Interval       Ecourt         Name       Field       Sumary functions:       Sacona       Overrides         Sumary functions:       Spacing       Colum Headings       Len       Pos       Editing         INTMM       4       0       Interval       Dec       Numeric         Name       Field       Sate       JANAME       Dec       Numeric         JBROME       1       Jaterval       Jate       Ecoure       JANAME																
DATÉ       Job       Job         TIME       Job       Job Pool         JSRUME       Job Pool         JSRUUENT       JOD         JSRUUENT       Physical Non Database Reads         JSRUB       Physical Non Database Reads         JBNDB       JOD         JSRUT       Job Priority         JBNTY       Job Priority         Summary functions:       Interval         Sumary functions:       Job Priority         JNTNUM       4       0         JBNDE       Interval       Pec <null< td="">         JBNTY       Job         JBNDE       Interval         JBNDE       Job         JBNME       Jab         JBNDE       Jab         JBNDE       Jab         JBNDE       Jab         JBNDE</null<>						enaing										
ТНЕ       JAB MARE       JAB MARE       JAB Paol         JABCPUCENT       JABCPUCENT       JABCPUCENT       CPU MI11/second         JABCPUCENT       CPU MI11/second       Repart Second       Repart Second         JABNARE       CPU MI11/second       Repart Second       Repart Second       Repart Second         JABNARE       Second       Physical Non Database       Resart Second       Repart Second       Repart Second         JABNARE       Second       JABNARE       Second       Repart Second </td <td></td> <td></td> <td></td> <td>10</td> <td>A</td> <td></td> <td>1</td> <td>Inte</td> <td>rval Numbe</td> <td>er</td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td>				10	A		1	Inte	rval Numbe	er						
JBRNMEJabJabJBRNMEJabJabJabJACPUSCE200CUJACPUSCE0CUJACPUSCE0Physical Non DatabaseJBNDBVPhysical Non DatabaseJBNDBVPhysical Non DatabaseJBNTJob PriorityJBNTJob Priority <td></td>																
JBCPUCENT20DJBCPUCENT20DJBCPUCENTCPU M111/secondsJBNDASPhysical Non Database ReadsJBNDTSDeb PriorityJBNTJob PriorityJBNTJac																
JBC PUPCENT       JBC PUSENT     CPU MIII iseconds       JBNDB     Physical Non Database Reads       JBNDB     Physical Non Database Reads       JBMRT     Sumary Support Suppor																
JBCPUSEC         20         P           JBCPUSEC         FPysical Non Database Reads           JBWRT         FPysical Vertuse           JBWRT         JBMPT           JBMRT         JBMPT           JBMRTY         JBMPT           Summary functions:         I-Total,           Summary functions:         1-Total,           Summary functions:         Spacing           Colum Headings         Len         Pos         Kaiting           Name         Functions         Spacing         Colum Headings         Len         Pos         Editing           INTNUM         4         2         date         6         I         I         I           JBMAE         5         1         Interval         I         I         I         I           JBMAME         5         1         Interval         I         I         I         I           JBCPUCENT         1 4         2         Quas								Job	Pool							
JBCPU       CPU Milliseconds         JBNDB       Physical Non Database       Reads         JBNRTY       Summary functions:       Elapsed Interval Seconds         Summary functions:       Interval       Seconds       Numerides         Summary functions:       Colum Headings       Len       Pos       Caluting         Name       Functions       Spacing       Colum Headings       Len       Pos       Editing         INTNM       4       Q       date       6       Numerides       Numerides         DATE       4       Q       date       6       S       Numerides       Numerides         JBRAME       5       Jab       Jab       Jab       Numerides       Numerides       Numerides         JBCPUCENT       1.4       2       Gpu secs       6       3       Jac       Numerides         JBCPUSEC       1.4       1       Cpu secs			Γ													
JBNDB       Physical Non Database Reads Physical Writes         JBNRT       Physical Writes         JBPRTY       JoPriority         JBPRTY       JoPriority         JBRTY       JoPriority         Summary functions:       1-104-11       2-Average, 3-Minimum, 4-Maximum, 5-Court       Overrides         Field       Summary functions:       1-104-11       2-Average, 3-Minimum, 4-Maximum, 5-Court       Overrides         Field       Summary functions:       1-104-11       2-Average, 3-Minimum, 4-Maximum, 5-Court       Overrides         Field       Summary functions:       1-104-11       2-Average, 3-Minimum, 4-Maximum, 5-Court       Overrides         Mane       Functions       Spacing       Column Headings       Len       Pos       Rumeric         Name       Functions       Spacing       Column Headings       Len       Pos       Editing         JNNUM       4       C       Mate       6       Spacing       Functions       Functions         JBAMAE       5       1       Job       Job       Job       Job       Job       Job         JBCPUSENT       1.4       1       Cpu seconds       S       Job       Job       Job         JBADB       1.4 <t< td=""><td></td><td></td><td></td><td>20</td><td>D</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></t<>				20	D											
JBRRT       Physical Writes'         READPSEC       JBPRTY         JITSEC       Elapsed Interval Seconds         Report colum Formating and sumary       Functions         Summary functions:       1.0 Lapsed Interval Seconds         Summary functions:       1.0 Lapsed Interval Seconds         Field       Summary Golum       Colum Headings       Len Pos         Name       Functions       Space       Len Pos         INTNM       4       Colum Headings       Len Pos       Editing         INTNM       4       Colum Headings       Len Pos       Editing         INTNM       4       Colum Headings       Len Pos       Editing         JBRAT       4       2       date       6       Editing         JBRAT       4       2       date       6       Editing         JBRAT       5       10       Interval       Editing         JBRODL       2       Jab       Editing       Editing         JBCPUSCL       1       1       Copu Seconds       S       3         JBCPUSCL       1       4       2       Copu Seconds       S       S         JBROB       1       4       1       Po																
READPSEC JBRRTY         Job Priority Elapsed Interval Seconds           Report colum formatting and summary functions: summary functions: 1-Tot-1 - 2-Average, 3-Minimum, 4-Maximum, 5-Court         Overrides           Summary functions: Field         Summary Court         Dec         Null         Dec Null           Name         Functions         Spacing         Colum Headings         Len         Pos         Cap         Len         Pos         Editing           Name         Functions         Spacing         Colum Headings         Len         Pos         Cap         Len         Pos         Editing           Name         Functions         Spacing         Colum Headings         Len         Pos         Editing           Name         Functions         Spacing         Colum Headings         Len         Pos         Editing           Number         6         5         1         Interval         Len         Pos         Editing           JBRNME         5         1         Interval         Len         Pos         Editing           JBRNME         2         2         Dot         Len         Pos         Editing           JBRNME         1.4         2         cpu shot         5         3         Editing											Reads					
JBRRTY       Job Priority         Report column formatting and summary functions:       Lapsed Interval Seconds         Summary functions:       1-70-at       2-Average, 3-Minimum, 4-Maximum, 5-Cunt       0verrides         Field       Summary       Column Headings       Len       Pos       Numeric         Name       Functions       Spacing       Colum Headings       Len       Pos       Editing         INTNUM       4       0       5       0       Editing       Editing         DATE       4       2       date       6       Interval       Interval       Interval       Interval         JBNMME       5       1       job       job       Interval		JBWRT						Phys	ical Write	es						
Intree Elapsed Interval Seconds         Report column formatting and summary functions:         Summary functions:         Summary functions:         Field       Summary         Field       Summary         Field       Summary       Our       Over rides         Name       Functions       Spacing       Column Headings       Len       Pos       Calumeric         Name       Functions       Spacing       Column Headings       Len       Pos       Calumeric         Interval       Dec       Number         JBNUM       4       2       Therval         JBNUME       5       1         Job         Fibility       Space         JBSPUUCENT       1       Over second       3         JBSPUUCENT       1       Over second       Space         JBSPUE																
Field       Summary functions:       Column formatting and summary functions:       Dec Null       Dec Null       Dec Numeric         Name       Functions       Spacing       Column Headings       Len       Pos       Cap       Len       Pos       Editing         INTNUM       4       0       5       0       Len       Pos       Editing         DATE       4       2       date       6       -       -       -       -         DATE       4       2       time       4       - </td <td></td>																
Summary functions:     1-Total, 2-Average, 3-Minimum, 4-Maximum, 5-Count     Overrides       Field     Summary     Column     Dec Null     Dec Numeric       Name     Functions     Spacing     Column Headings     Len Pos     Cap     Len Pos       INTNUM     4     0     5     0     Editing       DATE     4     2     date     6     Editing       DATE     4     2     time     4     Editing       DATE     4     2     time     4     Editing       DATE     5     1     10     Editing       DATE     4     2     time     4       JBNAME     5     1     10     Editing       JBPOOL     2     Cup &     5     3       JBCPUCENT     1     4     2     cup secs     6       JBCPUSEC     1     4     Cup secs     6     3       JBROB     1     4     Physical     11     0       Marites     Editing     11     0     Editing       JBRNB     1     1     Physical     11     0       Wittes     Editing     11     0     Editing       READPSEC     1     1     0 </td <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td>sed Inter</td> <td>val Secor</td> <td>ds</td> <td></td> <td></td> <td></td> <td></td> <td></td>									sed Inter	val Secor	ds					
FieldSummary PartinosColumnColumn Headings LenDec PosNumeric Cap LenNumeric PosCditingNameFunctionsSpacing ImmericColumn Headings ImmericLenPosCdit Cap LenPosEditingInterval NumberInterval NumberImmericImmericImmericImmericImmericDATE42date6ImmericImmericImmericDATE42time4ImmericImmericImmericJBNAME51ImmericImmericImmericImmericImmericJBPOOL2Job PoolImmericImmericImmericImmericJBCPUSEC142cpu secs63ImmericJBNDB141Physical Physical WitesImmericImmericImmericJBRNT142reads per second61ImmericJBRNT142reads per second61ImmericJBRTY2ImmericImmericImmericImmericImmericJBRTY142reads per second61ImmericJBRTY142reads per second61ImmericJBRTY142reads per second61ImmericJBRTY142reads per second61ImmericJBRTY142reads per second6 <td></td> <td>Report colu</td> <td>umn fo</td> <td>ormattin</td> <td>g and sum</td> <td>mary f</td> <td>function</td> <td>s</td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td>		Report colu	umn fo	ormattin	g and sum	mary f	function	s								
Name INTNUMFunctions 4Spacing Column Headings 5Len 5Pos Cap Len Pos 6EditingINTNUM405050DATE TIME42date 106DATE TIME42date 106JBRAME5110JBPOOL22JBCPUCENT142Cpu %53JBCPUSEC141Cpu secs Nonbabase Reads110JBNDB141Physical Nonbabase Reads110JBRTT142reads per second 361JBRTY142reads per second 361JBRTY142reads per second 361JBRTY142reads per second 361JBRTY142reads per second 361JBRTY142reads per second 361JBRTY143reads per second 361JBRTY23-3JBRTY23-3		Summary 1	functi	ions: 1	-Total, 2	-Avera	nge, 3-M	inimum	, 4-Maxim	um, 5-Cou	nt		Overrides			
INTNUM 4 0 5 5 0 Interval Number DATE 4 2 date 6 TIME 4 2 time 4 JBNAME 5 1 10 JBPOOL 2 0 JBPOOL 2 0 JBCPUCENT 1 4 2 cpu % 5 3 JBCPUSEC 1 4 1 cpu secs 6 3 JBCPU 2 11 0 CPU M111 iseconds JBNDB 1 4 1 Physical 11 0 Non Database ReaDPSEC 1 4 2 reads per second 6 1 JBNT 1 4 2 reads per second 6 1 JBPTY 2 Job		Field		Summa	ry Col	umn				De	c Null		Dec Numeric			
DATE       4       2       lnterval         TIME       4       2       time       4         JBNAME       5       1       10       10         JBNAME       5       1       20       20         JBPOOL       2       2       20         JBPONL       14       2       Cpu \$       5       3         JBCPUSEC       14       2       Cpu \$       5       3         JBRDB       14       1       Physical       11       0         Mon Database       1       0       1       0       1         JBMRT       14       1       11       0       0       1         Virtes       1       0       1       0       1       0       1         JBMRT       14       1       11       0       1       0       1       1       1       1       1       1       1       1       1       1       1       1       <		Name		Funct	ions Spa	cing	Column	Headin	gs	Len Po	s Cap	Len	n Pos Editing			
DATE       4       2       date       6         TME       4       2       time       6         TME       4       2       time       6         JBNAME       5       1       10       10         JBNAME       5       3       Job       10         JBPODL       2       2       2       2         JBCPUCENT       1       4       2       cpu %       5       3         JBCPUSEC       1       4       1       cpu secs       6       3         JBCPU       2       CPU       1       0       Non Database       Reads         JBMRT       1       4       1       11       0       0         Marites       -       11       0       0       0         READPSEC       1       4       2       14       0         READPSEC       1       2		INTNUM		4	0					5	0					
DATE     4     2     date     6       TIME     4     2     time     4       JBNAME     5     1     10       JBNAME     5     1     10       JBPOOL     2     2       JBPOOL     2     2       JBCPUCENT     1     4     2       JBCPUSEC     1     4     1       JBROB     1     4     1       JBNDB     1     4     1       JBNDS     1     4     1       JBNDS     1     4       JBNDS     1     0       Marties     1       JBROT     2       JBND     3							Interva	1								
TIME     4     2     time     4       JBNAME     5     1     10       JBPOOL     Job     Name       JBPOOL     2     2       JBPOOL     2     2       JBCPUCENT     1 4     2     cpu %       JBCPUSEC     1 4     2     cpu %     5       JBCPU     2     201       JBCPU     1 4     2     cpu %       JBCPU     1 4     1     cpu %     5       JBCPU     2     11     0       MON     Database     Non     0       MON     Database     11     0       Physical     11     0       Physical     11     0       Physical     1     0       Physical							Number									
JBNAME     5     1     JOB       JBPODL     2     2       JBPODL     2     JOB       JBCPUCENT     1     4     2     Cpu %     5     3       JBCPUSEC     1     4     2     Cpu %     5     3       JBCPUSEC     1     4     1     Cpu %     5     3       JBCPUSEC     1     4     1     Cpu %     5     3       JBCPUSEC     1     4     1     Cpu %     5     3       JBCPU     2     11     0       Milliseconds     Non Database     Non Database     Non Database       READPSEC     1     4     1     Physical       Writes     2     3     3       JBRTY     2     3     3		DATE		4	2		date			6						
JBPOOL     2     2       JBPOOL     2     Job       Pool     Pool       JBCPUCENT     1 4     2       JBCPUSEC     1 4     1       CPU     2     11       JBCPU     2     11       JBCPU     2     11       JBCPU     2     11       JBCPU     2     11       JBRDB     1 4     1       Physical     11       Non Database       READPSEC     1 4       JBRTY     2       Teads       JBPRTY     2       Job		TIME			2		time									
Name       JBPOOL     2     2       JBCPUCENT     1 4     2     cpu %     5     3       JBCPUSEC     1 4     1     cpu %     5     3       JBCPU     2     rum %     5     3       JBCPUSEC     1 4     2     cpu %     5     3       JBCPU     2     11     0       JBCPU     2     10     0       JBNDB     1 4     1     Physical     11     0       JBNNT     1 4     1     Physical     11     0       JBNNT     1 4     1     Physical     11     0       Virites     11     0     0     0       JBNNT     1 4     1     11     0       JBNNT     1 4     1     11     0       JBRTY     2     11     0       JBRTY     2     3     0		JBNAME		5	1					10						
JBPOOL     2     2       JBCPUCENT     1 4     2     cpu %     5     3       JBCPUSEC     1 4     1     cpu secs     6     3       JBCPU     2     11     0     0       JBCPUSEC     1 4     1     cpu secs     6     3       JBCPU     2     11     0       JBDDB     1 4     1     Physical     11       JBNDB     1 4     1     Physical     0       JBWRT     1 4     1     11     0       Physical     Non Database     0     0       Writes     Nrites     0     0       READPSEC     1 4     2     reads per second     6       JBPRTY     2     3     0							Job									
JBCPUCENT     1     4     2     Cpu %     5     3       JBCPUSEC     1     4     1     cpu secs     6     3       JBCPU     2     11     0       JBCPU     2     11     0       JBNDB     1     4     1     Physical       JBNDB     1     4     1     Physical       JBNDB     1     4     1     Physical       JBNDB     1     4     1     11       JBNDB     1     4     1     Physical       JBNDF     1     4     1     11       JBNT     1     4     1     11       JBNDF     2     11     0       JBNDF     1     4     1     1       JBNDF     1     4     1     1       JBNDF     2     3     1							Name									
Pool         JBCPUCENT       1       4       2       cpu %       5       3         JBCPUSEC       1       4       1       cpu secs       6       3         JBCPUSEC       1       4       1       cpu secs       6       3         JBCPU       2       11       0         Milliseconds       Milliseconds       1       0         JBNDB       1       4       1       Physical       11       0         JBWRT       1       4       1       Physical       11       0         Virites       Reads       1       1       0         READPSEC       1       4       2       reads per second       6       1         JBPRTY       2       3       Job       3       3		JBPOOL			2					2						
JBCPUCENT     1     4     2     cpu %     5     3       JBCPUSEC     1     4     1     cpu secs     6     3       JBCPU     2     11     0       CPU     Milliseconds       JBNDB     1     4     1     Physical       JBWRT     1     4     1     11     0       Non Database     Reads     1     1     0       Writes     Nrites     1     1     0       JBRTY     2     2     3       Job     Job     3     3							Job									
JBCPUCENT     1     4     2     cpu %     5     3       JBCPUSEC     1     4     1     cpu secs     6     3       JBCPU     2     11     0       CPU     Milliseconds       JBNDB     1     4     1     Physical       JBWRT     1     4     1     11     0       Non Database     Reads     1     1     0       Writes     Nrites     1     1     0       JBRTY     2     2     3       Job     Job     3     3							Poo1									
JBCPUSEC     1     1     cpu secs     6     3       JBCPU     2     11     0       CPU     Milliseconds       JBNDB     1     4     1     Physical     11     0       Non Database     Reads     1     0       JBWRT     1     4     1     11     0       Writes     1     0     1     0       READPSEC     1     4     2     reads per second     6     1       JBPRTY     2     3     3		JBCPUCENT	Г	14	2					5	3					
JBCPU 2 11 0 CPU Milliseconds JBNDB 1 4 1 Physical 11 0 Non Database Reads JBWRT 1 4 1 10 Physical Writes READPSEC 1 4 2 reads per second 6 1 JBPRTY 2 3 Job				14				s								
CPU Milliseconds JBNDB 1 4 1 Physical 11 0 Non Database Reads JBWRT 1 4 1 10 Physical Writes READPSEC 1 4 2 reads per second 6 1 JBPRTY 2 3		JBCPU			2					11	0					
JBNDB 1 4 1 Physical 11 0 Non Database Reads JBWRT 1 4 1 1 0 Physical Writes READPSEC 1 4 2 reads per second 6 1 JBPRTY 2 3 Job							CPU									
Non Database Reads JBWRT 1 4 1 11 0 Physical Writes READPSEC 1 4 2 reads per second 6 1 JBPRTY 2 3 Job							Millise	conds								
Non Database Reads JBWRT 1 4 1 11 0 Physical Writes READPSEC 1 4 2 reads per second 6 1 JBPRTY 2 3 Job		JBNDB		1 4	1					11	0					
JBWRT 1 4 1 11 0 Physical Writes READPSEC 1 4 2 reads per second 6 1 JBPRTY 2 3 Job																
JBWRT 1 4 1 11 0 Physical Writes READPSEC 1 4 2 reads per second 6 1 JBPRTY 2 3 Job							Reads									
Physical Writes READPSEC 1.4 2 reads per second 6 1 JBPRTY 2 3 Job		JBWRT		14	1					11	0					
Writes READPSEC 1 4 2 reads per second 6 1 JBPRTY 2 3 Job							Physica	1								
READPSEC 1 4 2 reads per second 6 1 JBPRTY 2 3 Job																
JBPRTY 2 3 Job		READPSEC		14	2			er sec	ond	6	1					
Job																
							Job			-						
								у								
								-								
	<u> </u>															

Figure 158. APPNJOIN3 Query Definition, Part 1

		IB	M Query/400		11/25/	96	10:33:	04	Page	3	
Report column for	matting and	i summary	functions (continued)								
Summary function	ns: 1-Tota	al, 2-Aver	age, 3-Minimum, 4-Maxi	mum, 5-Co	unt		Overr	ides			
Field	Summary	Column		De	ec Null		Dec	Numeric			
Name	Functions	Spacing	Column Headings	Len Po	os Cap	Len	Pos	Editing			
INTSEC		2	Elapsed	7	0						
			Interval								
			Seconds								
Report breaks											
Break New Su	opress Bi	reak									
Level Page Sur	nmaries Te	ext									
1 No No											
Selected output a	ttributes										
Output type			Database file								
			Summary only								
Line wrapping .			No								
Database file out	out										
File			APPNTASKS								
Library			MYLIB								
			LIOMTASK1								
			Replace member								
For a new file:											
			*LIBCRTAUT								
Text about											
			line iom (trn) ta	sks - ini	n innut						
Print definition											
Output file record											
Output record le			122								
Field list:											
Field	Begin L	.en Dec	Null Data Type	Text	t						
BREAKLVL	1	1	Character	BRF	- AK LEVEL						
OVERFLOW	2	1	Character		RELOW FL						
INTNUM	3	5 0	Zoned decimal		erval Nu						
INTNUM04	8	5 0	Zoned decimal	INTI		мах					
DATE04	13	6	Character	DATI		MAX					
DATE04	15	-	M Query/400	DAT	11/25/		10:33:	0.4	Page	4	
Output file record	t format (				11/25/	90	10.55.	04	rage	4	
Field list:	i iorinat (t	.oncinueu)									
Field	Begin L	.en Dec	Null Data Type	Text							
TIME04	ведія і 19	.en Dec 4	Character	TIM		мах					
	23	4 7 0	Zoned decimal								
JBNAME05				JBN/		COUNT					
JBCPUCEN01	30	8 3	Zoned decimal			TOTAL					
JBCPUCEN04	38	5 3	Zoned decimal			MAX					
JBCPUSEC01	43	9 3	Zoned decimal			TOTAL					
JBCPUSEC04	52	6 3	Zoned decimal			MAX					
JBNDB01	58	14 0	Zoned decimal	JBNI		TOTAL					
JBNDB04	72	11 0	Zoned decimal	JBNI		MAX					
JBWRT01	83	14 0	Zoned decimal	JBWI		TOTAL					
JBWRT04	97	11 0	Zoned decimal	JBWI		MAX					
READPSEC01	108	9 1	Zoned decimal			TOTAL					
READPSEC04	117	6 1	Zoned decimal			МАХ					
*	* * * *	END	OF QUERY PR	INT *	* * * *						

Figure 159. APPNJOIN3 Query Definition, Part 2

# D.5 CPUALLOC Query (System Processor Usage by Categories)

_							-
-							
5716QU1 V3R6		M Query/400	SYSTEM01	11/25/96	10:33:11	Page	1
			essor usage by ca	tegories			
	age id						
	ryid						
	the decimal separator ch		query ***				
	equence	Hexadecimal					
Processing	options						
	ling						
Ignore de	cimal data errors	No (default)					
	bstitution warnings						
	ting for all compares .	Yes					
Special con							
	records selected by defau	lt ***					
Selected file							
ID File			cord Format				
TO1 QAPM		Q963121422 QA	PMSYSR				
Result fields							
Name	Expression		n Heading	Len D			
CPUTIL	((syscpu+sycpu2+sycpu3+	sycpu4)/ cpu 위		3	1		
	1000)/intsec*100						
BTCHUTIL	((sbcpu/1000)/intsec)*1			3	1		
IAUTIL	((sicpu/1000)/intsec)*1			3	1		
SYSSECS	(syscpu+sycpu2+sycpu3+s	ycpu4)/ total	cpu secs	5	2		
	1000						
DDMSECS	sdcpu/1000	DDM s		5	2		
DDMUTIL	(ddmsecs/intsec)*100	DDM %		3	1		
PCSECS	swcpu/1000		0 secs	5	2		
PCSUTIL	(pcsecs/intsec)*100	CA/40		3	1		
PASSTHRU	spcpu/1000		hru secs	5	2		
PTHUTIL	(passthru/intsec)*100		hru %	3 5	1 2		
MRTSECS MRTUTIL	smcpu/1000 (mrtsecs/intsec)*100	MRT s					
MKIUIIL		MRT %		3	1	D	2
Result fields		M Query/400		11/25/96	10:33:11	Page	Z
Name	Expression	Colum	n Heading	Len D			
S36ESECS	s6cpu/1000		secs	5	2		
S36EUTIL	(s36esecs/intsec)*100	s/36e		3	1		
EVOKESECS	secpu/1000		secs	5	2		
EVOKEUTIL	(evokesecs/intsec)*100	evoke		3	1		
AUTOSECS	sacpu/1000		start secs	5	2		
AUTOUTIL	(autosecs/intsec)*100		start %	3	1		
BATCHSECS	sbcpu/1000		secs	5	2		
IASECS	sicpu/1000	I/A s		5	2		
SPOOLSECS	sxcpu/1000		secs	5	2		
SPOOLUTIL	(spoolsecs/intsec)*100	spool		3	1		
MCODESECS	shcpu/1000		code secs	5	2		
MCODEUTIL	(mcodesecs/intsec)*100	micro	code %	3	1		
TIMESTAMP	substr(dtetim,7,4)	time					
HOUR	substr(dtetim,1,2)	hour					
	elected fields						
Field		/ Break Field					
Name	Priority Descendin	g Level Text					
INTNUM		Interva	1 Number				
TIMESTAMP							
SYSSECS							
CPUTIL							
MCODESECS							
MCODEUTIL							
BATCHSECS							
BTCHUTIL							
IASECS							
IAUTIL							
PCSECS							
PCSUTIL							
PASSTHRU							
PTHUTIL							
EVOKESECS							
EVOKEUTIL							
AUTOSECS							
AUTOUTIL SPOOLSECS							
SPOOLUTIL							
MRTSECS							
MRTUTIL							
DDMSECS							
DDMSECS							
S36ESECS							
S36ESECS S36EUTIL							
HOUR							
noon							

Figure 160. CPUALLOC Query Definition, Part 1

		IB	M Query/400		1	1/25/9	96	10:33:	11	Page	3	
eport column fo										-		
			age, 3-Minimum, 4-Max	kimum, 5∙				Overr				
Field	Summary	Column				Null			Numeric			
Name	Functions		Column Headings		Pos	Cap	Len	Pos	Editing			
INTNUM		0		5	0							
			Interval									
			Number									
TIMESTAMP		2	time	4								
SYSSECS		2	total cpu secs	5	2							
CPUTIL	2	2	cpu %	3	1							
MCODESECS		2	micro code secs	5								
MCODEUTIL	234	2	micro code %	3	1							
BATCHSECS	234	2	batch secs batch %	5	2							
BTCHUTIL	234	2	I/A secs	3 5	2							
IASECS	234	2	I/A secs I/A %	5	2							
IAUTIL PCSECS	2 3 4	2	CA/400 secs	5	2							
PCSUTIL	234	2	CA/400 Secs	3	1							
PASSTHRU	2 3 4	2	passthru secs	5	2							
PTHUTIL	234	2	passthru %	3	1							
EVOKESECS	۷ کا ۲	2	evoke secs	3 5	2							
EVOKESEUS	234	2	evoke secs	5	2							
AUTOSECS	234	2	evoke % auto start secs	3 5	1							
AUTOUTIL	234	2	auto start secs auto start %	5	2							
SPOOLSECS	2 3 4	2	spool secs	5	2							
SPOOLSECS	234	2	spool %	3								
MRTSECS	۷ کا ۲	2	MRT secs	3 5	2							
MRISEUS	234	2	MRT %	5	2							
DDMSECS	۷ کا ۲	2	DDM secs	3	2							
DDMSECS	234	2	DDM secs	3								
S36ESECS	2 3 4	2	s/36e secs	3								
S36EUTIL	234	2	s/36e %	3	1							
HOUR		2	hour	2	1							
elected output	attributes	-	nour	-								
			Database file									
Form of output												
Form of output			Detail									
Line wrapping atabase file ou File Library . Member			. Detail . No M Query/400 . CPUALLOC . MYLIB . CPUALLOC		1	1/25/9	96	10:33:	11	Page	4	
Line wrapping atabase file of File Library Member Data in file For a new file			Detail No M Query/400 CPUALLOC MYLIB CPUALLOC Replace file		1	1/25/9	96	10:33:	11	Page	4	
Line wrapping atabase file of File Library Member Data in file For a new file			. Detail . No M Query/400 . CPUALLOC . MYLIB . CPUALLOC		1	1/25/9	96	10:33:	11	Page	4	
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Figure 161. CPUALLOC Query Definition, Part 2

### D.6 APPNALL Query (ASync Communications I/O Task Activity)

57160U1 V3R6M0 950929 IBM Ouerv/400 SYSTEM01 11/25/96 10:31:52 Page 1 Library . . . . . . . . . . . . . . MYLIB 37 Collating sequence . . . . . . . . . Hexadecimal Use collating for all compares . . . Yes Selected files File Library Record Format ΙD Member APPNTASKS T2TASK1 APPNTASKS T01 MYLIB T02 APPNTASKS MYLIB APPNTASK1 APPNTASKS T03 APPNTASKS MYLIB LIOMTASK1 APPNTASKS SYSNAME SYSNAME SYSNAME T04 MYLIB T05 CPUALLOC MYLIB CPUALLOC CPUALLOC Join tests Type of join . . . . . . . . . . . . Matched records Test Field EQ TO2.INTNUM Field T01.INTNUM T01.INTNUM EQ T03.INTNUM T01.INTNUM EO TO4 INTNUM T01.INTNUM EQ T05.INTNUM Select record tests AND/OR Field T01.BREAKLVL Value (Field, Numbers, or 'Characters') Test EQ IBM Query/400 11/25/96 10:31:52 Page 2 Ordering of selected fields Field Sort Ascending/ Break Field Name Priority Descending Level Text T01.INTNUM Interval Number T01.DATE04 T01.TIME04 DATE мах TIME MAX T04.GDES T05.CPUTIL ((syscpu+sycpu2+sycpu3+sycpu4)/ 1000)/intsec\*100 T02.JBNAME05 JBNAME COUNT T02.JBCPUCEN01 JBCPUCENT TOTAL T02.JBCPUCEN04 JBCPUCENT MAX T02.JBNDB01 JBNDB TOTAL T02.JBWRT01 JBWRT TOTAL T03.JBCPUCEN01 JBCPUCENT TOTAL T03.JBNDB01 JBNDB TOTAL T03.JBWRT01 JBWRT TOTAL JBNAME T01.JBNAME05 COUNT T01.JBCPUCEN01 JBCPUCENT TOTAL T01.JBNDB01 JBNDB TOTAL T01.JBWRT01 JBWRT TOTAL Report column formatting and summary functions Summary functions: 1-Total, 2-Average, 3-Minimum, 4-Maximum, 5-Count Overrides Dec Numeric Field Summary Column Dec Null Functions Spacing Column Headings Len Pos Cap Len Pos Editing Name T01.INTNUM 0 5 0 Interval Number T01.DATE04 DATE 6 1 MAX 4 T01.TIME04 1 TIME MAX T04.GDES 1 GDES 10 T05.CPUTIL 24 2 cpu 🖇 1 T02.JBNAME05 2 JBNAME 7 0 COUNT T02.JBCPUCEN01 2 4 2 JBCPUCENT 8 3 TOTAL T02.JBCPUCEN04 2 JBCPUCENT 5 3 MAX T02.JBNDB01 2 JBNDB 14 0 TOTAL T02.JBWRT01 2 JBWRT 14 0 TOTAL T03.JBCPUCEN01 2 JBCPUCENT 8 3 TOTAL T03.JBNDB01 2 JBNDB 14 0 TOTAL

Figure 162. APPNALL Query Definition, Part 1

lanant column fr	umatting		M Query/400	<b>`</b>	1	1/25/9	90 .	10:31:	52	Page	3	
			functions (continued									
•		-	age, 3-Minimum, 4-Ma	ximum, 5-				0verr				
Field	Summary	Column				Null			Numeric			
Name	Functions		Column Headings			Cap	Len	Pos	Editing			
T03.JBWRT01		2	JBWRT	14	0							
701 100000000			TOTAL	-								
T01.JBNAME05		2	JBNAME	7	0							
T01 10000000000		2	COUNT JBCPUCENT	8	3							
T01.JBCPUCEN01		2	TOTAL	8	3							
T01.JBNDB01		2	JBNDB	14	0							
101.JBNDB01		Z	JENDE	14	0							
			JBWRT									
T01.JBWRT01		2	*=	14	0							
			TOTAL									
Selected output Output type .			Decistor									
Form of output												
Line wrapping			NO									
Printer Output Printer device			*DDINT									
Report size			• • "PKINI									
			66 (default)									
Width												
			132 6 (default)									
			60 (default)									
			Single space									
Print definiti	-		* 1									
Printer Spooled			NO									
			(Defaults to va	luo in n	uint f	51a (	וחווחחר	ארדו /				
			(Defaults to va									
Copies				iue in p	i inc i	116, 1	QrQUri	(IIL)				
			(Defaults to va	luo in n	nint f	Filo (	ופווחפה					
			M Query/400	iue in p		1/25/9			E 2	Page	4	
Cover Page		10	n Query/400		1	1/20/5	. 00	10.31:	JL	raye	4	
Print cover pa	n o		Ves									
Cover page t	-											
		sk resour	ce utilization summa	rv								
Page headings an		JK ICSOUI	ce acriization summa	. 3								
Print standard	-	a	Ves									
Page heading	page neadin	·	103									
rage neading												
Page footing												

Figure 163. APPNALL Query Definition, Part 2

### D.7 APPNDETAIL Query (APPN Tasks - Detailed Resource Usage)

5716QU1 V3R6M0 950929 IBM Query/400 SYSTEM01 11/25/96 10:32:48 Page 1 37 Query country id . . . . . . . . . US \*\*\* . is the decimal separator character for this query \*\*\* Collating sequence . . . . . . . . . Hexadecimal Processing options Use rounding . . . . . . . . . Yes (default) Ignore decimal data errors . . . . No (default) Ignore substitution warnings . . . . Yes Use collating for all compares . . . Yes Selected files Library ID File TO1 QAPMJOBS Member Record Format QPFRDATA TEST1307 OAPMJOBR Result fields JBCPUSEC Expression Column Heading Len Dec jbcpu/1000 cpu secs 6 3 JBCPUCENT (jbcpusec/intsec)\*100 cpu % 5 3 TOSUM jbdbr+jbndb+jbwrt tot i/o 7 0 TOTOPSPSEC iosum/intsec total dasd i/os 6 1 per second READPSEC jbndb/intsec reads per second 6 1 TIME substr(dtetim,7,4) time DATE substr(dtetim,1,6) date IOMSORT substr(jbname,2,2) iom type Select record tests Test Value (Field, Numbers, or 'Characters') AND/OR Field JBCPUSEC GT 0 AND JBNAME LIST ' LMLOCMGR' ' LCCPMGR 'LCCPS' ' I CDS' IBM Query/400 11/25/96 10:32:48 Page 2 Select record tests (continued) Value (Field, Numbers, or 'Characters') AND/OR Field Test 'LCTRS' Ordering of selected fields Sort Ascending/ Break Field Field Name Priority Descending Level Text Interval Number INTNUM 10 А 1 DATE TIME JBNAME Job Name JBPOOL Job Pool JBCPUCENT JBCPUSEC 20 D JBCPU CPU Milliseconds JBNDB Physical Non Database Reads JBWRT Physical Writes READPSEC JBPRTY Job Priority INTSEC Elapsed Interval Seconds Report column formatting and summary functions Summary functions: 1-Total, 2-Average, 3-Minimum, 4-Maximum, 5-Count Overrides Field Summary Column Dec Null Dec Numeric Functions Spacing Column Headings Len Pos Cap Len Pos Editing Name INTNUM 0 5 0 4 Interval Number DATE 4 2 date 6 TIME 4 2 time 4 JBNAME 5 1 10 Joh Name JBPOOL 2 2 Job Poo1 JBCPUCENT 14 2 cpu % 5 3 JBCPUSEC 14 1 cpu secs 6 3 JBCPU 2 11 0 CPU Milliseconds .1RNDR 14 1 Physical 11 0 Non Database Reads

Figure 164. APPNDETAIL Query Definition, Part 1

			M Query/400		1	1/25/9	96	10:32:	48	Page	3	
			functions (continued)	-								
			age, 3-Minimum, 4-Maximu	um, 5-				Overr				
Field	Summary	Column				Null			Numeric			
Name	Functions		Column Headings	Len	Pos	Cap	Len	Pos	Editing			
JBWRT	1 4	1		11	0							
			Physical									
		_	Writes									
READPSEC	1 4	2	reads per second	6	1							
JBPRTY		2		3								
			Job									
INTOFO		0	Priority	-								
INTSEC		2	Elapsed	7	0							
			Interval Seconds									
and the second sec			Seconds									
eport breaks	Suppose D-	a a k										
Break New Level Page		reak										
Level Page 1 No	No											
I NO elected output												
			Dicplay									
Form of output												
Line wrapping												
atabase file c												
			APPNTASKS									
			APPNTASK1									
			Replace member									
For a new fil			· · Reprace member									
			*LIBCRTAUT									
Text about												
			appn tasks - join	input								
	ion											
			M Query/400		1	1/25/9	96	10:32:	48	Page	4	
utput file rec	ord format									3 =		
			67									
Output record												
Output record Field list:				Т	ext							
	Begin L	.en Dec	Null Data Type									
Field list:	Begin L 1	en Dec. 50	Null Data Type Packed decimal	I	nterv	al Nur	nber					
Field list: Field	-		••		nterv ubstr			6)				
Field list: Field INTNUM	1	5 0	Packed decimal	s		(dtet	im,1,					
Field list: Field INTNUM DATE	1 4	5 0 6	Packed decimal Character	s s	ubstr	(dtet (dtet	im,1,					
Field list: Field INTNUM DATE TIME	1 4 10	5 0 6 4	Packed decimal Character Character	s J	ubstr ubstr	(dtet (dtet me	im,1,					
Field list: Field INTNUM DATE TIME JBNAME	1 4 10 14	5 0 6 4 10	Packed decimal Character Character Character	s J J	ubstr ubstr ob Na ob Po	(dtet (dtet me ol	im,1, im,7,					
Field list: Field INTNUM DATE TIME JBNAME JBPOOL	1 4 10 14 24	5 0 6 4 10 2	Packed decimal Character Character Character Character	s J J (	ubstr ubstr ob Na ob Po	(dtet (dtet me ol sec/in	im,1, im,7,	4)				
Field list: Field INTNUM DATE TIME JBNAME JBPOOL JBCPUCENT	1 4 10 14 24 26 31	5 0 6 4 10 2 5 3	Packed decimal Character Character Character Character Zoned decimal	s J J ( j	ubstr ubstr ob Na ob Po jbcpu	(dtet (dtet me ol sec/in 1000	im,1, im,7, ntsec	4) )*100				
Field list: Field INTNUM DATE TIME JBNAME JBPOOL JBCPUCENT JBCPUSEC	1 4 10 14 24 26 31 37	5 0 6 4 10 2 5 3 6 3	Packed decimal Character Character Character Character Zoned decimal Zoned decimal	s J J ( j C	ubstr ob Na ob Po jbcpu bcpu/ PU Mi	(dtet (dtet me ol sec/in 1000 llised	im,1, im,7, ntsec conds	4) )*100	Reads			
Field list: Field INTNUM DATE TIME JBNAME JBPOOL JBCPUCENT JBCPUSEC JBCPU	1 4 10 14 24 26 31 37 43	5 0 6 4 10 2 5 3 6 3 11 0	Packed decimal Character Character Character Zoned decimal Zoned decimal Packed decimal	s J J ( j C P	ubstr ob Na ob Po jbcpu bcpu/ PU Mi	(dtet (dtet ol sec/in 1000 llised al Nor	im,1, im,7, ntsec conds n Dat	4) )*100	Reads			
Field list: Field INTNUM DATE TIME JBNAME JBPOOL JBCPUCENT JBCPUSEC JBCPU JBNDB	1 4 10 14 24 26 31 37 43	5 0 6 4 10 2 5 3 6 3 11 0 11 0	Packed decimal Character Character Character Zoned decimal Packed decimal Packed decimal	s J J ( j C P P	ubstr ob Na ob Po jbcpu bcpu/ PU Mi hysic	(dtet (dtet me ol sec/in 1000 llise al Non al Wr	im,1, im,7, ntsec conds n Dat ites	4) )*100	Reads			
Field list: Field INTNUM DATE TIME JBNAME JBCPUCENT JBCPUSEC JBCPU JBNDB JBWRT	1 4 10 14 24 26 31 37 43 49	5 0 6 4 10 2 5 3 6 3 11 0 11 0 11 0	Packed decimal Character Character Character Zoned decimal Packed decimal Packed decimal Packed decimal	s J J C P J J J J J J J J J	ubstr ob Na ob Po jbcpu/ PU Mi hysic	(dtet (dtet me ol sec/in 1000 1lised al Non al Wr intsed	im,1, im,7, ntsec conds n Dat ites c	4) )*100	Reads			
Field list: Field INTNUM DATE TIME JBNAME JBPOOL JBCPUSEC JBCPU JBCPU JBCPU JBNDB JBNDB JBNRT READPSEC	1 4 10 14 24 26 31 37 43 49 55	$\begin{array}{cccc} 5 & 0 \\ 6 \\ 4 \\ 10 \\ 2 \\ 5 \\ 3 \\ 6 \\ 3 \\ 11 \\ 0 \\ 11 \\ 0 \\ 11 \\ 0 \\ 6 \\ 1 \end{array}$	Packed decimal Character Character Character Zoned decimal Packed decimal Packed decimal Packed decimal	s J J J ( j C P P J J	ubstr ob Na ob Po jbcpu bcpu/ PU Mi hysic hysic bndb/ ob Pr	(dtet (dtet me ol sec/in 1000 llised al Non al Wr intsed iority	im,1, im,7, ntsec conds n Dat ites c y	4) )*100				

Figure 165. APPNDETAIL Query Definition, Part 2

# D.8 APPNT2DTL Query (T2 Station IOP Task Detail)

<u> </u>												
	5716QU1 V				BM Query/40		SYSTEM01	11/25/96	13	3:51:35	Page	1
	Query .				APPNT	2DTL						
	Library	y			MYLIB							
	Query te	xt.										
						r this query *	**					
	Collating	g sequ	ence		Hexad	ecimal						
	Processi	ng opt	ions									
	Use ro	unding			Yes (	default)						
					No (d							
				rnings .								
				compares.								
			g ioi aii	compares	· · · 165							
	Selected f											
		ile		brary	Member	Record Fo	rmat					
	T01 Q/	APMJOB	S QF	FRDATA	Q96312142	2 QAPMJOBR						
	Result fie	lds										
	Name	Ex	pression			Column Headi	ng	Len	Dec			
	JBCPUSEC	ib	cpu/1000			cpu secs		6	3			
	JBCPUCEN		bcpusec/ir	tsec)*100		cpu %		5	3			
	IOSUM		dbr+jbndb+			tot i/o		7	Ő			
							1					
	101062621	EC 10	sum/intsec			total dasd i		6	1			
						per second						
	READPSEC	-	ndb/intsec			reads per se	cond	6	1			
	TIME	su	bstr(dteti	m,7,4)		time						
	DATE	su	bstr(dteti	m,1,6)		date						
	IOMSORT		bstr(jbnam			iom type						
	Select rec			.,-,-/								
	AND/OR	Field		Test	Value (Fi	eld, Numbers,	or 'Cham	actors()				
	AND/ UK	JBCPU		GT	Value (F1 0	cia, nullipers,	or undr	uccers )				
	AND	JBNAM	E	LIKE	′T2-%′							
					BM Query/40	0		11/25/96	13	3:51:35	Page	2
	Ordering o	f sele	cted field	ls								
	Field		Sort	Ascendin	g/ Break	Field						
	Name		Priority	Descendi	ng Level	Text						
	INTNUM		10	A		Interval Numbe	r					
	DATE		10	A	1	Incervar Nambe						
	TIME											
	JBNAME					Job Name						
	JBPOOL					Job Pool						
	JBCPUCEN	Т										
	JBCPUSEC		20	D								
	JBCPU					CPU Millisecon	ds					
	JBNDB					Physical Non D		Reads				
	JBWRT					Physical Write		neuus				
						rnysical write	5					
	READPSEC											
	JBPRTY					Job Priority						
	INTSEC					Elapsed Interv	al Secon	ds				
	Report col	umn fo	rmatting a	ind summary	functions							
	Summary	functi	ons: 1-To	tal, 2-Ave	rage, 3-Min	imum, 4-Maximu	m, 5-Cou	nt	(	Overrides		
	Field		Summary	Column			De	c Null		Dec Numeric		
	Name		-		Column He	adings	Len Po			Pos Editing		
	INTNUM		4	0		<b>J</b> -		0				
				·	Interval		5	-				
					Number							
	DATE		4	2	date		6					
	TIME		4	2	time		4					
	JBNAME		5	1			10					
					Job							
					Name							
	JBPOOL			2			2					
	ODIUUL			-	Job		-					
	10.05	-			Pool		-					
	JBCPUCEN		14	2	cpu %			3				
	JBCPUSEC		14	1	cpu secs			3				
	JBCPU			2			11	0				
					CPU							
					Milliseco	nds						
	JBNDB		1 4	1	Physical		11	0				
				-	Non Datab	ase		-				
					Reads							
	101/27		1.4		ĸeadS			•				
	JBWRT		14	1			11	0				
					Physical							
					Writes							
	READPSEC		1 4	2	reads per	second	6	1				
	JBPRTY			2			3					
					Job		-					
					Priority							
					instity							

Figure 166. APPNT2DTL Query Definition, Part 1

			BM Query/400		11	/25/96	1	3:51:	35	Page	3		
Report column	formatting a	nd summary	functions (continued)										
Summary func	tions: 1-To	tal, 2-Ave	rage, 3-Minimum, 4-Max	imum, 5-	Count			Overr	ides				
Field	Summary	Column			Dec	Null		Dec	Numeric				
Name	Function	s Spacing	Column Headings	Len	Pos	Cap	Len	Pos	Editing				
INTSEC		2	Elapsed Interval Seconds	7	0								
Report breaks													
Break New	Suppress	Break											
Level Page	Summaries	Text											
1 No	No												
Selected outpu	it attributes												
Output type			Display										
Form of outp	out		Detail										
Line wrappin	g		No										
Database file	output												
File			APPNTASKS										
Library .			MYLIB										
Member			T2TASK1										
Data in file			Replace file										
For a new fi	le:												
Authoritv			*LIBCRTAUT										
Text about													
Text about the file			t2 station iom t	asks - j	oin ir	iput							
Text about the file Print defini	 tion			asks - j	oin ir	iput							
Text about the file Print defini Dutput file re	tion cord format		No	asks – j	oin ir	iput							
Text about the file Print defini Dutput file re Output recor	 tion		No	asks – j	oin ir	iput							
Text about the file Print defini Dutput file re Output recor Field list:	tion cord format d length		No	-		iput							
Text about the file Print defini Dutput file re Output recor Field list: Field	tion cord format d length . Begin		No 67 Null Data Type	T	ext								
Text about the file Print defini Dutput file re Output recor Field list: Field INTNUM	tion cord format d length . Begin 1		No 67 Null Data Type Packed decimal	T	ext nterva	1 Numb							
Text about the file Print defini Dutput file re Output recor Field list: Field INTNUM DATE	tion cord format d length . Begin 1 4	Len Dec 5 0 6	No 67 Null Data Type Packed decimal Character	T I S	ext nterva ubstr(	1 Numb	1,1,6						
Text about the file Print defini Dutput file re Output recor Field list: Field INTNUM	tion cord format d length . Begin 1		No 67 Null Data Type Packed decimal	T I S	ext nterva ubstr(	1 Numb	1,1,6						
Text about the file Print defini Dutput file re Output recor Field list: Field INTNUM DATE TIME JBNAME	tion cord format d length . Begin 1 4 10 14	 Len Dec 5 0 6 4 10	No 67 Null Data Type Packed decimal Character Character Character	T I S J	ext nterva ubstr( ubstr(	1 Numb dtetim dtetim	1,1,6						
Text about the file Print defini Dutput file re Output recor Field list: Field INTNUM DATE TIME	tion cord format d length . Begin 1 4 10	Len Dec 5 0 6 4 10 2	No 67 Null Data Type Packed decimal Character Character Character Character	T I S J	ext nterva ubstr( ubstr( ob Nam ob Poc	1 Numb dtetim dtetim ne	n,1,6 n,7,4	)					
Text about the file Print defini Dutput file re Output recor Field list: Field list: INTNUM DATE TIME JBNAME JBPOOL	tion cord format d length . Begin 1 4 10 14 24	 Len Dec 5 0 6 4 10 2	No Null Data Type Packed decimal Character Character Character Character BM Query/400	T I S J	ext nterva ubstr( ubstr( ob Nam ob Poc	1 Numb dtetim dtetim	n,1,6 n,7,4		35	Page	4		
Text about the file Print defini Dutput file re Output recor Field list: Field INTNUM DATE TIME JBNAME JBPOOL Dutput file re	tion cord format d length . Begin 1 4 10 14 24	 Len Dec 5 0 6 4 10 2	No Null Data Type Packed decimal Character Character Character Character BM Query/400	T I S J	ext nterva ubstr( ubstr( ob Nam ob Poc	1 Numb dtetim dtetim ne	n,1,6 n,7,4	)	35	Page	4		
Text about the file Print defini Dutput file re Output recor Field list: Field INTNUM DATE TIME JBNAME JBPOOL Dutput file re Field list:	tion cord format d length . Begin 1 4 10 14 24 ecord format	Len Dec 5 0 6 4 10 2 11 (continued	No Null Data Type Packed decimal Character Character Character Character Character M Query/400	T I S J J	ext nterva ubstr( ubstr( ob Nam ob Poc 11	1 Numb dtetim dtetim ne	n,1,6 n,7,4	)	35	Page	4		
Text about the file Print defini Dutput file re Output recor Field list: JBPOOL JBPOOL Dutput file re Field list: Field	tion ecord format d length 1 4 10 14 24 ecord format Begin		No Null Data Type Packed decimal Character Character Character Character Character BM Query/400 Null Data Type	T I S J J T	ext nterva ubstr( ubstr( ob Nam ob Poc 11 ext	dtetim dtetim dtetim Ne /25/96	i,1,6 i,7,4	.3:51:	35	Page	4		
Text about the file Print defini Dutput file re Output recor Field list: Field INTNUM DATE TIME JBNAME JBPOOL Dutput file re Field list: Field JBCPUCENT	tion ecord format d length Begin 4 10 14 24 ecord format Begin 26		No 67 Null Data Type Packed decimal Character Character Character Character BM Query/400 Null Data Type Zoned decimal	T I S J J J T (	ext nterva ubstr( ubstr( ob Nam ob Poc 11 ext jbcpus	dtetim dtetim dtetim 25/96 ec/int	i,1,6 i,7,4	.3:51:	35	Page	4		
Text about the file Print defini Dutput file re Output recor Field list: Field JBNAME JBPOOL Dutput file re Field list: Field list: Field list:	tion ecord format d length 1 4 10 14 24 ecord format Begin 26 31	Len Dec 5 0 6 4 10 2 11 (continued, 5 3 6 3	No Null Data Type Packed decimal Character Character Character SM Query/400 Null Data Type Zoned decimal Zoned decimal	T I J J J T ( j	ext nterva ubstr( ob Nam ob Poc 11 ext jbcpus bcpu/1	dtetim dtetim e /25/96 ec/int .000	1,1,6 1,7,4 5 1	.3:51:	35	Page	4		
Text about the file Print defini Dutput file re Output recor Field list: Field INTNUM JBROOL JBPOOL Dutput file re Field list: Field JBCPUSET JBCPUSET JBCPUS	tion eccord format d length 1 4 10 14 24 eccord format Begin 26 31 37	Len Dec 5 0 6 4 10 2 II (continued) Len Dec 5 3 6 3 11 0	No Null Data Type Packed decimal Character Character Character Character BM Query/400 Null Data Type Zoned decimal Packed decimal	T I J J J T J C C C	ext nterva ubstr( ob Nam ob Poc 11 ext jbcpus bcpu/1 PU Mil	I Numb dtetim dtetim e /25/96 ec/int 000 liseco	n, 1, 6 n, 7, 4 5 1 :sec)	*100		Page	4		
Text about the file Print defini Dutput file re Output recor Field list: Field INTNUM DATE TIME JBNOME Dutput file re Field list: Field JBCPUSENT JBCPUSENT JBCPUS	tion	Len Dec 5 0 6 4 10 2 11 (continued, 5 3 6 3 11 0 11 0	No Null Data Type Packed decimal Character Character Character Character BM Query/400 Null Data Type Zoned decimal Packed decimal Packed decimal	T I S J J T ( ( J P P	ext nterva ubstr( ubstr( ob Nam ob Poc 11 ext jbcpus bcpu/1 PU Mil hysica	1 Numb dtetim dtetim e /25/96 ec/int 000 liseco 1 Non	n,1,6 n,7,4 sec) onds Data	*100		Page	4		
Text about the file Print defini Dutput file re Output recor Field list: Field list: TIME JBNAME JBPOOL Dutput file re Field list: Field list: Field JBCPUECT JBCPUSEC JBCPU JBNDB JBNDB	tion eccord format d length . Begin 1 4 10 14 24 eccord format Begin 26 31 37 43 49	Len Dec 5 0 6 4 10 2 II (continued Len Dec 5 3 6 3 11 0 11 0 11 0	No Null Data Type Packed decimal Character Character Character Character Character SM Query/400 Null Data Type Zoned decimal Packed decimal Packed decimal Packed decimal	T I J J T ( j P P	ext nterva ubstr( ubstr( ob Nam ob Poc 11 ext jbcpus bcpu/1 PU Mil hysica hysica	dtetim dtetim ee /25/96 eec/int 000 liseco il Non il Writ	n,1,6 n,7,4 sec) onds Data	*100		Page	4		
Text about the file Print defini Dutput file re Output recor Field list: Field INTNUM JBPOOL Dutput file re Field list: Field JBCPUEST JBCPUEST JBCPUS JBNDB JBWRT READPSEC	tion ecord format d length 1 4 10 14 24 ecord format Begin 26 31 37 43 49 55	Len Dec 5 0 6 4 10 2 7 [] (continued Len Dec 5 3 6 3 11 0 11 0 11 0 6 1	No Null Data Type Packed decimal Character Character Character Character Character BM Query/400 Null Data Type Zoned decimal Packed decimal Packed decimal Zoned decimal Character	T I J J T ( j C P P J j j	ext nterva ubstr( ob Nam ob Poc 11 ext jbcpus bcpu/1 PU Mil hysica hysica bndb/i	dtetim dtetim ee /25/96 /25/96	n,1,6 n,7,4 sec) onds Data	*100		Page	4		
Text about the file Print defini Dutput recor Field list: Field INTNUM DATE TIME JBNOML JBPOOL Dutput file re Field list: Field JBCPUSEC JBCPUS JBNDB JBNDB JBNDB JBNDFSEC JBPRTY	tion cord format d length . Begin 14 24 ecord format Begin 26 31 37 43 49 55 61		No Null Data Type Packed decimal Character Character Character Character BM Query/400 Null Data Type Zoned decimal Packed decimal Packed decimal Character Null Data Type Zoned decimal Character Character Null Data Type Zoned decimal Character Character Null Data Type Zoned decimal Character Character	T I J J J T ( ( C P P P J J	ext nterva ubstr( ob Nam ob Poc 11 ext 11 PU Mil hysica bndb/i ob Pri	dtetim dtetim e	n,1,6 n,7,4 i,7,4 i 1 ssec) unds Data es	) 3:51: *100 base	Reads	Page	4		
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Figure 167. APPNT2DTL Query Definition, Part 2

#### Appendix E. SNA Queries

This appendix provides query definitions that can be used to examine SNA environments. All of the queries use input from the OS/400 Performance Monitor and run with trace options. There are eight queries defined:

- SNA\_ALL
- SNA\_CON
- SNA\_IPAC
- SNA\_PAC1
- SNA\_PAC2
- SNA\_PAC3
- SNA\_LIN
- SNA\_TRQ

The SNA\_ALL query is simple. It shows you all of the values in the QAPMSNA file. The only thing you have to define is the file name and member name that contains the performance data. The rest are defaults so it takes you only a few minutes to create the query.

The SNA\_CON query shows you the number of connections started and ended, the number of sessions started and ended, and the number of start and end brackets sent and received.

The SNA\_IPAC query shows you the internal session level pacing wait time per session type/priority.

The SNA\_PAC1 query shows you the average pacing response time per session type/priority.

The SNA\_PAC2 query shows you the percent pacing wait per session type/priority.

The SNA\_PAC3 query shows you the average pacing window size per session type/priority.

The SNA\_LIN query shows you the line transmission time per session type/priority.

The SNA\_TRQ query shows you the transmission queue wait time per session type/priority.

# E.1 SNA\_ALL

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	STSKNM						ion I/O Manager					
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	SCTYP						ler Type					
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	SRMFS						Maximum Frame					
	STLLBU					Date ar	nd Time of Most	Recent Con	nection			
	SNLBU					Connect	ions Establishe	d with Remo	ote System			
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Figure 168. SNA\_ALL Query Definition, Part 1

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Ordering of	selected fields					
Field	Sort	Ascending/	Break	Field		
Name	Priority	Descending	Leve1			
ENQTRR				N - Transmission Queue Wait Time		
ENNRUD				N - RUs Delivered to Adjacent System		
ENTRUD				N - Length of RUs Delivered to Adjacent System N - Service Time to Deliver RU to Adjacent System		
ENNRUR				N - RUs Received from Adjacent System		
ENLRUR				N - Length of RUs Received from Adjacent System		
EHNSS				High Priority Sessions Started		
EHNSE				High Priority Sessions Ended		
EHNBB				H - Begin Bracket Request Units		
EHNEB				H - End Bracket Request Units		
EHSPWT				H - Session-level Send Pacing Wait Time		
EHSPNW				H - Session-level Send Pacing Waits		
EHSPPW				H - Session-level Send Pacing Potential Waits		
EHSPWS				H - Session-level Send Pacing Window Size		
EHIPWT EHIPNW				H - Internal Session-level Pacing Wait Time H - Internal Session-level Pacing Waits		
EHQNRE				H - RUs Entering Transmission Queue		
EHQLRE				H - Length of RUs Entering Transmission Queue		
EHQNRL				H - RUs Leaving Transmission Queue		
EHQLRL				H - Length of RUs Leaving Transmission Queue		
EHQTRR				H - Transmission Queue Wait Time		
EHNRUD				H - RUs Delivered to Adjacent System		
EHLRUD				H - Length of RUs Delivered to Adjacent System		
EHTRUD				H - Service Time to Deliver RU to Adjacent System		
EHNRUR				H - RUs Received from Adjacent System		
EHLRUR				H - Length of RUs Received from Adjacent System		
EMNSS				Medium Priority Sessions Started		
EMNSE				Medium Priority Sessions Ended M - Begin Bracket Request Units		
EMNBB EMNEB						
EMNEB				M - End Bracket Request Units M - Session-level Send Pacing Wait Time		
EMSPNW				M - Session-level Send Pacing Waits		
EMSPPW				M - Session-level Send Pacing Potential Waits		
		IBM	Query/4	-	Page	4
Ordering of	selected fields					
Field	Sort	Ascending/	Break			
Field Name	Sort		Break	Text		
Field Name EMSPWS	Sort	Ascending/	Break	Text M - Session-level Send Pacing Window Size		
Field Name EMSPWS EMIPWT	Sort	Ascending/	Break	Text M - Session-level Send Pacing Window Size M - Internal Session-level Pacing Wait Time		
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Field           Name           EMSPWS           EMIPWT           EMIPWT           EMQRE           EMNRUD           EMRUD           EMRUD           EMRUD           ELNSE           ELSPN           ELSPNW           ELSPNW           ELSPNW           ELIPNW           ELQARE           ELQNRL           ELQRRL           ELQUTLR           ELNUD	Sort	Ascending/	Break	Text M - Session-level Send Pacing Window Size M - Internal Session-level Pacing Wait Time M - Internal Session-level Pacing Waits M - RUS Entering Transmission Queue M - Length of RUS Entering Transmission Queue M - RUS Leaving Transmission Queue M - RUS Leaving Transmission Queue M - RUS Leaving Transmission Queue M - RUS Delivered to Adjacent System M - Length of RUS Delivered to Adjacent System M - Length of RUS Delivered to Adjacent System M - RUS Received from Adjacent System M - Length of RUS Received from Adjacent System L ow Priority Sessions Started Low Priority Sessions Started Low Priority Sessions Lended L - Begin Bracket Request Units L - Session-level Send Pacing Wait Time L - Session-level Send Pacing Wait S L - Session-level Send Pacing Waits L - Internal Session-level Pacing Wait L - Internal Session-level Pacing Wait L - RUS Entering Transmission Queue L - Length of RUS Leaving Transmission Queue L - RUS Delivered to Adjacent System		
Field Name EMSPWS EMIPWT EMIPWT EMURE EMQNRL EMQNRL EMQNRL EMQNRL EMQNRL EMURUD EMIRUD EMIRUD EMIRUD EMIRUD ELINSE ELINSE ELINSE ELISPW ELISPW ELISPW ELISPW ELISPW ELIPNW ELIPNW ELQNRE ELQNRL ELQNRL ELQNRL	Sort	Ascending/	Break	Text M - Session-level Send Pacing Window Size M - Internal Session-level Pacing Wait Time M - Internal Session-level Pacing Waits M - RUS Entering Transmission Queue M - Length of RUS Entering Transmission Queue M - RUS Leaving Transmission Queue M - RUS Leaving Transmission Queue M - RUS Leaving Transmission Queue M - RUS Delivered to Adjacent System M - RUS Delivered to Adjacent System M - Service time to Deliver RU to Adjacent System M - Service time to Deliver RU to Adjacent System M - RUS Received from Adjacent System M - RUS Received from Adjacent System M - RUS Received from Adjacent System M - RUS Received Intox Low Priority Sessions Started Low Priority Sessions Started Low Sesion-level Send Pacing Waits L - Session-level Pacing Waits L - Session-level Pacing Waits L - Sustentring Transmission Queue L - Length of RUS Entering Transmission Queue L - RUS Leaving Transmission Queue L - Length of RUS Leaving Transmission Queue L - Length of RUS Leaving Transmission Queue L - Length of RUS Leaving Transmission Queue L - RUS Delivered to Adjacent System L - Length of RUS Delivered to Adjacent System		
Field Name EMSPWS EMIPWT EMIPWT EMIPWT EMQRE EMQRE EMQRE EMQRE EMQLE EMQLE EMQLE EMQLE EMQLE EMQLE EMQLE EMQLE EMQLE EMQLE EMQLE EMRUD ELSPN	Sort	Ascending/	Break	Text M - Session-level Send Pacing Window Size M - Internal Session-level Pacing Wait Time M - Internal Session-level Pacing Waits M - RUS Entering Transmission Queue M - Length of RUS Entering Transmission Queue M - RUS Leaving Transmission Queue M - RUS Leaving Transmission Queue M - RUS Leaving Transmission Queue M - Transmission Queue Wait Time M - RUS Delivered to Adjacent System M - Length of RUS Delivered to Adjacent System M - RUS Leaving Transmission Queue Longth of RUS Deliver RU to Adjacent System M - RUS Received from Adjacent System M - Length of RUS Received from Adjacent System Low Priority Sessions Ended L - Begin Bracket Request Units L - End Bracket Request Units L - Session-level Send Pacing Wait Time L - Session-level Send Pacing Mait S L - Session-level Send Pacing Mait S L - Sussion-level Send Pacing Waits L - Sussion-level Pacing Waits L - Sussion-level Pacing Waits L - Internal Session-level Pacing Waits L - RUS Entering Transmission Queue L - Length of RUS entering Transmission Queue L - Session Queue Wait Time L - RUS Leaving Transmission Queue L - Transmission Queue Wait Time L - RUS Delivered to Adjacent System L - Length of RUS Delivered to Adjacent System L - Service Time to Deliver RU to Adjacent System		
Field Name EMSPWS EMIPWT EMIPWT EMURE EMQNRL EMQNRL EMQNRL EMQNRL EMQNRL EMURUD EMIRUD EMIRUD EMIRUD EMIRUD ELINSE ELINSE ELINSE ELISPW ELISPW ELISPW ELISPW ELISPW ELIPNW ELIPNW ELQNRE ELQNRL ELQNRL ELQNRL	Sort	Ascending/	Break	Text M - Session-level Send Pacing Window Size M - Internal Session-level Pacing Wait Time M - Internal Session-level Pacing Waits M - RUS Entering Transmission Queue M - Length of RUS Entering Transmission Queue M - RUS Leaving Transmission Queue M - RUS Leaving Transmission Queue M - RUS Leaving Transmission Queue M - RUS Delivered to Adjacent System M - RUS Delivered to Adjacent System M - Service time to Deliver RU to Adjacent System M - Service time to Deliver RU to Adjacent System M - RUS Received from Adjacent System M - RUS Received from Adjacent System M - RUS Received from Adjacent System M - RUS Received Intox Low Priority Sessions Started Low Priority Sessions Started Low Sesion-level Send Pacing Waits L - Session-level Pacing Waits L - Session-level Pacing Waits L - Sustentring Transmission Queue L - Length of RUS Entering Transmission Queue L - RUS Leaving Transmission Queue L - Length of RUS Leaving Transmission Queue L - Length of RUS Leaving Transmission Queue L - Length of RUS Leaving Transmission Queue L - RUS Delivered to Adjacent System L - Length of RUS Delivered to Adjacent System		

Figure 169. SNA\_ALL Query Definition, Part 2

		IBM	Query/4	00 11/27/96 14:56:16	Page	5
Ordering of	selected fields			• • • • • • •	5	
Field	Sort	Ascending/	Break	Field		
Name	Priority	Descending				
INNSS		beseenang	20101	Network Priority Sessions Started		
INNSE				Network Priority Sessions Ended		
INNBB				N - Begin Bracket Request Units		
INNEB				N - End Bracket Request Units		
INSPWT				N - Session-level Send Pacing Wait Time		
INSPNW				N - Session-level Send Pacing Waits		
INSPPW				N - Session-level Send Pacing Potential Waits		
INSPWS				N - Session-level Send Pacing Window Size		
INIPWT				N - Internal Session-level Pacing Wait Time		
INIPNW				N - Internal Session-level Pacing Waits		
INQNRE				N - RUs Entering Transmission Queue		
INQLRE				N - Length of RUs Entering Transmission Queue		
INQNRL				N - RUs Leaving Transmission Queue		
INQLRL				N - Length of RUs Leaving Transmission Queue		
INQTRR				N - Transmission Queue Wait Time		
INNRUD				N - RUs Delivered to Adjacent System		
INLRUD				N - Length of RUs Delivered to Adjacent System		
INTRUD				N - Service Time to Deliver RU to Adjacent System		
INNRUR				N - RUs Received from Adjacent System		
INLRUR				N - Length of RUs Received from Adjacent System		
IHNSS				High Priority Sessions Started		
IHNSE				High Priority Sessions Ended		
IHNBB				H - Begin Bracket Request Units		
IHNEB				H - End Bracket Request Units		
IHSPWT				H - Session-level Send Pacing Wait Time		
IHSPNW				H - Session-level Send Pacing Waits		
IHSPPW				H - Session-level Send Pacing Potential Waits		
IHSPWS				H - Session-level Send Pacing Window Size		
IHIPWT				H - Internal Session-level Pacing Wait Time		
IHIPNW				H - Internal Session-level Pacing Waits		
IHQNRE				H - RUs Entering Transmission Queue		
IHQLRE				H - Length of RUs Entering Transmission Queue		
IHQNRL				H - RUs Leaving Transmission Queue		
		TDM	Query/4	00 11/27/96 14:56:16	Page	6
		1 DPI	Quei y/ 4			
Ordering of	selected fields					
Ordering of Field	selected fields Sort	(continued)				
	Sort	(continued) Ascending/	Break	Field		
Field Name	Sort	(continued)	Break	Field Text		
Field Name IHQLRL	Sort	(continued) Ascending/	Break	Field Text H - Length of RUs Leaving Transmission Queue		
Field Name IHQLRL IHQTRR	Sort	(continued) Ascending/	Break	Field Text H - Length of RUs Leaving Transmission Queue H - Transmission Queue Wait Time		
Field Name IHQLRL IHQTRR IHNRUD	Sort	(continued) Ascending/	Break	Field Text H - Length of RUs Leaving Transmission Queue H - Transmission Queue Wait Time H - RUs Delivered to Adjacent System		
Field Name IHQLRL IHQTRR IHNRUD IHLRUD	Sort	(continued) Ascending/	Break	Field Text H - Length of RUs Leaving Transmission Queue H - Transmission Queue Wait Time H - RUs Delivered to Adjacent System H - Length of RUs Delivered to Adjacent System		
Field Name IHQLRL IHQTRR IHNRUD IHLRUD IHTRUD	Sort	(continued) Ascending/	Break	Field Text H - Length of RUs Leaving Transmission Queue H - Transmission Queue Wait Time H - RUs Delivered to Adjacent System H - Length of RUs Delivered to Adjacent System H - Service Time to Deliver RU to Adjacent System		
Field Name IHQLRL IHQTRR IHNRUD IHLRUD IHTRUD IHTRUD	Sort	(continued) Ascending/	Break	Field Text H - Length of RUS Leaving Transmission Queue H - Transmission Queue Wait Time H - RUS Delivered to Adjacent System H - Length of RUS Delivered to Adjacent System H - Service Time to Deliver RU to Adjacent System H - RUS Received from Adjacent System		
Field Name IHQLRL IHQTRR IHNRUD IHLRUD IHTRUD IHTRUD IHNRUR IHLRUR	Sort	(continued) Ascending/	Break	Field Text H - Length of RUs Leaving Transmission Queue H - Transmission Queue Wait Time H - RUS Delivered to Adjacent System H - Length of RUS Delivered to Adjacent System H - RUS Received from Adjacent System H - Length of RUS Received from Adjacent System		
Field Name IHQLRL IHQTRR IHNRUD IHLRUD IHTRUD IHNRUR IHLRUR IMNSS	Sort	(continued) Ascending/	Break	Field Text H - Length of RUs Leaving Transmission Queue H - Transmission Queue Wait Time H - RUS Delivered to Adjacent System H - Length of RUs Delivered to Adjacent System H - Service Time to Deliver RU to Adjacent System H - Length of RUs Received from Adjacent System Medium Priority Sessions Started		
Field Name IHQLRL IHQTRR IHNRUD IHLRUD IHTRUD IHTRUD IHNRUR IHLRUR	Sort	(continued) Ascending/	Break	Field Text H - Length of RUs Leaving Transmission Queue H - Transmission Queue Wait Time H - RUS Delivered to Adjacent System H - Length of RUS Delivered to Adjacent System H - RUS Received from Adjacent System H - Length of RUS Received from Adjacent System		
Field Name IHQLRL IHQTRR IHNRUD IHLRUD IHTRUD IHNRUR IHLRUR IMNSS	Sort	(continued) Ascending/	Break	Field Text H - Length of RUs Leaving Transmission Queue H - Transmission Queue Wait Time H - RUS Delivered to Adjacent System H - Length of RUs Delivered to Adjacent System H - Service Time to Deliver RU to Adjacent System H - Length of RUs Received from Adjacent System Medium Priority Sessions Started		
Field Name IHQLRL IHQTRR IHNRUD IHTRUD IHTRUD IHTRUR IHLRUR IMNSS IMNSE	Sort	(continued) Ascending/	Break	Field Text H - Length of RUs Leaving Transmission Queue H - Transmission Queue Wait Time H - RUs Delivered to Adjacent System H - Length of RUs Deliver RU to Adjacent System H - Service Time to Deliver RU to Adjacent System H - RUs Received from Adjacent System H - Length of RUs Received from Adjacent System Medium Priority Sessions Started Medium Priority Sessions Ended		
Field Name IHQLRL IHQTRR IHNRUD IHTRUD IHTRUD IHTRUR IHLRUR IMNSS IMNSE IMNBB	Sort	(continued) Ascending/	Break	Field Text H - Length of RUs Leaving Transmission Queue H - Transmission Queue Wait Time H - RUS Delivered to Adjacent System H - Length of RUS Delivered to Adjacent System H - Service Time to Deliver RU to Adjacent System H - RUS Received from Adjacent System H - Length of RUS Received from Adjacent System Medium Priority Sessions Ended M - Begin Bracket Request Units		
Field Name IHQLRL IHQTRR IHNRUD IHLRUD IHTRUD IHTRUD IHNRUR IHNSS IMNSE IMNBB IMNBB	Sort	(continued) Ascending/	Break	Field Text H - Length of RUS Leaving Transmission Queue H - Transmission Queue Wait Time H - RUS Delivered to Adjacent System H - Length of RUS Delivered to Adjacent System H - Service Time to Deliver RU to Adjacent System H - RUS Received from Adjacent System Medium Priority Sessions Started Medium Priority Sessions Ended M - Begin Bracket Request Units M - End Bracket Request Units M - Sesion-level Send Pacing Wait Time		
Field Name HHQLRL HHQTRR HHRUD HHLRUD HHTRUD HHTRUD HHLRUR IMNSS IMNSE IMNSE IMNBB IMNBB IMSPWT IMSPNW	Sort	(continued) Ascending/	Break	Field Text H - Length of RUs Leaving Transmission Queue H - Transmission Queue Wait Time H - RUS Delivered to Adjacent System H - Length of RUS Delivered to Adjacent System H - Suster Time to Deliver RU to Adjacent System H - RUS Received from Adjacent System H - Length of RUS Received from Adjacent System Medium Priority Sessions Ended M - Begin Bracket Request Units M - Session-level Send Pacing Waits M - Session-level Send Pacing Waits		
Field Name HQLRL HQTRR HNRUD HHRUD HHRUR HHRUR IMNSE IMNSE IMNSE IMNEB IMNEB IMSPW IMSPW IMSPW	Sort	(continued) Ascending/	Break	Field Text H - Length of RUs Leaving Transmission Queue H - Transmission Queue Wait Time H - RUs Delivered to Adjacent System H - Length of RUs Delivered to Adjacent System H - RUs Received from Adjacent System H - Length of RUs Received from Adjacent System Medium Priority Sessions Started Medium Priority Sessions Started Medium Priority Sessions Ended M - Begin Bracket Request Units M - End Bracket Request Units M - Session-level Send Pacing Wait Time M - Session-level Send Pacing Waits M - Session-level Send Pacing Votential Waits		
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Field Name IHQLRL IHQLRR IHNRUD IHLRUD IHTRUD IHTRUD IHNRUR IMNSE IMNSE IMNSB IMNSB IMNSB IMNSB IMSPW IMSPW IMSPW IMSPW	Sort	(continued) Ascending/	Break	Field Text H - Length of RUS Leaving Transmission Queue H - Transmission Queue Wait Time H - RUS Delivered to Adjacent System H - Length of RUS Delivered to Adjacent System H - Suster Time to Deliver RU to Adjacent System H - RUS Received from Adjacent System H - Length of RUS Received from Adjacent System Medium Priority Sessions Ended M - Begin Bracket Request Units M - Session-level Send Pacing Wait Time M - Session-level Send Pacing Waits M - Session-level Send Pacing Waits M - Session-level Send Pacing Witt Size M - Internal Session-level Pacing Wait Time		
Field Name IHQLRL IHQLRL IHQTRR IHNRUD IHNRUD IHNRUR IHNRUR IMNSE IMNSE IMNSE IMNSE IMSPW IMSPW IMSPW IMSPW IMSPW IMSPW	Sort	(continued) Ascending/	Break	Field Text H - Length of RUs Leaving Transmission Queue H - Transmission Queue Wait Time H - RUs Delivered to Adjacent System H - Length of RUs Delivered to Adjacent System H - RUs Received from Adjacent System H - Length of RUs Received from Adjacent System Medium Priority Sessions Ended M - Begin Bracket Request Units M - End Bracket Request Units M - Session-level Send Pacing Wait Time M - Session-level Send Pacing Waits M - Staten Session-level Pacing Wait Time M - Internal Session-level Pacing Waits		
Field Name IHQLRL IHQTRR IHNRUD IHLRUD IHTRUD IHLRUD IHNRUR IMNSS IMNSS IMNSS IMNSS IMNSB IMNSB IMNSPM IMSPNN IMSPNN IMSPNS IMIPWT IMIPWT	Sort	(continued) Ascending/	Break	Field Text H - Length of RUS Leaving Transmission Queue H - Transmission Queue Wait Time H - RUS Delivered to Adjacent System H - Lungth of RUS Delivered to Adjacent System H - Service Time to Deliver RU to Adjacent System H - RUS Received from Adjacent System Medium Priority Sessions Started Medium Priority Sessions Ended M - Begin Bracket Request Units M - End Bracket Request Units M - Session-level Send Pacing Wait Time M - Session-level Send Pacing Waits M - Session-level Send Pacing Window Size M - Internal Session-level Pacing Window Size M - Internal Session-level Pacing Wait Time M - Internal Session-level Pacing Waits M - RUS Entering Transmission Queue		
Field Name IHQIRL IHQIRR IHNRUD IHTRUD IHTRUD IHTRUD IHNEU IMNEB IMNEB IMNEB IMNEB IMSPNW IMSPPW IMSPPW IMSPPW IMSPPW IMSPRW IMSPRW IMSPRW	Sort	(continued) Ascending/	Break	Field Text H - Length of RUS Leaving Transmission Queue H - Transmission Queue Wait Time H - RUS Delivered to Adjacent System H - Length of RUS Delivered to Adjacent System H - Suster Time to Deliver RU to Adjacent System H - RUS Received from Adjacent System H - Length of RUS Received from Adjacent System Medium Priority Sessions Ended M - Begin Bracket Request Units M - End Bracket Request Units M - Session-level Send Pacing Wait Time M - Session-level Send Pacing Waits M - Session-level Send Pacing Waits M - Session-level Pacing Waits M - Internal Session-level Pacing Waits M - Internal Session-level Pacing Waits M - RUS Entering Transmission Queue		
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Field Name IHQIRL IHQIRR IHNRUD IHTRUD IHTRUD IHTRUD IHNEU IMNEB IMNEB IMNEB IMNEB IMSPNW IMSPPW IMSPPW IMSPPW IMSPPW IMSPRW IMSPRW IMSPRW	Sort	(continued) Ascending/	Break	Field Text H - Length of RUS Leaving Transmission Queue H - Transmission Queue Wait Time H - RUS Delivered to Adjacent System H - Length of RUS Delivered to Adjacent System H - Suster Time to Deliver RU to Adjacent System H - RUS Received from Adjacent System H - Length of RUS Received from Adjacent System Medium Priority Sessions Ended M - Begin Bracket Request Units M - End Bracket Request Units M - Session-level Send Pacing Wait Time M - Session-level Send Pacing Waits M - Session-level Send Pacing Waits M - Session-level Pacing Waits M - Internal Session-level Pacing Waits M - Internal Session-level Pacing Waits M - RUS Entering Transmission Queue		
Field Name IHQLRL IHQLRL IHQTRR IHNRUD IHNRUD IHNRUD IHNRUR IMNSE IMNSE IMNSE IMNSE IMSPW IMSPW IMSPW IMSPW IMSPW IMSPW IMSPW IMSPW IMSPW IMSPW IMSPW IMSPW IMSPW IMSPW	Sort	(continued) Ascending/	Break	Field Text H - Length of RUs Leaving Transmission Queue H - Transmission Queue Wait Time H - RUS Delivered to Adjacent System H - Length of RUS Delivered to Adjacent System H - Service Time to Deliver RU to Adjacent System H - RUS Received from Adjacent System Medium Priority Sessions Started Medium Priority Sessions Ended M - Begin Bracket Request Units M - End Bracket Request Units M - Session-level Send Pacing Waits M - Session-level Send Pacing Waits M - Session-level Send Pacing Waits M - Internal Session-level Pacing Wait M - Internal Session-level Pacing Waits M - Internal Session-level Pacing Waits M - RUS Entering Transmission Queue M - RUS Leaving Transmission Queue		
Field Name HQLRL HQTRR HHRUD HHRUD HHRUD IHRUD IMNUR IMNUR IMNUS IMNSE IMNSE IMNSE IMNSE IMSPW	Sort	(continued) Ascending/	Break	Field Text H - Length of RUS Leaving Transmission Queue H - Transmission Queue Wait Time H - RUS Delivered to Adjacent System H - Length of RUS Delivered to Adjacent System H - Service Time to Deliver RU to Adjacent System H - RUS Received from Adjacent System Medium Priority Sessions Started Medium Priority Sessions Started Medium Priority Sessions Ended M - Begin Bracket Request Units M - End Bracket Request Units M - Session-level Send Pacing Wait Time M - Session-level Send Pacing Waits M - Session-level Send Pacing Window Size M - Internal Session-level Pacing Window Size M - Internal Session-level Pacing Wait M - RUS Leaving Transmission Queue M - RUS Leaving Transmission Queue		
Field Name IHQLRL IHQLRL IHQTRR IHNRUD IHNRUD IHNRUD IHNRUR IMNSE IMNSE IMNSE IMNSE IMSPW	Sort	(continued) Ascending/	Break	Field Text H - Length of RUS Leaving Transmission Queue H - Transmission Queue Wait Time H - RUS Delivered to Adjacent System H - Length of RUS Delivered to Adjacent System H - Service Time to Deliver RU to Adjacent System H - RUS Received from Adjacent System Medium Priority Sessions Started Medium Priority Sessions Ended M - Begin Bracket Request Units M - End Bracket Request Units M - Session-level Send Pacing Waits M - Session-level Send Pacing Waits M - Session-level Send Pacing Waits M - Internal Session-level Pacing Wait M - Internal Session-level Pacing Waits M - RUS Entering Transmission Queue M - Length of RUS Leaving Transmission Queue M - RUS Leaving Transmission Queue		
Field Name HQLRL HQTRR HHRUD HHRUD HHRUD IHRUD IMNSS IMNSS IMNSS IMNSS IMNSB IMSPW IMAPW I	Sort	(continued) Ascending/	Break	Field Text H - Length of RUS Leaving Transmission Queue H - Transmission Queue Wait Time H - RUS Delivered to Adjacent System H - Length of RUS Delivered to Adjacent System H - Stervice Time to Deliver RU to Adjacent System H - RUS Received from Adjacent System H - Length of RUS Received from Adjacent System Medium Priority Sessions Started Medium Priority Sessions Started Medium Priority Sessions Ended M - Begin Bracket Request Units M - End Bracket Request Units M - Session-level Send Pacing Wait Time M - Session-level Send Pacing Waits M - Session-level Send Pacing Window Size M - Internal Session-level Pacing Wint M - Internal Session-level Pacing Wait M - RUS Leaving Transmission Queue M - Length of RUS Leaving Transmission Queue M - Length of RUS Leaving Transmission Queue M - RUS Delivered to Adjacent System		
Field Name IHQIRL IHQIRL IHQIRR IHNRUD IHNRUD IHNRUD IHNRUD IMNEB IMNEB IMNEB IMNEB IMNEB IMSPNW IMSPPW IMSPPW IMSPPW IMSPRW IMS	Sort	(continued) Ascending/	Break	Field Text H - Length of RUS Leaving Transmission Queue H - Transmission Queue Wait Time H - RUS Delivered to Adjacent System H - Length of RUS Delivered to Adjacent System H - Length of RUS Deliver RU to Adjacent System H - Length of RUS Received from Adjacent System Medium Priority Sessions Ended M - Begin Bracket Request Units M - End Bracket Request Units M - Session-level Send Pacing Wait Time M - Session-level Send Pacing Waits M - Session-level Send Pacing Waits M - Session-level Pacing Waits M - Sus Entering Transmission Queue M - Length of RUS Leaving Transmission Queue M - Length of RUS Delivered to Adjacent System M - Length of RUS Delivered to Adjacent System		
Field Name IHQLRL IHQLRL IHQTRR IHNRUD IHNRUD IHNRUR IMNSS IMNSE IMNSE IMNSE IMSPW I	Sort	(continued) Ascending/	Break	Field Text H - Length of RUS Leaving Transmission Queue H - Transmission Queue Wait Time H - RUS Delivered to Adjacent System H - Length of RUS Delivered to Adjacent System H - Service Time to Deliver RU to Adjacent System H - RUS Received from Adjacent System Medium Priority Sessions Started Medium Priority Sessions Ended M - Begin Bracket Request Units M - End Bracket Request Units M - Session-level Send Pacing Waits M - Internal Session-level Pacing Waits M - Internal Session-level Pacing Waits M - Length of RUS Leaving Transmission Queue M - Length of RUS Leaving Transmission Queue M - Transmission Queue Wait Time M - RUS Delivered to Adjacent System M - Length of RUS Delivered to Adjacent System M - Service Time to Deliver RU to Adjacent System M - Service Time to Deliver RU to Adjacent System		
Field Name IHQLRL IHQLRL IHQLRC IHNEND IHTRUD IHTRUD IHTRUD IMNSS IMNSS IMNSS IMNSS IMNSS IMNSB IMSPW IMQRE IMQLRL IMQLRL	Sort	(continued) Ascending/	Break	Field Text H - Length of RUS Leaving Transmission Queue H - Transmission Queue Wait Time H - RUS Delivered to Adjacent System H - Length of RUS Delivered to Adjacent System H - Service Time to Deliver RU to Adjacent System H - RUS Received from Adjacent System Medium Priority Sessions Started Medium Priority Sessions Started Medium Priority Sessions Ended M - Begin Bracket Request Units M - End Bracket Request Units M - Session-level Send Pacing Wait Time M - Session-level Send Pacing Waits M - Session-level Send Pacing Window Size M - Internal Session-level Pacing Wint M - RUS Entering Transmission Queue M - Length of RUS Leaving Transmission Queue M - RUS Delivered to Adjacent System M - RUS Delivered to Adjacent System M - RUS Received from Adjacent System		
Field Name IHQIRL IHQIRL IHQIRR IHNRUD IHNRUD IHNRUR IMNEB IMNEB IMNEB IMNEB IMNEB IMSPNW IMSPNW IMSPNW IMSPNW IMSPNW IMSPNW IMSPRW IMS	Sort	(continued) Ascending/	Break	Field Text H - Length of RUS Leaving Transmission Queue H - Transmission Queue Wait Time H - RUS Delivered to Adjacent System H - Length of RUS Delivered to Adjacent System H - Length of RUS Deliver RU to Adjacent System H - Length of RUS Received from Adjacent System H - Length of RUS Received Junis M - Begin Bracket Request Units M - Session-level Send Pacing Wait Time M - Session-level Send Pacing Waits M - Session-level Send Pacing Waits M - Suscion-level Pacing Waits M - RUS Learing Transmission Queue M - Length of RUS Entering Transmission Queue M - Length of RUS Leaving Transmission Queue M - Length of RUS Received from Adjacent System M - Length of RUS Received from Adjacent System M - Length of RUS Received from Adjacent System M - Length of RUS Received from Adjacent System		
Field Name IHQLRL IHQLRL IHQLRA IHLRUD IHLRUD IHLRUD IHLRUR IMNSE IMNSE IMNSE IMSPW	Sort	(continued) Ascending/	Break	Field Text H - Length of RUS Leaving Transmission Queue H - Transmission Queue Wait Time H - RUS Delivered to Adjacent System H - Length of RUS Delivered to Adjacent System H - Survice Time to Deliver RU to Adjacent System H - RUS Received from Adjacent System H - Length of RUS Received from Adjacent System H - Length of RUS Received from Adjacent System Medium Priority Sessions Started Medium Priority Sessions Ended M - Begin Bracket Request Units M - End Bracket Request Units M - Session-level Send Pacing Waits M - Session-level Send Pacing Waits M - Session-level Send Pacing Waits M - Internal Session-level Pacing Waits M - Internal Session-level Pacing Waits M - Length of RUS Leaving Transmission Queue M - Length of RUS Leaving Transmission Queue M - RUS Leaving Transmission Queue M - RUS Delivered to Adjacent System M - Length of RUS Delivered to Adjacent System M - Super Time to Deliver RU to Adjacent System M - Super Comme Adjacent System M - Length of RUS Delivered to Adjacent System M - Service Time to Deliver RU to Adjacent System M - Super Super Started Low Priority Sessions Started Low Priority Sessions Ended		
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Field Name IHQLRL IHQLRL IHQLRA IHLRUD IHLRUD IHLRUD IHLRUR IMNSE IMNSE IMNSE IMSPW	Sort	(continued) Ascending/	Break	Field Text H - Length of RUS Leaving Transmission Queue H - Transmission Queue Wait Time H - RUS Delivered to Adjacent System H - Length of RUS Delivered to Adjacent System H - Survice Time to Deliver RU to Adjacent System H - RUS Received from Adjacent System H - Length of RUS Received from Adjacent System H - Length of RUS Received from Adjacent System Medium Priority Sessions Started Medium Priority Sessions Ended M - Begin Bracket Request Units M - End Bracket Request Units M - Session-level Send Pacing Waits M - Session-level Send Pacing Waits M - Session-level Send Pacing Waits M - Internal Session-level Pacing Waits M - Internal Session-level Pacing Waits M - Length of RUS Leaving Transmission Queue M - Length of RUS Leaving Transmission Queue M - RUS Leaving Transmission Queue M - RUS Delivered to Adjacent System M - Length of RUS Delivered to Adjacent System M - Super Time to Deliver RU to Adjacent System M - Super Comme Adjacent System M - Length of RUS Delivered to Adjacent System M - Service Time to Deliver RU to Adjacent System M - Super Super Started Low Priority Sessions Started Low Priority Sessions Ended		
Field Name IHQLRL IHQLRL IHQLRC IHNRUD IHTRUD IHTRUD IHTRUD IMNSS IMNSS IMNSS IMNSS IMNSB IMSPW IMQRL IMQRL IMNRUD IMTRUD	Sort	(continued) Ascending/	Break	Field Text H - Length of RUS Leaving Transmission Queue H - Transmission Queue Wait Time H - RUS Delivered to Adjacent System H - Length of RUS Delivered to Adjacent System H - RUS Received from Adjacent System H - RUS Received from Adjacent System H - Length of RUS Received from Adjacent System Medium Priority Sessions Started Medium Priority Sessions Ended M - Begin Bracket Request Units M - End Bracket Request Units M - Session-level Send Pacing Wait Time M - Session-level Send Pacing Waits M - Session-level Send Pacing Window Size M - Internal Session-level Pacing Wintow Size M - Internal Session-level Pacing Wait Time M - Internal Session-level Pacing Waits M - RUS Leaving Transmission Queue M - Length of RUS Leaving Transmission Queue M - RUS Leaving Transmission Queue M - RUS Leaving Transmission Queue M - RUS Delivered to Adjacent System M - RUS Delivered to Adjacent System M - RUS Recived from Adjacent System M - Length of RUS Received from Adjacent System M - RUS Recived from Adjacent System M - Length of RUS Received from Adjacent System Low Priority Sessions Started Low Priority Sessions Started Low Priority Sessions Reded L - Bejin Bracket Request Units		

Figure 170. SNA\_ALL Query Definition, Part 3

			4 Outomu (400			1/27/04		4.55	16	D a	7		
)rdering of	selected fields		M Query/400 d)		11	1/27/90	5 1	4:56:	16	Page	7		
Field	Sort		-, / Break Field										
Name	Priority	Descending	g Level Text										
ILSPPW	-		L - Session	-level S	Send Pa	acing	oten	tial	Vaits				
ILSPWS			L - Session										
ILIPWT			L - Interna										
ILIPNW			L - Interna	1 Sessio	on-leve	el Pac	ing W	aits					
ILQNRE			L - RUs Ent	ering Tr	ransmis	ssion (	)ueue						
ILQLRE			L - Length						Queue				
ILQNRL			L – RUs Lea	wing Tra	ansmiss	sion Qu	ieue						
ILQLRL			L - Length	of RUs L	Leaving	g Tran	smiss	ion Q	Jeue				
ILQTRR			L - Transmi	ssion Qu	ueue Wa	ait Tir	ne						
I LNRUD			L - RUs Del	ivered t	to Adja	acent :	Syste	m					
ILLRUD			L - Length	of RUs D	Deliver	red to	Adja	cent	System				
ILTRUD			L - Service	e Time to	Deliv	/er RU	to A	djace	nt System	1			
ILNRUR			L - RUs Rec	eived fr	rom Adg	jacent	Syst	em					
ILLRUR			L - Length	of RUs R	Receive	ed from	n Adj	acent	System				
leport colum	mn formatting and	d summary '	functions										
			age, 3-Minimum, 4-Max	imum, 5-	-Count			Overr	ides				
Field	Summary	Column			Dec			Dec	Numeric				
Name		Spacing	Column Headings	Len	Pos	Cap	Len		Editing				
INTNUM		0	-	5	0				-				
			Interval										
			Number										
DTETIM		2	Interval	12									
			Date and Time										
INTSEC		2	Elapsed	7	0								
			Interval										
			Seconds										
SCTLNM		2	Controller	10									
			Description										
		d summary	Description Name M Query/400 functions (continued) age 3-Minimum 4-Max			L/27/9				Page	8		
Summary fu Field	unctions: 1-Tota Summary	d summary al, 2-Avera Column	Name M Query/400 functions (continued) age, 3-Minimum, 4-Max	imum, 5-	-Count Dec	Null		Overr Dec	ides Numeric	Page	8		
Summary fu Field Name	unctions: 1-Tota Summary	d summary al, 2-Avera Column Spacing	Name M Query/400 functions (continued) age, 3-Minimum, 4-Max Column Headings	imum, 5- Len	-Count	Null		Overr Dec	ides	Page	8		
Summary fu Field	unctions: 1-Tota Summary	d summary al, 2-Avera Column	Name M Query/400 functions (continued) age, 3-Minimum, 4-Max Column Headings Line Description	imum, 5-	-Count Dec	Null		Overr Dec	ides Numeric	Page	8		
Summary fu Field Name SLINNM	unctions: 1-Tota Summary	d summary f al, 2-Avera Column Spacing 2	Name M Query/400 functions (continued) age, 3-Minimum, 4-Max Column Headings Line Description Name	imum, 5- Len 10	-Count Dec	Null		Overr Dec	ides Numeric	Page	8		
Summary fu Field Name	unctions: 1-Tota Summary	d summary al, 2-Avera Column Spacing	Name 4 Query/400 functions (continued) age, 3-Minimum, 4-Max Column Headings Line Description Name T2 Station	imum, 5- Len	-Count Dec	Null		Overr Dec	ides Numeric	Page	8		
Summary fu Field Name SLINNM	unctions: 1-Tota Summary	d summary f al, 2-Avera Column Spacing 2	Name 4 Query/400 functions (continued) age, 3-Minimum, 4-Max Column Headings Line Description Name T2 Station I/O Manager Task	imum, 5- Len 10	-Count Dec	Null		Overr Dec	ides Numeric	Page	8		
Summary fu Field Name SLINNM STSKNM	unctions: 1-Tota Summary	d summary al, 2-Avera Column Spacing 2 2	Name M Query/400 functions (continued) age, 3-Minimum, 4-Max Column Headings Line Description Name T2 Station I/O Manager Task Name	Len 10	-Count Dec	Null		Overr Dec	ides Numeric	Page	8		
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Summary fu Field Name SLINNM STSKNM SLIOMT	unctions: 1-Tota Summary	d summary al, 2-Avera Column Spacing 2 2 2	Name 4 Query/400 functions (continued) ge, 3-Minimum, 4-Max Column Headings Line Description Name T2 Station I/O Manager Task Name Line I/O Manager Task Name	Len Len 10 6	-Count Dec	Null		Overr Dec	ides Numeric	Page	8		
Summary fu Field Name SLINNM STSKNM	unctions: 1-Tota Summary	d summary al, 2-Avera Column Spacing 2 2	Name M Query/400 functions (continued) age, 3-Minimum, 4-Max Column Headings Line Description Name T2 Station I/O Manager Task Name Line I/O Manager Task Name Adjacent	Len 10	-Count Dec	Null		Overr Dec	ides Numeric	Page	8		
Summary fu Field Name SLINNM STSKNM SLIOMT	unctions: 1-Tota Summary	d summary al, 2-Avera Column Spacing 2 2 2	Name 4 Query/400 functions (continued) age, 3-Minimum, 4-Max Column Headings Line Description Name T2 Station I/O Manager Task Name Line I/O Manager Task Name Adjacent CP	Len Len 10 6	-Count Dec	Null		Overr Dec	ides Numeric	Page	8		
Summary fu Field Name SLINNM STSKNM SLIOMT	unctions: 1-Tota Summary	d summary al, 2-Avera Column Spacing 2 2 2	Name 4 Query/400 functions (continued) age, 3-Minimum, 4-Max Column Headings Line Description Name T2 Station I/O Manager Task Name Line I/O Manager Task Name Adjacent CP Name	Len Len 10 6	-Count Dec	Null		Overr Dec	ides Numeric	Page	8		
Summary fu Field Name SLINNM STSKNM SLIOMT SACPNM	unctions: 1-Tota Summary	d summary al, 2-Avera Column Spacing 2 2 2 2	Name 4 Query/400 functions (continued) age, 3-Minimum, 4-Max Column Headings Line Description Name T2 Station I/O Manager Task Name Line I/O Manager Task Name Adjacent CP	timum, 5- Len 10 6 6 8	-Count Dec	Null		Overr Dec	ides Numeric	Page	8		
Summary fu Field Name SLINNM STSKNM SLIOMT SACPNM	unctions: 1-Tota Summary	d summary al, 2-Avera Column Spacing 2 2 2 2	Name 4 Query/400 functions (continued) age, 3-Minimum, 4-Max Column Headings Line Description Name T2 Station I/O Manager Task Name Line I/O Manager Task Name Adjacent CP Name	timum, 5- Len 10 6 6 8	-Count Dec	Null		Overr Dec	ides Numeric	Page	8		
Summary fu Field Name SLINNM STSKNM SLIOMT SACPNM	unctions: 1-Tota Summary	d summary al, 2-Avera Column Spacing 2 2 2 2	Name 4 Query/400 functions (continued) age, 3-Minimum, 4-Max Column Headings Line Description Name T2 Station I/O Manager Task Name Line I/O Manager Task Name Adjacent CP Name Adjacent Network	timum, 5- Len 10 6 6 8	-Count Dec	Null		Overr Dec	ides Numeric	Page	8		
Summary fu Field Name SLINNM STSKNM SLIOMT SACPNM SANWID	unctions: 1-Tota Summary	d summary 11, 2-Averi Column Spacing 2 2 2 2 2 2	Name M Query/400 functions (continued) age, 3-Minimum, 4-Max Column Headings Line Description Name T2 Station I/O Manager Task Name Line I/O Manager Task Name Adjacent CP Name Adjacent Network ID	timum, 5- Len 10 6 8 8	-Count Dec	Null		Overr Dec	ides Numeric	Page	8		
Summary fu Field Name SLINNM STSKNM SLIOMT SACPNM SANWID	unctions: 1-Tota Summary	d summary 11, 2-Averi Column Spacing 2 2 2 2 2 2	Name 4 Query/400 functions (continued) age, 3-Minimum, 4-Max Column Headings Line Description Name T2 Station I/O Manager Task Name Line I/O Manager Task Name Adjacent CP Name Adjacent Network	timum, 5- Len 10 6 8 8	-Count Dec	Null		Overr Dec	ides Numeric	Page	8		
Summary fu Field Name SLINNM SLINNM SLIOMT SACPNM SANNID SAPPN	unctions: 1-Tota Summary	d summary 4 11, 2-Avera Column 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2	Name 4 Query/400 functions (continued) age, 3-Minimum, 4-Max Column Headings Line Description Name T2 Station I/O Manager Task Name Line I/O Manager Task Name Adjacent CP Name Adjacent Name Adjacent Name Adjacent Name Adjacent Name Adjacent Name Adjacent Name Adjacent Name Adjacent Name Adjacent Name	timum, 5- Len 10 6 8 8 8	-Count Dec	Null		Overr Dec	ides Numeric	Page	8		
Summary fu Field Name SLINNM SLINNM SLIOMT SACPNM SANNID SAPPN	unctions: 1-Tota Summary	d summary 4 11, 2-Avera Column 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2	Name M Query/400 functions (continued) age, 3-Minimum, 4-Max Column Headings Line Description Name T2 Station I/O Manager Task Name Line I/O Manager Task Name Adjacent CP Name Adjacent Network ID APPN-Capable Controller	timum, 5- Len 10 6 8 8 8	-Count Dec	Null		Overr Dec	ides Numeric	Page	8		
Summary fu Field Name SLINNM SLINNM SLIOMT SACPNM SANNID SAPPN	unctions: 1-Tota Summary	d summary 4 11, 2-Avera Column 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2	Name 4 Query/400 functions (continued) age, 3-Minimum, 4-Max Column Headings Line Description Name T2 Station I/O Manager Task Name Line I/O Manager Task Name Adjacent CP Name Adjacent Name Adjacent Name Adjacent Name Adjacent Name Adjacent Name Adjacent Name Adjacent Name Adjacent Name Adjacent Name	timum, 5- Len 10 6 8 8 8	-Count Dec	Null		Overr Dec	ides Numeric	Page	8		
Summary fu Field Name SLINNM SLINNM SLIOMT SACPNM SANNID SAPPN SCTYP	unctions: 1-Tota Summary	d summary al, 2-Avera column 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2	Name M Query/400 functions (continued) age, 3-Minimum, 4-Max Column Headings Line Description Name T2 Station I/O Manager Task Name Line I/O Manager Task Name Adjacent Adjacent Network ID APPN-Capable Controller Type	:imum, 5- Len 10 6 8 8 1 1	-Count Dec Pos	Null		Overr Dec	ides Numeric	Page	8		
Summary fu Field Name SLINNM SLINNM SLIOMT SACPNM SANNID SAPPN SCTYP	unctions: 1-Tota Summary	d summary al, 2-Avera column 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2	Name 4 Query/400 functions (continued) age, 3-Minimum, 4-Max Column Headings Line Description Name T2 Station I/O Manager Task Name Adjacent CP Name Adjacent CP Name Adjacent Name Adjacent Name Adjacent Network ID APPN-Capable Controller Type Send	:imum, 5- Len 10 6 8 8 1 1	-Count Dec Pos	Null		Overr Dec	ides Numeric	Page	8		
Summary fu Field Sacpin SLIOMT SACPNM SANWID SAPPN SCTYP SSMFS	unctions: 1-Tota Summary	d summary al, 2-Avera Column Spacing 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2	Name M Query/400 functions (continued) age, 3-Minimum, 4-Max Column Headings Line Description Name T2 Station I/O Manager Task Name Line I/O Manager Task Name Adjacent Adjacent Network ID APPN-Capable Controller Type Send Maximum Frame Size	(imum, 5- Len 10 6 8 8 1 1 1	-Count Dec Pos	Null		Overr Dec	ides Numeric	Page	8		
Summary fu Field Sacpin SLIOMT SACPNM SANWID SAPPN SCTYP SSMFS	unctions: 1-Tota Summary	d summary al, 2-Avera Column Spacing 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2	Name M Query/400 functions (continued) age, 3-Minimum, 4-Max Column Headings Line Description Name T2 Station I/O Manager Task Name Line I/O Manager Task Name Adjacent Adjacent Network ID APPN-Capable Controller Type Send Maximum Frame Size Receive	(imum, 5- Len 10 6 8 8 1 1 1	-Count Dec Pos	Null		Overr Dec	ides Numeric	Page	8		
Summary fu Field SLINNM SLINNM SLINNM SLIOMT SACPNM SANWID SANWID SAPPN SCTYP SSMFS	unctions: 1-Tota Summary	d summary al, 2-Avera Column Spacing 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2	Name 4 Query/400 functions (continued) age, 3-Minimum, 4-Max Column Headings Line Description Name T2 Station I/O Manager Task Name Adjacent CP Name Adjacent CP Name Adjacent Network ID APPN-Capable Controller Type Send Maximum Frame Size Receive	:imum, 5- Len 10 6 8 8 1 1 1 11	-Count Dec Pos	Null		Overr Dec	ides Numeric	Page	8		
Summary fu Field SLINNM SLINNM SLINNM SLIOMT SACPNM SANWID SANWID SAPPN SCTYP SSMFS	unctions: 1-Tota Summary	d summary al, 2-Avera Column Spacing 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2	Name M Query/400 functions (continued) age, 3-Minimum, 4-Max Column Headings Line Description Name T2 Station I/O Manager Task Name Line I/O Manager Task Name Adjacent CP Name Adjacent Network ID APPN-Capable Controller Type Send Maximum Frame Size Receive Maximum Frame Size Nate Size Date and	:imum, 5- Len 10 6 8 8 1 1 1 11	-Count Dec Pos	Null		Overr Dec	ides Numeric	Page	8		
Summary fu Field SLINNM SLINNM SLINNM SLIOMT SACPNM SANWID SANWID SAPPN SCTYP SSMFS	unctions: 1-Tota Summary	d summary al, 2-Avera Column Spacing 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2	Name M Query/400 functions (continued) age, 3-Minimum, 4-Max Column Headings Line Description Name T2 Station I/O Manager Task Name Line I/O Manager Task Name Adjacent CP Name Adjacent Network ID APPN-Capable Controller Type Send Maximum Frame Size Receive Maximum Frame Size Date and Time of Most Recent	:imum, 5- Len 10 6 8 8 1 1 1 11	-Count Dec Pos	Null		Overr Dec	ides Numeric	Page	8		
Summary fu Field Name SLINNM SLINNM SLIOMT SACPNM SANWID SANWID SAPPN SCTYP SSMFS SRMFS STLLBU	unctions: 1-Tota Summary	d summary al, 2-Avera Column Spacing 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2	Name 4 Query/400 functions (continued) age, 3-Minimum, 4-Max Column Headings Line Description Name T2 Station I/O Manager Task Name I/O Manager Task Name Adjacent CP Name Adjacent Network ID APPN-Capable Controller Type Send Maximum Frame Size Receive Maximum Frame Size Receive Maximum Frame Size Nation Size Receive Maximum Frame Size Date and Time of Most Recent	(imum, 5- Len 10 6 8 8 1 1 1 11 11 12	Ount Dec Pos	Null		Overr Dec	ides Numeric	Page	8		
Summary fu Field Name SLINNM SLINNM SLIOMT SACPNM SANWID SANWID SAPPN SCTYP SSMFS SRMFS STLLBU	unctions: 1-Tota Summary	d summary al, 2-Avera Column Spacing 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2	Name M Query/400 functions (continued) age, 3-Minimum, 4-Max Column Headings Line Description Name T2 Station I/O Manager Task Name Line I/O Manager Task Name Adjacent CP Name Adjacent Network ID APPN-Capable Controller Type Send Maximum Frame Size Receive Maximum Frame Size Receive Maximum Frame Size Receive Date and Time of Most Recent Connection Connections Established with	(imum, 5- Len 10 6 8 8 1 1 1 11 11 12	Ount Dec Pos	Null		Overr Dec	ides Numeric	Page	8		
Summary fu Field Name SLINNM SLINNM SLIOMT SACPNM SANWID SANWID SAPPN SCTYP SSMFS SRMFS STLLBU	unctions: 1-Tota Summary	d summary al, 2-Avera Column Spacing 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2	Name M Query/400 functions (continued) age, 3-Minimum, 4-Max Column Headings Line Description Name T2 Station I/O Manager Task Name Line I/O Manager Task Name Adjacent CP Name Adjacent Network ID APPN-Capable Controller Type Send Maximum Frame Size Receive Maximum Frame Size Date and Time of Most Recent Connections	(imum, 5- Len 10 6 8 8 1 1 1 11 11 12	Ount Dec Pos	Null		Overr Dec	ides Numeric	Page	8		
Summary fu Field Samma SLINNM SLINNM SLIOMT SACPNM SANWID SANWID SAPPN SCTYP SSMFS STLLBU SNLBU	unctions: 1-Tota Summary	d summary al, 2-Avera Column Spacing 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2	Name 4 Query/400 functions (continued) age, 3-Minimum, 4-Max Column Headings Line Description Name T2 Station I/O Manager Task Name T2 Station I/O Manager Task Name Adjacent CP Name Adjacent CP Name Adjacent Network ID APPN-Capable Controller Type Send Maximum Frame Size Receive Maximum Frame Size Receive Maximum Frame Size The of Most Recent Connections Established with Remote System	(imum, 5- Len 10 6 8 8 1 1 11 11 12 11	O O O O	Null		Overr Dec	ides Numeric	Page	8		

Figure 171. SNA\_ALL Query Definition, Part 4

			M Query/400			1/27/9	96	14:56:	16	Page	9		
		summary	functions (continued)										
Summary func	tions: 1-Total	, 2-Aver	age, 3-Minimum, 4-Maxi	mum, 5-	-Coun	t		Overr	ides				
Field		Column				Null			Numeric				
Name			Column Headings			Cap	Len	Pos	Editing				
SNACVO		2	Auto-created	11	0								
			and/or Varied on										
			Devices										
SNADD		2		11	0								
			Auto-deleted										
			Devices										
SNWAIN		2	Messages	11	0								
			Received by the										
			T2 SIOM Task										
SNWAOU		2	Messages	11	0								
			Sent by the										
			T2 SIOM Task										
ENNSS		2	Network	11	0								
			Priority Sessions										
			Started										
ENNSE		2	Network	11	0								
			Priority Sessions										
511100			Ended										
ENNBB		2	N - Begin	11	0								
			Bracket										
ENNER		0	Request Units										
ENNEB		2	N - End	11	0								
			Bracket										
ENG DUT			Request Units										
ENSPWT		2	N - Session-level	11	0								
			Send Pacing										
ENCONU		0	Wait Time										
ENSPNW		2	N - Session-level	11	0								
			Send Pacing										
ENSPON		2	Wait N - Session-level	11	0								
ENSPPW				11									
		-											
		-	Send Pacing		-								
			Send Pacing Potential Waits			11/27/	16	14.55	16	Dace	10		
	formatting and	IB	Send Pacing Potential Waits M Query/400			11/27/9	96	14:56:	16	Page	10		
eport column		IB summary	Send Pacing Potential Waits M Query/400 functions (continued)				96			Page	10		
eport column Summary func	tions: 1-Total	IB summary , 2-Aver	Send Pacing Potential Waits M Query/400		-Coun	t	96	0verr	ides	Page	10		
eport column Summary func Field	tions: 1-Total Summary	IB summary , 2-Aver Column	Send Pacing Potential Waits M Query/400 functions (continued) age, 3-Minimum, 4-Maxi	mum, 5-	-Coun Dec	t Null		Overr Dec	ides Numeric	Page	10		
eport column Summary func Field Name	tions: 1-Total Summary Functions	IB summary , 2-Aver Column	Send Pacing Potential Waits M Query/400 functions (continued) age, 3-Minimum, 4-Max Column Headings		-Coun	t Null		Overr Dec	ides	Page	10		
eport column Summary func Field	tions: 1-Total Summary Functions	IB summary , 2-Aver Column Spacing	Send Pacing Potential Waits M Query/400 functions (continued) age, 3-Minimum, 4-Maxi	mum, 5- Len	-Coun Dec Pos	t Null		Overr Dec	ides Numeric	Page	10		
eport column Summary func Field Name	tions: 1-Total Summary Functions	IB summary , 2-Aver Column Spacing	Send Pacing Potential Waits M Query/400 functions (continued) age, 3-Minimum, 4-Maxi Column Headings N - Session-level	mum, 5- Len	-Coun Dec Pos	t Null		Overr Dec	ides Numeric	Page	10		
eport column Summary func Field Name	tions: 1-Total Summary Functions	IB summary , 2-Aver Column Spacing	Send Pacing Potential Waits M Query/400 functions (continued) age, 3-Minimum, 4-Max Column Headings N - Session-level Send Pacing	mum, 5- Len	-Coun Dec Pos	t Null		Overr Dec	ides Numeric	Page	10		
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Figure 172. SNA\_ALL Query Definition, Part 5

			M Query/400		1	1/27/9	96	14:56	:16	Page	11	
			functions (continued)									
			age, 3-Minimum, 4-Maxi	mum, 5-				0ver				
Field	Summary	Column				Null			Numeric			
Name	Functions		Column Headings		Pos	Cap	Len	Pos	Editing			
ENNRUR		2	N - RUs Received from	11	0							
			Adjacent System									
ENLRUR		2	N - Length of	11	0							
ENERGY		2	RUs Received		0							
			from Adjacent System									
EHNSS		2	High	11	0							
			Priority Sessions									
			Started									
EHNSE		2	High	11	0							
			Priority Sessions									
			Ended									
EHNBB		2	H - Begin	11	0							
			Bracket									
		_	Request Units									
EHNEB		2	H - End	11	0							
			Bracket Boguest Units									
EUSDUT		2	Request Units	11	0							
EHSPWT		2	H - Session-level Send Pacing	11	U							
			Wait Time									
EHSPNW		2	H - Session-level	11	0							
		-	Send Pacing		5							
			Waits									
EHSPPW		2	H - Session-level	11	0							
			Send Pacing									
			Potential Waits									
EHSPWS		2	H - Session-level	11	0							
			Send Pacing									
			Window Size									
EHIPWT		2	H - Internal	11	0							
					-							
			Session-level		-							
			Pacing Wait Time			1/07//		14.50	16	Deve	10	
Penort column	formatting and		Pacing Wait Time M Query/400			1/27/9	96	14:56	:16	Page	12	
		summary	Pacing Wait Time M Query/400 functions (continued)		1		96			Page	12	
Summary fun	ctions: 1-Tota	summary 1, 2-Aver	Pacing Wait Time M Query/400		1 -Count		96	0ver	rides	Page	12	
		summary 1, 2-Aver Column	Pacing Wait Time M Query/400 functions (continued)		1 -Count			Over Dec	rides Numeric	Page	12	
Summary fun Field	ctions: 1-Tota Summary	summary 1, 2-Aver Column	Pacing Wait Time M Query/400 functions (continued) age, 3-Minimum, 4-Maxi	mum, 5-	1 -Count Dec	Null		Over Dec	rides	Page	12	
Summary fun Field Name	ctions: 1-Tota Summary	summary 1, 2-Aver Column Spacing	Pacing Wait Time M Query/400 functions (continued) age, 3-Minimum, 4-Maxi Column Headings	mum, 5- Len	1 -Count Dec Pos	Null		Over Dec	rides Numeric	Page	12	
Summary fun Field Name	ctions: 1-Tota Summary	summary 1, 2-Aver Column Spacing	Pacing Wait Time M Query/400 functions (continued) rage, 3-Minimum, 4-Maxi Column Headings H - Internal	mum, 5- Len	1 -Count Dec Pos	Null		Over Dec	rides Numeric	Page	12	
Summary fun Field Name	ctions: 1-Tota Summary	summary 1, 2-Aver Column Spacing	Pacing Wait Time M Query/400 functions (continued) age, 3-Minimum, 4-Maxi Column Headings H - Internal Session-level Pacing Waits H - RUS	mum, 5- Len	1 -Count Dec Pos	Null		Over Dec	rides Numeric	Page	12	
Summary fun Field Name EHIPNW	ctions: 1-Tota Summary	summary 1, 2-Aver Column Spacing 2	Pacing Wait Time M Query/400 functions (continued) age, 3-Minimum, 4-Maxi Column Headings H - Internal Session-level Pacing Waits H - RUs Entering	mum, 5- Len 11	1 Dec Pos 0	Null		Over Dec	rides Numeric	Page	12	
Summary fun Field Name EHIPNW EHQNRE	ctions: 1-Tota Summary	summary 1, 2-Aver Column Spacing 2 2	Pacing Wait Time M Query/400 functions (continued) age, 3-Minimum, 4-Maxi Column Headings H - Internal Session-level Pacing Waits H - RUs Entering Transmission Queue	mum, 5- Len 11 11	1 Dec Pos 0	Null		Over Dec	rides Numeric	Page	12	
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Summary fun Field Name EHIPNW EHQNRE EHQLRE	ctions: 1-Tota Summary	summary 1, 2-Aver Column Spacing 2 2 2	Pacing Wait Time M Query/400 functions (continued) age, 3-Minimum, 4-Maxi Column Headings H - Internal Session-level Pacing Waits H - RUS Entering Transmission Queue H - Length of RUS Entering Transmission Queue	mum, 5- Len 11 11	1 Dec Pos 0 0	Null		Over Dec	rides Numeric	Page	12	
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Summary fun Field Name EHIPNW EHQNRE EHQLRE EHQNRL	ctions: 1-Tota Summary	2 2 2	Pacing Wait Time M Query/400 functions (continued) age, 3-Minimum, 4-Maxi Column Headings H - Internal Session-level Pacing Waits H - RUS Entering Transmission Queue H - Length of RUS Entering Transmission Queue H - RUS Leaving Transmission Queue H - Length of RUS Leaving	mum, 5- Len 11 11 11	1 Dec Pos 0 0 0	Null		Over Dec	rides Numeric	Page	12	
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Figure 173. SNA\_ALL Query Definition, Part 6

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			Priority Sessions										
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LINDD		2	Bracket	11	0								
			Request Units										
EMNEB		2	M - End	11	0								
EMINED		2	Bracket	11	0								
			Request Units										
EMSPWT		2	M - Session-level	11	0								
LHJFWI		2	Send Pacing	11	0								
			Wait Time										
EMSPNW		2	M - Session-level	11	0								
ENSTIN		-	Send Pacing	11	0								
			Waits										
EMSPPW		2	M - Session-level	11	0								
200114		-	Send Pacing	11	0								
			Potential Waits										
EMSPWS		2	M - Session-level	11	0								
		-	Send Pacing	11	0								
			Window Size										
EMIPWT		2	M - Internal	11	0								
		-	Session-level										
			Pacing Wait Time										
EMIPNW		2	M - Internal	11	0								
		-	Session-level										
			Pacing Waits										
EMONRE		2	*	11	0								
EMQNRE	:	2	M - RUs Entering	11	0								
EMQNRE	:	2	M - RUs Entering	11	0								
EMQNRE	:		M - RÜs Entering Transmission Queue	11		1/27/9	96	14:56:	16	Page	14		
		IB	M - RUs Entering			1/27/9	96	14:56:	16	Page	14		
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Figure 174. SNA\_ALL Query Definition, Part 7

			M Query/400		1	1/27/9	96	14:56:	16	Page	15	
			functions (continued)	num 6	Count			Overr	idor			
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Name			Column Headings	Lon	Pos		۱۵n		Editing			
ELNBB	Tunctions	2	L - Begin	11	0	cap	Len	rus	Luiting			
EENDD		2	Bracket		0							
			Request Units									
ELNEB		2	L - End	11	0							
			Bracket									
			Request Units									
ELSPWT		2	L - Session-level	11	0							
			Send Pacing									
			Wait Time									
ELSPNW		2	L - Session-level	11	0							
			Send Pacing									
			Waits									
ELSPPW		2	L - Session-level	11	0							
			Send Pacing									
EL C DUC		0	Potential Waits									
ELSPWS		2	L - Session-level	11	0							
			Send Pacing Window Size									
ELIPWT		2	L - Internal	11	0							
CCITWI		-	Session-level	11	J							
			Pacing Wait Time									
ELIPNW		2	L - Internal	11	0							
			Session-level		5							
			Pacing Waits									
ELQNRE		2	L - RUs	11	0							
			Entering									
			Transmission Queue									
ELQLRE		2	L - Length of	11	0							
			RUs Entering									
			Transmission Queue									
ELQNRL		2										
		2	L – RUs	11	0							
		2	Leaving Transmission	11	0							
			Leaving Transmission Queue	11		1 / 07 //		14.50	16	Dama	16	
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		IB summary	Leaving Transmission Queue M Query/400 functions (continued)		1		96			Page	16	
	tions: 1-Tota	IB summary 1, 2-Aver	Leaving Transmission Queue M Query/400		1 -Count		96	0verr	ides	Page	16	
Summary funct	tions: 1-Tota Summary	IB summary 1, 2-Aver Column	Leaving Transmission Queue M Query/400 functions (continued)		1 -Count Dec			Overr Dec	ides Numeric	Page	16	
Summary funct Field	tions: 1-Tota Summary	IB summary 1, 2-Aver Column	Leaving Transmission Queue M Query/400 functions (continued) age, 3-Minimum, 4-Maxin	num, 5-	1 -Count Dec	Null		Overr Dec	ides	Page	16	
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Summary funct Field Name ELQLRL ELQTRR ELNRUD ELLRUD ELLRUD ELLRUR INNSS INNSE INNBB	tions: 1-Tota Summary	IB summary 1, 2-Aver Column Spacing 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2	Leaving Transmission Queue W Query/400 functions (continued) age, 3-Minimum, 4-Maxin Column Headings L - Length of RUS Leaving Transmission Queue L - Transmission Queue Wait Time L - RUS Delivered to Adjacent System L - Length of RUS Pelivered to Adjacent System L - Service Time to Adjacent System L - RUS Received from Adjacent System L - RUS Received from Adjacent System L - Length of RUS Received from Adjacent System Network Priority Sessions Started Network Priority Sessions Ended N - Begin Bracket Request Units	num, 5- Len 11 11 11 11 11 11 11 11 11	1 Dec Pos 0 0 0 0 0 0 0 0 0 0 0 0 0	Null		Overr Dec	ides Numeric	Page	16	
Summary funct Field Name ELQLRL ELQTRR ELNRUD ELLRUD ELLRUD ELLRUR ELLRUR INNSS INNSE	tions: 1-Tota Summary	18 summary 1, 2-Aver column 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2	Leaving Transmission Queue M Query/400 functions (continued) age, 3-Minimum, 4-Maxin Column Headings L - Length of RUS Leaving Transmission Queue L - Transmission Queue Wait Time L - RUS Delivered to Adjacent System L - Length of RUS Delivered to Adjacent System L - Service Time to Adjacent System L - Sus Received from Adjacent System L - RUS Received from Adjacent System L - Length of RUS Received from Adjacent System L - Length of RUS Received from Adjacent System Network Priority Sessions Started Network Priority Sessions Ended Network Priority Sessions Ended Request Units N - End	num, 5- Len 11 11 11 11 11 11 11 11	1 Dec Pos 0 0 0 0 0 0 0 0 0 0 0 0 0	Null		Overr Dec	ides Numeric	Page	16	
Summary funct Field Name ELQLRL ELQTRR ELNRUD ELLRUD ELLRUD ELLRUR INNSS INNSE INNBB	tions: 1-Tota Summary	IB summary 1, 2-Aver Column Spacing 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2	Leaving Transmission Queue W Query/400 functions (continued) age, 3-Minimum, 4-Maxin Column Headings L - Length of RUS Leaving Transmission Queue L - Transmission Queue Wait Time L - RUS Delivered to Adjacent System L - Length of RUS Pelivered to Adjacent System L - Service Time to Adjacent System L - RUS Received from Adjacent System L - RUS Received from Adjacent System L - Length of RUS Received from Adjacent System Network Priority Sessions Started Network Priority Sessions Ended N - Begin Bracket Request Units	num, 5- Len 11 11 11 11 11 11 11 11 11	1 Dec Pos 0 0 0 0 0 0 0 0 0 0 0 0 0	Null		Overr Dec	ides Numeric	Page	16	

Figure 175. SNA\_ALL Query Definition, Part 8

			M Query/400		1	1/27/9	96	14:56:	16	Page	17	
			functions (continued)									
			age, 3-Minimum, 4-Maxi	mum, 5-				0verr				
Field		Column				Null			Numeric			
Name			Column Headings	Len		Cap	Len	Pos	Editing			
INSPWT	:	2	N - Session-level	11	0							
			Send Pacing									
		_	Wait Time									
INSPNW	:	2	N - Session-level	11	0							
			Send Pacing									
			Waits									
INSPPW	1	2	N - Session-level	11	0							
			Send Pacing									
			Potential Waits									
INSPWS	1	2	N - Session-level	11	0							
			Send Pacing									
			Window Size									
INIPWT	1	2	N - Internal	11	0							
			Session-level									
			Pacing Wait Time									
INIPNW	1	2	N - Internal	11	0							
			Session-level									
			Pacing Waits									
INQNRE	:	2	N – RUS	11	0							
			Entering									
			Transmission Queue									
INQLRE	1	2	N - Length of	11	0							
			RUs Entering									
			Transmission Queue									
INQNRL	:	2	N – RUs	11	0							
			Leaving Transmission									
			Queue									
INQLRL	2	2	N - Length of	11	0							
			RUs Leaving									
			Transmission Queue									
INQTRR	:	2	N -	11	0							
INQTRR	:	2	N -	11	0							
INQTRR	:	2		11	0							
INQTRR	:		N - Transmission Queue	11		1/27/9	96	14:56:	16	Page	18	
		IB	N - Transmission Queue Wait Time	11		1/27/9	96	14:56:	16	Page	18	
eport column	formatting and	IB summary	N - Transmission Queue Wait Time M Query/400		1		96	14:56: Overr		Page	18	
eport column	formatting and tions: 1-Total	IB summary	N - Transmission Queue Wait Time M Query/400 functions (continued)		1 -Count		96	0verr		Page	18	
eport column Summary func	formatting and tions: 1-Total Summary	IB summary , 2-Aver Column	N - Transmission Queue Wait Time M Query/400 functions (continued)		1 -Count			Overr Dec	ides	Page	18	
eport column Summary func Field	formatting and s tions: 1-Total Summary Functions S	IB summary , 2-Aver Column	N - Transmission Queue Wait Time M Query/400 functions (continued) age, 3-Minimum, 4-Maxi	mum, 5-	1 -Count Dec	Null		Overr Dec	ides Numeric	Page	18	
eport column Summary func Field Name	formatting and s tions: 1-Total Summary Functions S	IB summary , 2-Aver Column Spacing	N - Transmission Queue Wait Time M Query/400 functions (continued) age, 3-Minimum, 4-Maxi Column Headings	mum, 5- Len	1 -Count Dec Pos	Null		Overr Dec	ides Numeric	Page	18	
eport column Summary func Field Name	formatting and s tions: 1-Total Summary Functions S	IB summary , 2-Aver Column Spacing	N - Transmission Queue Wait Time M Query/400 functions (continued) age, 3-Minimum, 4-Maxi Column Headings N - RUs	mum, 5- Len	1 -Count Dec Pos	Null		Overr Dec	ides Numeric	Page	18	
eport column Summary func Field Name	formatting and tions: 1-Total Summary ( Functions )	IB summary , 2-Aver Column Spacing	N - Transmission Queue Wait Time M Query/400 functions (continued) age, 3-Minimum, 4-Maxi Column Headings N - RUS Delivered to	mum, 5- Len	1 -Count Dec Pos	Null		Overr Dec	ides Numeric	Page	18	
eport column Summary func Field Name INNRUD	formatting and tions: 1-Total Summary ( Functions )	IB summary , 2-Aver Column Spacing 2	N - Transmission Queue Wait Time M Query/400 functions (continued) age, 3-Minimum, 4-Maxi Column Headings N - RUs Delivered to Adjacent System	mum, 5- Len 11	1 Dec Pos 0	Null		Overr Dec	ides Numeric	Page	18	
eport column Summary func Field Name INNRUD	formatting and tions: 1-Total Summary ( Functions )	IB summary , 2-Aver Column Spacing 2	N - Transmission Queue Wait Time M Query/400 functions (continued) age, 3-Minimum, 4-Maxi Column Headings N - RUS Delivered to Adjacent System N - Length of RUS Delivered	mum, 5- Len 11	1 Dec Pos 0	Null		Overr Dec	ides Numeric	Page	18	
eport column Summary func Field Name INNRUD	formatting and tions: 1-Total Summary ( Functions :	IB summary , 2-Aver Column Spacing 2	N - Transmission Queue Wait Time M Query/400 functions (continued) age, 3-Minimum, 4-Maxi Column Headings N - RUS Delivered to Adjacent System N - Length of	mum, 5- Len 11	1 Dec Pos 0	Null		Overr Dec	ides Numeric	Page	18	
eport column Summary func Field Name INNRUD INLRUD	formatting and tions: 1-Total Summary ( Functions :	IB summary , 2-Aver Column Spacing 2	N - Transmission Queue Wait Time M Query/400 functions (continued) age, 3-Minimum, 4-Maxi Column Headings N - RUs Delivered to Adjacent System N - Length of RUS Delivered to Adjacent System	mum, 5- Len 11 11	1 Dec Pos 0	Null		Overr Dec	ides Numeric	Page	18	
eport column Summary func Field Name INNRUD INLRUD	formatting and tions: 1-Total Summary ( Functions :	IB summary , 2-Aver Column Spacing 2	N - Transmission Queue Wait Time M Query/400 functions (continued) age, 3-Minimum, 4-Maxi Column Headings N - RUs Delivered to Adjacent System N - Length of RUS Delivered to Adjacent System N - Service Time to Deliver RU	mum, 5- Len 11 11	1 Dec Pos 0	Null		Overr Dec	ides Numeric	Page	18	
eport column Summary func Field Name INNRUD INLRUD	formatting and tions: 1-Total Summary ( Functions :	IB summary , 2-Aver Column Spacing 2	N - Transmission Queue Wait Time M Query/400 functions (continued) age, 3-Minimum, 4-Maxi Column Headings N - RUS Delivered to Adjacent System N - Length of RUS Delivered to Adjacent System N - Service Time	mum, 5- Len 11 11	1 Dec Pos 0	Null		Overr Dec	ides Numeric	Page	18	
eport column Summary func Field Name INNRUD INLRUD INTRUD	formatting and tions: 1-Total Summary ( Functions :	IB summary , 2-Aver Column Spacing 2 2 2	N - Transmission Queue Wait Time M Query/400 functions (continued) age, 3-Minimum, 4-Maxi Column Headings N - RUS Delivered to Adjacent System N - Length of RUS Delivered to Adjacent System N - Service Time to Deliver RU to Adjacent System N - RUS	mum, 5. Len 11 11	1 Dec Pos 0 0	Null		Overr Dec	ides Numeric	Page	18	
eport column Summary func Field Name INNRUD INLRUD INTRUD	formatting and tions: 1-Total Summary ( Functions :	IB summary , 2-Aver Column Spacing 2 2 2	N - Transmission Queue Wait Time M Query/400 functions (continued) age, 3-Minimum, 4-Maxi Column Headings N - RUS Delivered to Adjacent System N - Length of RUS Delivered to Adjacent System N - Service Time to Deliver RU to Adjacent System N - RUS Received from	mum, 5. Len 11 11	1 Dec Pos 0 0	Null		Overr Dec	ides Numeric	Page	18	
eport column Summary func Field Name INNRUD INLRUD INTRUD INNRUR	formatting and tions: 1-Total Summary ( Functions : ;	IB summary , 2-Aver Column Spacing 2 2 2 2	N - Transmission Queue Wait Time M Query/400 functions (continued) age, 3-Minimum, 4-Maxi Column Headings N - RUS Delivered to Adjacent System N - Length of RUS Delivered to Adjacent System N - Service Time to Deliver RU to Adjacent System N - RUS Received from Adjacent System	mum, 5- Len 11 11 11	1 Dec Pos 0 0 0	Null		Overr Dec	ides Numeric	Page	18	
eport column Summary func Field Name INNRUD INLRUD INTRUD	formatting and tions: 1-Total Summary ( Functions : ;	IB summary , 2-Aver Column Spacing 2 2 2	N - Transmission Queue Wait Time M Query/400 functions (continued) age, 3-Minimum, 4-Maxi Column Headings N - RUS Delivered to Adjacent System N - Length of RUS Delivered to Adjacent System N - Service Time to Deliver RU to Adjacent System N - RUS Received from Adjacent System N - Length of	mum, 5. Len 11 11	1 Dec Pos 0 0	Null		Overr Dec	ides Numeric	Page	18	
eport column Summary func Field Name INNRUD INLRUD INTRUD INNRUR	formatting and tions: 1-Total Summary ( Functions : ;	IB summary , 2-Aver Column Spacing 2 2 2 2	N - Transmission Queue Wait Time M Query/400 functions (continued) age, 3-Minimum, 4-Maxi Column Headings N - RUS Delivered to Adjacent System N - Length of RUS Delivered to Adjacent System N - Service Time to Deliver RU to Adjacent System N - RUS Received from Adjacent System N - Length of RUS Received	mum, 5- Len 11 11 11	1 Dec Pos 0 0 0	Null		Overr Dec	ides Numeric	Page	18	
eport column Summary func Field Name INNRUD INLRUD INTRUD INNRUR INLRUR	formatting and tions: 1-Total Summary ( Functions : ;	IB summary , 2-Aver Column Spacing 2 2 2 2 2	N - Transmission Queue Wait Time M Query/400 functions (continued) age, 3-Minimum, 4-Maxi Column Headings N - RUS Delivered to Adjacent System N - Length of RUS Delivered to Adjacent System N - Service Time to Deliver RU to Adjacent System N - RUS Received from Adjacent System N - Length of RUS Reiceived from Adjacent System	mum, 5- Len 11 11 11 11	1 Dec Pos 0 0 0 0 0	Null		Overr Dec	ides Numeric	Page	18	
eport column Summary func Field Name INNRUD INLRUD INTRUD INNRUR	formatting and tions: 1-Total Summary ( Functions : ;	IB summary , 2-Aver Column Spacing 2 2 2 2	N - Transmission Queue Wait Time M Query/400 functions (continued) age, 3-Minimum, 4-Maxi Column Headings N - RUS Delivered to Adjacent System N - Length of RUS Delivered to Adjacent System N - Service Time to Deliver RU to Adjacent System N - RUS Received from Adjacent System N - Length of RUS Received from Adjacent System	mum, 5- Len 11 11 11	1 Dec Pos 0 0 0	Null		Overr Dec	ides Numeric	Page	18	
eport column Summary func Field Name INNRUD INLRUD INTRUD INNRUR INLRUR	formatting and tions: 1-Total Summary ( Functions : ;	IB summary , 2-Aver Column Spacing 2 2 2 2 2	N - Transmission Queue Wait Time M Query/400 functions (continued) age, 3-Minimum, 4-Maxi Column Headings N - RUS Delivered to Adjacent System N - Length of RUS Delivered to Adjacent System N - Service Time to Deliver RU to Adjacent System N - RUS Received from Adjacent System N - Length of RUS Received from Adjacent System High Priority Sessions	mum, 5- Len 11 11 11 11	1 Dec Pos 0 0 0 0 0	Null		Overr Dec	ides Numeric	Page	18	
eport column Summary func Field Name INNRUD INLRUD INLRUD INNRUR INNRUR INLRUR IHNSS	formatting and tions: 1-Total Summary ( Functions : ; ; ; ;	IB summary , 2-Aver Column Spacing 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2	N - Transmission Queue Wait Time M Query/400 functions (continued) age, 3-Minimum, 4-Maxi Column Headings N - RUS Delivered to Adjacent System N - Length of RUS Delivered to Adjacent System N - Service Time to Deliver RU to Adjacent System N - RUS Received from Adjacent System N - Length of RUS Reieved from Adjacent System High Priority Sessions Started	mum, 5- Len 11 11 11 11 11	1 -Count Dec Pos 0 0 0 0 0 0 0	Null		Overr Dec	ides Numeric	Page	18	
eport column Summary func Field Name INNRUD INLRUD INTRUD INNRUR INLRUR	formatting and tions: 1-Total Summary ( Functions : ; ; ; ;	IB summary , 2-Aver Column Spacing 2 2 2 2 2	N - Transmission Queue Wait Time M Query/400 functions (continued) age, 3-Minimum, 4-Maxi Column Headings N - RUS Delivered to Adjacent System N - Length of RUS Delivered to Adjacent System N - Service Time to Deliver RU to Adjacent System N - RUS Received from Adjacent System N - Length of RUS Received from Adjacent System Figh Priority Sessions Started High	mum, 5- Len 11 11 11 11	1 Dec Pos 0 0 0 0 0	Null		Overr Dec	ides Numeric	Page	18	
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eport column Summary func Field Name INNRUD INLRUD INLRUD INNRUR INNRUR INNRUR IHNSS IHNSE	formatting and tions: 1-Total Summary ( Functions : ; ; ; ; ; ; ; ; ; ; ; ; ; ; ; ; ; ; ;	IB summary, 2-Aver Column Spacing 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2	N - Transmission Queue Wait Time M Query/400 functions (continued) age, 3-Minimum, 4-Maxi Column Headings N - RUS Delivered to Adjacent System N - Length of RUS Delivered to Adjacent System N - Service Time to Deliver RU to Adjacent System N - RUS Received from Adjacent System N - Length of RUS Received from Adjacent System High Priority Sessions Started High Priority Sessions	mum, 5. Len 11 11 11 11 11 11	1 -Count Dec Pos 0 0 0 0 0 0 0 0	Null		Overr Dec	ides Numeric	Page	18	
eport column Summary func Field Name INNRUD INLRUD INLRUD INNRUR INNRUR INLRUR IHNSS	formatting and tions: 1-Total Summary ( Functions : ; ; ; ; ; ; ; ; ; ; ; ; ; ; ; ; ; ; ;	IB summary , 2-Aver Column Spacing 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2	N - Transmission Queue Wait Time M Query/400 functions (continued) age, 3-Minimum, 4-Maxi Column Headings N - RUS Delivered to Adjacent System N - Length of RUS Delivered to Adjacent System N - Service Time to Deliver RU to Adjacent System N - RUS Received from Adjacent System N - Length of RUS Received from Adjacent System N - Length of RUS Received from Adjacent System High Priority Sessions Started High Priority Sessions Ended	mum, 5- Len 11 11 11 11 11	1 -Count Dec Pos 0 0 0 0 0 0 0 0	Null		Overr Dec	ides Numeric	Page	18	
eport column Summary func Field Name INNRUD INLRUD INLRUD INNRUR INNRUR INNRUR IHNSS IHNSE	formatting and tions: 1-Total Summary ( Functions : ; ; ; ; ; ; ; ; ; ; ; ; ; ; ; ; ; ; ;	IB summary, 2-Aver Column Spacing 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2	N - Transmission Queue Wait Time M Query/400 functions (continued) age, 3-Minimum, 4-Maxi Column Headings N - RUS Delivered to Adjacent System N - Length of RUS Delivered to Adjacent System N - Service Time to Deliver RU to Adjacent System N - Service Time to Deliver RU to Adjacent System N - RUS Received from Adjacent System N - Length of RUS Received from Adjacent System High Priority Sessions Started High Priority Sessions Ended H - Begin Bracket	mum, 5. Len 11 11 11 11 11 11	1 -Count Dec Pos 0 0 0 0 0 0 0 0	Null		Overr Dec	ides Numeric	Page	18	
eport column Summary func Field Name INNRUD INLRUD INLRUD INNRUR INNRUR INNRUR IHNSS IHNSE IHNBB	formatting and tions: 1-Total Summary ( Functions : ; ; ; ; ; ; ; ; ; ; ; ; ; ; ; ; ; ; ;	IB summary, 2-Aver Column Spacing 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2	N - Transmission Queue Wait Time M Query/400 functions (continued) age, 3-Minimum, 4-Maxi Column Headings N - RUS Delivered to Adjacent System N - Length of RUS Delivered to Adjacent System N - Service Time to Deliver RU to Adjacent System N - RUS Received from Adjacent System N - RUS Received from Adjacent System N - RUS Received from Adjacent System Fuit System Started High Priority Sessions Ended H - Begin Bracket Request Units	num, 5- Len 11 11 11 11 11 11 11	1 -Count Dec Pos 0 0 0 0 0 0 0 0 0 0 0 0 0	Null		Overr Dec	ides Numeric	Page	18	
eport column Summary func Field Name INNRUD INLRUD INLRUD INNRUR INNRUR INNRUR IHNSS IHNSE	formatting and tions: 1-Total Summary ( Functions : ; ; ; ; ; ; ; ; ; ; ; ; ; ; ; ; ; ; ;	IB summary, 2-Aver Column Spacing 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2	N - Transmission Queue Wait Time M Query/400 functions (continued) age, 3-Minimum, 4-Maxi Column Headings N - RUS Delivered to Adjacent System N - Length of RUS Delivered to Adjacent System N - Service Time to Deliver RU to Adjacent System N - RUS Received from Adjacent System N - Length of RUS Received from Adjacent System N - Length of RUS Received from Adjacent System High Priority Sessions Started High Priority Sessions Ended H - Begin Bracket Request Units H - End	mum, 5. Len 11 11 11 11 11 11	1 -Count Dec Pos 0 0 0 0 0 0 0 0 0 0 0 0 0	Null		Overr Dec	ides Numeric	Page	18	
eport column Summary func Field Name INNRUD INLRUD INLRUD INNRUR INNRUR INNRUR IHNSS IHNSE IHNBB	formatting and tions: 1-Total Summary ( Functions : ; ; ; ; ; ; ; ; ; ; ; ; ; ; ; ; ; ; ;	IB summary, 2-Aver Column Spacing 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2	N - Transmission Queue Wait Time M Query/400 functions (continued) age, 3-Minimum, 4-Maxi Column Headings N - RUS Delivered to Adjacent System N - Length of RUS Delivered to Adjacent System N - Service Time to Deliver RU to Adjacent System N - Service Time to Deliver RU to Adjacent System N - Service Time to Deliver RU to Adjacent System N - RUS Received from Adjacent System N - Length of RUS Received from Adjacent System High Priority Sessions Ended H - Begin Bracket	num, 5- Len 11 11 11 11 11 11 11	1 -Count Dec Pos 0 0 0 0 0 0 0 0 0 0 0 0 0	Null		Overr Dec	ides Numeric	Page	18	
eport column Summary func Field Name INNRUD INLRUD INLRUD INNRUR INNRUR INNRUR IHNSS IHNSE IHNBB IHNBB	formatting and tions: 1-Total Summary Functions : ; ; ; ; ; ; ; ; ; ; ; ; ; ; ; ; ; ; ;	IB summary, 2-Aver Column Spacing 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2	N - Transmission Queue Wait Time M Query/400 functions (continued) age, 3-Minimum, 4-Maxi Column Headings N - RUS Delivered to Adjacent System N - Length of RUS Delivered to Adjacent System N - Service Time to Deliver RU to Adjacent System N - RUS Received from Adjacent System N - RUS Received from Adjacent System N - RUS Received from Adjacent System N - RUS Received System Fior Adjacent System High Priority Sessions Started High Priority Sessions Ended H - Begin Bracket Request Units	num, 5- Len 11 11 11 11 11 11 11 11	1 1 Dec Pos 0 0 0 0 0 0 0 0 0 0 0 0	Null		Overr Dec	ides Numeric	Page	18	
eport column Summary func Field Name INNRUD INLRUD INLRUD INNRUR INNRUR INNRUR IHNSS IHNSE IHNBB	formatting and tions: 1-Total Summary Functions : ; ; ; ; ; ; ; ; ; ; ; ; ; ; ; ; ; ; ;	IB summary, 2-Aver Column Spacing 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2	N - Transmission Queue Wait Time M Query/400 functions (continued) age, 3-Minimum, 4-Maxi Column Headings N - RUS Delivered to Adjacent System N - Length of RUS Delivered to Adjacent System N - Service Time to Deliver RU to Adjacent System N - RUS Received from Adjacent System N - Length of RUS Received from Adjacent System N - Length of RUS Received from Adjacent System N - Length of RUS Received from Adjacent System High Priority Sessions Started High Priority Sessions Ended H - Begin Bracket Request Units H - Sesion-level	num, 5- Len 11 11 11 11 11 11 11	1 1 Dec Pos 0 0 0 0 0 0 0 0 0 0 0 0	Null		Overr Dec	ides Numeric	Page	18	
eport column Summary func Field Name INNRUD INLRUD INLRUD INNRUR INNRUR INNRUR IHNSS IHNSE IHNBB IHNBB	formatting and tions: 1-Total Summary Functions : ; ; ; ; ; ; ; ; ; ; ; ; ; ; ; ; ; ; ;	IB summary, 2-Aver Column Spacing 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2	N - Transmission Queue Wait Time M Query/400 functions (continued) age, 3-Minimum, 4-Maxi Column Headings N - RUS Delivered to Adjacent System N - Length of RUS Delivered to Adjacent System N - Service Time to Deliver RU to Adjacent System N - Service Time to Deliver RU to Adjacent System N - Service Time to Deliver RU to Adjacent System N - Length of RUS Received from Adjacent System N - Length of RUS Received from Adjacent System N - Length of RUS Received from Adjacent System High Priority Sessions Ended H - Begin Bracket Request Units H - Session-level Send Pacing	num, 5- Len 11 11 11 11 11 11 11 11	1 1 Dec Pos 0 0 0 0 0 0 0 0 0 0 0 0	Null		Overr Dec	ides Numeric	Page	18	
eport column Summary func Field Name INNRUD INLRUD INLRUD INNRUR INNRUR INNRUR IHNSS IHNSE IHNBB IHNBB IHNEB	formatting and tions: 1-Total Summary Functions : ; ; ; ; ; ; ; ; ; ; ; ; ; ; ; ; ; ; ;	IB summary, 2-Aver Column Spacing 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2	N - Transmission Queue Wait Time M Query/400 functions (continued) age, 3-Minimum, 4-Maxi Column Headings N - RUS Delivered to Adjacent System N - Length of RUS Delivered to Adjacent System N - Service Time to Deliver RU to Adjacent System N - RUS Received from Adjacent System N - RUS Received from Adjacent System N - RUS Received from Adjacent System N - RUS Received from Adjacent System N - RUS Received System Fior Ty Sessions Started High Priority Sessions Ended H - Begin Bracket Request Units H - End Bracket Request Units H - Session-level Send Pacing Wait Time	mum, 5- Len 11 11 11 11 11 11 11 11 11	1 Dec Pos 0 0 0 0 0 0 0 0 0 0 0 0	Null		Overr Dec	ides Numeric	Page	18	
eport column Summary func Field Name INNRUD INLRUD INLRUD INNRUR INNRUR INNRUR IHNSS IHNSE IHNBB IHNBB	formatting and tions: 1-Total Summary Functions : ; ; ; ; ; ; ; ; ; ; ; ; ; ; ; ; ; ; ;	IB summary, 2-Aver Column Spacing 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2	N - Transmission Queue Wait Time M Query/400 functions (continued) age, 3-Minimum, 4-Maxi Column Headings N - RUS Delivered to Adjacent System N - Length of RUS Delivered to Adjacent System N - Service Time to Deliver RU to Adjacent System N - Service Time to Deliver RU to Adjacent System N - Service Time to Deliver RU to Adjacent System N - Length of RUS Received from Adjacent System N - Length of RUS Received from Adjacent System N - Length of RUS Received from Adjacent System High Priority Sessions Ended H - Begin Bracket Request Units H - Session-level Send Pacing	num, 5- Len 11 11 11 11 11 11 11 11	1 Dec Pos 0 0 0 0 0 0 0 0 0 0 0 0	Null		Overr Dec	ides Numeric	Page	18	
eport column Summary func Field Name INNRUD INLRUD INLRUD INNRUR INNRUR INNRUR IHNSS IHNSE IHNBB IHNBB IHNEB	formatting and tions: 1-Total Summary Functions : ; ; ; ; ; ; ; ; ; ; ; ; ; ; ; ; ; ; ;	IB summary, 2-Aver Column Spacing 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2	N - Transmission Queue Wait Time M Query/400 functions (continued) age, 3-Minimum, 4-Maxi Column Headings N - RUS Delivered to Adjacent System N - Length of RUS Delivered to Adjacent System N - Service Time to Deliver RU to Adjacent System N - RUS Received from Adjacent System N - RUS Received from Adjacent System N - RUS Received from Adjacent System N - RUS Received from Adjacent System N - RUS Received System Fior Ty Sessions Started High Priority Sessions Ended H - Begin Bracket Request Units H - End Bracket Request Units H - Session-level Send Pacing Wait Time	mum, 5- Len 11 11 11 11 11 11 11 11 11	1 Dec Pos 0 0 0 0 0 0 0 0 0 0 0 0	Null		Overr Dec	ides Numeric	Page	18	

Figure 176. SNA\_ALL Query Definition, Part 9

			M Query/400		1	1/27/9	96	14:56:	16	Page	19	
			functions (continued)									
			age, 3-Minimum, 4-Maxi	num, 5-				Overn				
Field	Summary	Column	Column Has !!			Null			Numeric			
Name	Functions	Spacing 2	Column Headings		Pos 0	Cap	Len	POS	Editing			
IHSPPW		2	H - Session-level Send Pacing	11	0							
			Potential Waits									
IHSPWS		2	H - Session-level	11	0							
1113FW3		2	Send Pacing	11	0							
			Window Size									
IHIPWT		2	H - Internal	11	0							
			Session-level									
			Pacing Wait Time									
IHIPNW		2	H - Internal	11	0							
			Session-level									
			Pacing Waits									
IHQNRE		2	H – RUS	11	0							
			Entering									
			Transmission Queue									
IHQLRE		2	H - Length of	11	0							
			RUs Entering									
THONDI		2	Transmission Queue		~							
IHQNRL		2	H - RUS Leaving Transmission	11	0							
			Leaving Transmission Queue									
IHQLRL		2	Queue H - Length of	11	0							
*****		-	RUs Leaving	11	J							
			Transmission Queue									
IHQTRR		2	H -	11	0							
			 Transmission Queue		0							
			Wait Time									
IHNRUD		2	H - RUS	11	0							
			Delivered to									
			Adjacent System									
IHLRUD												
THEROD		2	H - Length of	11	0							
THEROD		2	H - Length of RUs Delivered	11	0							
INEROD		2		11	0							
		IB	RUs Delivered to Adjacent System M Query/400	11		1/27/9	96	14:56:	16	Page	20	
eport column		IB summary	RUs Delivered to Adjacent System M Query/400 functions (continued)		1		96			Page	20	
eport column Summary func	tions: 1-Tota	IB summary 1, 2-Aver	RUs Delivered to Adjacent System M Query/400		1 -Count		96	0vern	ides	Page	20	
eport column Summary func Field	tions: 1-Tota Summary	IB summary l, 2-Aver Column	RUs Delivered to Adjacent System M Query/400 functions (continued) age, 3-Minimum, 4-Maxin	num, 5-	1 -Count Dec	Null		Overn Dec	ides Numeric	Page	20	
eport column Summary func Field Name	tions: 1-Tota	IB summary 1, 2-Aver Column Spacing	RUs Delivered to Adjacent System M Query/400 functions (continued) age, 3-Minimum, 4-Maxin Column Headings	num, 5- Len	-Count Dec Pos			Overn Dec	ides	Page	20	
eport column Summary func Field	tions: 1-Tota Summary	IB summary l, 2-Aver Column	RUs Delivered to Adjacent System M Query/400 functions (continued) age, 3-Minimum, 4-Maxin Column Headings H - Service Time	num, 5-	1 -Count Dec	Null		Overn Dec	ides Numeric	Page	20	
eport column Summary func Field Name	tions: 1-Tota Summary	IB summary 1, 2-Aver Column Spacing	RUS Delivered to Adjacent System M Query/400 functions (continued) age, 3-Minimum, 4-Maxin Column Headings H - Service Time to Deliver RU	num, 5- Len	-Count Dec Pos	Null		Overn Dec	ides Numeric	Page	20	
eport column Summary func Field Name IHTRUD	tions: 1-Tota Summary	IB summary 1, 2-Aver Column Spacing 2	RUS Delivered to Adjacent System M Query/400 functions (continued) age, 3-Minimum, 4-Maxin Column Headings H - Service Time to Deliver RU to Adjacent System	num, 5- Len 11	l Dec Pos 0	Null		Overn Dec	ides Numeric	Page	20	
eport column Summary func Field Name	tions: 1-Tota Summary	IB summary 1, 2-Aver Column Spacing	RUS Delivered to Adjacent System M Query/400 functions (continued) age, 3-Minimum, 4-Maxin Column Headings H - Service Time to Deliver RU to Adjacent System H - RUS	num, 5- Len	l Dec Pos 0	Null		Overn Dec	ides Numeric	Page	20	
eport column Summary func Field Name IHTRUD	tions: 1-Tota Summary	IB summary 1, 2-Aver Column Spacing 2	RUS Delivered to Adjacent System M Query/400 functions (continued) age, 3-Minimum, 4-Maxin Column Headings H - Service Time to Deliver RU to Adjacent System H - RUS Received from	num, 5- Len 11	l Dec Pos 0	Null		Overn Dec	ides Numeric	Page	20	
eport column Summary func Field Name IHTRUD	tions: 1-Tota Summary	IB summary 1, 2-Aver Column Spacing 2	RUS Delivered to Adjacent System M Query/400 functions (continued) age, 3-Minimum, 4-Maxin Column Headings H - Service Time to Deliver RU to Adjacent System H - RUs Received from Adjacent System	num, 5- Len 11	-Count Dec Pos O	Null		Overn Dec	ides Numeric	Page	20	
eport column Summary func Field Name IHTRUD IHNRUR	tions: 1-Tota Summary	IB summary 1, 2-Aver Column Spacing 2 2	RUS Delivered to Adjacent System M Query/400 functions (continued) age, 3-Minimum, 4-Maxin Column Headings H - Service Time to Deliver RU to Adjacent System H - RUS Received from	num, 5- Len 11 11	-Count Dec Pos O	Null		Overn Dec	ides Numeric	Page	20	
eport column Summary func Field Name IHTRUD IHNRUR	tions: 1-Tota Summary	IB summary 1, 2-Aver Column Spacing 2 2	RUS Delivered to Adjacent System M Query/400 functions (continued) age, 3-Minimum, 4-Maxin Column Headings H - Service Time to Deliver RU to Adjacent System H - RUS Received from Adjacent System H - Length of RUS Received	num, 5- Len 11 11	-Count Dec Pos O	Null		Overn Dec	ides Numeric	Page	20	
eport column Summary func Field Name IHTRUD IHNRUR	tions: 1-Tota Summary	IB summary 1, 2-Aver Column Spacing 2 2	RUS Delivered to Adjacent System M Query/400 functions (continued) age, 3-Minimum, 4-Maxin Column Headings H - Service Time to Deliver RU to Adjacent System H - RUS Received from Adjacent System H - Length of	num, 5- Len 11 11	-Count Dec Pos O	Null		Overn Dec	ides Numeric	Page	20	
eport column Summary func: Field Name IHTRUD IHNRUR IHLRUR	tions: 1-Tota Summary	IB summary 1, 2-Aver Column Spacing 2 2	RUS Delivered to Adjacent System M Query/400 functions (continued) age, 3-Minimum, 4-Maxin Column Headings H - Service Time to Deliver RU to Adjacent System H - RUs Received from Adjacent System H - Length of RUS Received from Adjacent System	num, 5- Len 11 11	-Count Dec Pos 0 0	Null		Overn Dec	ides Numeric	Page	20	
eport column Summary func: Field Name IHTRUD IHNRUR IHLRUR	tions: 1-Tota Summary	IB summary 1, 2-Aver Column Spacing 2 2	RUS Delivered to Adjacent System M Query/400 functions (continued) age, 3-Minimum, 4-Maxin Column Headings H - Service Time to Deliver RU to Adjacent System H - RUS Received from Adjacent System H - Length of RUS Received from Adjacent System Medium	num, 5- Len 11 11	-Count Dec Pos 0 0	Null		Overn Dec	ides Numeric	Page	20	
eport column Summary func: Field Name IHTRUD IHNRUR IHLRUR	tions: 1-Tota Summary	IB summary 1, 2-Aver Column Spacing 2 2	RUS Delivered to Adjacent System M Query/400 functions (continued) age, 3-Minimum, 4-Maxin Column Headings H - Service Time to Deliver RU to Adjacent System H - RUS Received from Adjacent System H - Length of RUS Received from Adjacent System Medium Priority Sessions	num, 5- Len 11 11	I Dec Pos 0 0 0	Null		Overn Dec	ides Numeric	Page	20	
eport column Summary func: Field Name IHTRUD IHNRUR IHLRUR IMNSS	tions: 1-Tota Summary	IB Summary 1, 2-Aver Column Spacing 2 2 2 2	RUS Delivered to Adjacent System M Query/400 functions (continued) age, 3-Minimum, 4-Maxin Column Headings H - Service Time to Deliver RU to Adjacent System H - RUs Received from Adjacent System H - Length of RUS Received from Adjacent System Medium Priority Sessions Started	num, 5- Len 11 11 11	I Dec Pos 0 0 0	Null		Overn Dec	ides Numeric	Page	20	
eport column Summary func: Field Name IHTRUD IHNRUR IHLRUR IMNSS	tions: 1-Tota Summary	IB Summary 1, 2-Aver Column Spacing 2 2 2 2	RUS Delivered to Adjacent System M Query/400 functions (continued) age, 3-Minimum, 4-Maxin Column Headings H - Service Time to Deliver RU to Adjacent System H - RUS Received from Adjacent System H - Length of RUS Received from Adjacent System Medium Priority Sessions Started Medium Priority Sessions Ended	num, 5- Len 11 11 11	I Dec Pos 0 0 0	Null		Overn Dec	ides Numeric	Page	20	
eport column Summary func: Field Name IHTRUD IHNRUR IHLRUR IMNSS	tions: 1-Tota Summary	IB Summary 1, 2-Aver Column Spacing 2 2 2 2	RUS Delivered to Adjacent System M Query/400 functions (continued) age, 3-Minimum, 4-Maxin Column Headings H - Service Time to Deliver RU to Adjacent System H - RUs Received from Adjacent System H - Length of RUS Received from Adjacent System Medium Priority Sessions Started Medium Priority Sessions Ended M - Begin	num, 5- Len 11 11 11	I Dec Pos 0 0 0	Null		Overn Dec	ides Numeric	Page	20	
eport column Summary func: Field Name IHTRUD IHNRUR IHLRUR IMNSS IMNSE	tions: 1-Tota Summary	IB summary 1, 2-Aver Column Spacing 2 2 2 2 2 2 2 2 2 2 2 2 2	RUS Delivered to Adjacent System M Query/400 functions (continued) age, 3-Minimum, 4-Maxin Column Headings H - Service Time to Deliver RU to Adjacent System H - RUS Received from Adjacent System H - Length of RUS Received from Adjacent System Medium Priority Sessions Started Medium Priority Sessions Ended M - Begin Bracket	num, 5. Len 11 11 11 11	J Dec Pos 0 0 0 0	Null		Overn Dec	ides Numeric	Page	20	
eport column Summary func: Field Name IHTRUD IHNRUR IHLRUR IMNSS IMNSE IMNBB	tions: 1-Tota Summary	IB summary 1, 2-Aver Column Spacing 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2	RUS Delivered to Adjacent System M Query/400 functions (continued) age, 3-Minimum, 4-Maxin Column Headings H - Service Time to Deliver RU to Adjacent System H - RUS Received from Adjacent System H - Length of RUS Received from Adjacent System Medium Priority Sessions Started Medium Priority Sessions Ended M - Begin Bracket Request Units	num, 5. Len 11 11 11 11 11	J -Counti Dec Pos 0 0 0 0 0	Null		Overn Dec	ides Numeric	Page	20	
eport column Summary func: Field Name IHTRUD IHNRUR IHLRUR IMNSS IMNSE	tions: 1-Tota Summary	IB summary 1, 2-Aver Column Spacing 2 2 2 2 2 2 2 2 2 2 2 2 2	RUS Delivered to Adjacent System M Query/400 functions (continued) age, 3-Minimum, 4-Maxin Column Headings H - Service Time to Deliver RU to Adjacent System H - RUs Received from Adjacent System H - Length of RUS Received from Adjacent System Medium Priority Sessions Started Medium Priority Sessions Started M - Begin Bracket Request Units M - End	num, 5. Len 11 11 11 11	I Dec Pos 0 0 0 0 0 0	Null		Overn Dec	ides Numeric	Page	20	
eport column Summary func: Field Name IHTRUD IHNRUR IHLRUR IMNSS IMNSE IMNBB	tions: 1-Tota Summary	IB summary 1, 2-Aver Column Spacing 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2	RUS Delivered to Adjacent System M Query/400 functions (continued) age, 3-Minimum, 4-Maxin Column Headings H - Service Time to Deliver RU to Adjacent System H - RUS Received from Adjacent System H - Length of RUS Received from Adjacent System Medium Priority Sessions Started Medium Priority Sessions Ended M - Begin Bracket	num, 5. Len 11 11 11 11 11	J -Counti Dec Pos 0 0 0 0 0	Null		Overn Dec	ides Numeric	Page	20	
eport column Summary func: Field Name IHTRUD IHNRUR IHLRUR IMNSS IMNSE IMNBB IMNBB	tions: 1-Tota Summary	IB summary 1, 2-Aver Column Spacing 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2	RUS Delivered to Adjacent System M Query/400 functions (continued) age, 3-Minimum, 4-Maxin Column Headings H - Service Time to Deliver RU to Adjacent System H - RUS Received from Adjacent System H - Length of RUS Received from Adjacent System Medium Priority Sessions Started Medium Priority Sessions Ended M - Begin Bracket Request Units Request Units	num, 5- Len 11 11 11 11 11 11	1 Dec Pos 0 0 0 0 0 0 0 0	Null		Overn Dec	ides Numeric	Page	20	
eport column Summary func: Field Name IHTRUD IHNRUR IHLRUR IMNSS IMNSE IMNBB	tions: 1-Tota Summary	IB summary 1, 2-Aver Column Spacing 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2	RUS Delivered to Adjacent System M Query/400 functions (continued) age, 3-Minimum, 4-Maxin Column Headings H - Service Time to Deliver RU to Adjacent System H - RUS Received from Adjacent System H - Length of RUS Received from Adjacent System Medium Priority Sessions Started Medium Priority Sessions Started M - Begin Bracket Request Units M - End Bracket Request Units	num, 5. Len 11 11 11 11 11	1 Dec Pos 0 0 0 0 0 0 0 0	Null		Overn Dec	ides Numeric	Page	20	
eport column Summary func: Field Name IHTRUD IHNRUR IHLRUR IMNSS IMNSE IMNBB IMNBB	tions: 1-Tota Summary	IB summary 1, 2-Aver Column Spacing 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2	RUS Delivered to Adjacent System M Query/400 functions (continued) age, 3-Minimum, 4-Maxin Column Headings H - Service Time to Deliver RU to Adjacent System H - RUS Received from Adjacent System H - Length of RUS Received from Adjacent System Medium Priority Sessions Started Medium Priority Sessions Ended M - Begin Bracket Request Units M - End Bracket Request Units M - Session-level Send Pacing	num, 5- Len 11 11 11 11 11 11	1 Dec Pos 0 0 0 0 0 0 0 0	Null		Overn Dec	ides Numeric	Page	20	
eport column Summary func: Field Name IHTRUD IHNRUR IHLRUR IMNSS IMNSE IMNBB IMNBB IMNBB	tions: 1-Tota Summary	IB summary 1, 2-Aver Column Spacing 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2	RUS Delivered to Adjacent System M Query/400 functions (continued) age, 3-Minimum, 4-Maxin Column Headings H - Service Time to Deliver RU to Adjacent System H - RUS Received from Adjacent System H - Length of RUS Received from Adjacent System Medium Priority Sessions Started Medium Priority Sessions Ended M - Begin Bracket Request Units M - End Bracket Request Units M - Session-level Send Pacing Wait Time	num, 5. Len 11 11 11 11 11 11 11	J -Count Dec Pos 0 0 0 0 0 0 0 0 0 0	Null		Overn Dec	ides Numeric	Page	20	
eport column Summary func: Field Name IHTRUD IHNRUR IHLRUR IMNSS IMNSE IMNBB IMNBB	tions: 1-Tota Summary	IB summary 1, 2-Aver Column Spacing 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2	RUS Delivered to Adjacent System M Query/400 functions (continued) age, 3-Minimum, 4-Maxin Column Headings H - Service Time to Deliver RU to Adjacent System H - RUS Received from Adjacent System H - Length of RUS Received from Adjacent System Medium Priority Sessions Started Medium Priority Sessions Started M - Begin Bracket Request Units M - End Bracket Request Units M - Session-level Send Pacing Wait Time M - Session-level	num, 5- Len 11 11 11 11 11 11	J -Count Dec Pos 0 0 0 0 0 0 0 0 0 0	Null		Overn Dec	ides Numeric	Page -	20	
eport column Summary func: Field Name IHTRUD IHNRUR IHLRUR IMNSS IMNSE IMNBB IMNBB IMNBB	tions: 1-Tota Summary	IB summary 1, 2-Aver Column Spacing 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2	RUS Delivered to Adjacent System M Query/400 functions (continued) age, 3-Minimum, 4-Maxin Column Headings H - Service Time to Deliver RU to Adjacent System H - RUS Received from Adjacent System H - Length of RUS Received from Adjacent System Medium Priority Sessions Started Medium Priority Sessions Ended M - Begin Bracket Request Units M - End Bracket Request Units M - Session-level Send Pacing Wait Time M - Session-level Send Pacing	num, 5. Len 11 11 11 11 11 11 11	J -Count Dec Pos 0 0 0 0 0 0 0 0 0 0	Null		Overn Dec	ides Numeric	Page -	20	
eport column Summary func: Field Name IHTRUD IHNRUR IHLRUR IMNSS IMNSE IMNBB IMNBB IMNBB IMNBB	tions: 1-Tota Summary	IB summary 1, 2-Aver column spacing 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2	RUS Delivered to Adjacent System M Query/400 functions (continued) age, 3-Minimum, 4-Maxin Column Headings H - Service Time to Deliver RU to Adjacent System H - RUS Received from Adjacent System H - Length of RUS Received from Adjacent System Medium Priority Sessions Started Medium Priority Sessions Ended M - Begin Bracket Request Units M - End Bracket Request Units M - Session-level Send Pacing Waits	num, 5- Len 11 11 11 11 11 11 11 11	J Dec Pos 0 0 0 0 0 0 0 0 0 0 0 0 0	Null		Overn Dec	ides Numeric	Page	20	
eport column Summary func: Field Name IHTRUD IHNRUR IHLRUR IMNSS IMNSE IMNBB IMNBB IMNBB	tions: 1-Tota Summary	IB summary 1, 2-Aver Column Spacing 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2	RUS Delivered to Adjacent System M Query/400 functions (continued) age, 3-Minimum, 4-Maxin Column Headings H - Service Time to Deliver RU to Adjacent System H - RUS Received from Adjacent System H - Length of RUS Received from Adjacent System Medium Priority Sessions Started Medium Priority Sessions Started M - Begin Bracket Request Units M - End Bracket Request Units M - Session-level Send Pacing Wait Time M - Session-level Send Pacing Waits	num, 5. Len 11 11 11 11 11 11 11	J -Count Dec Pos 0 0 0 0 0 0 0 0 0 0 0 0 0	Null		Overn Dec	ides Numeric	Page	20	
eport column Summary func: Field Name IHTRUD IHNRUR IHLRUR IMNSS IMNSE IMNBB IMNBB IMNBB IMNBB	tions: 1-Tota Summary	IB summary 1, 2-Aver column spacing 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2	RUS Delivered to Adjacent System M Query/400 functions (continued) age, 3-Minimum, 4-Maxin Column Headings H - Service Time to Deliver RU to Adjacent System H - RUS Received from Adjacent System H - Length of RUS Received from Adjacent System Medium Priority Sessions Started Medium Priority Sessions Ended M - Begin Bracket Request Units M - End Bracket Request Units M - Session-level Send Pacing Waits M - Session-level Send Pacing	num, 5- Len 11 11 11 11 11 11 11 11	J Dec Pos 0 0 0 0 0 0 0 0 0 0 0 0 0	Null		Overn Dec	ides Numeric	Page -	20	
eport column Summary func: Field Name IHTRUD IHNRUR IHLRUR IMNSS IMNSE IMNBB IMNBB IMNBB IMSPWT IMSPNW IMSPPW	tions: 1-Tota Summary	IB summary 1, 2-Aver column spacing 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2	RUS Delivered to Adjacent System M Query/400 functions (continued) age, 3-Minimum, 4-Maxin Column Headings H - Service Time to Deliver RU to Adjacent System H - RUS Received from Adjacent System H - Length of RUS Received from Adjacent System Medium Priority Sessions Started Medium Priority Sessions Ended M - Begin Bracket Request Units M - End Bracket Request Units M - End Bracket Request Units M - Session-level Send Pacing Waits M - Session-level Send Pacing Waits	num, 5- Len 11 11 11 11 11 11 11 11 11	I Dec Pos 0 0 0 0 0 0 0 0 0 0 0 0 0 0	Null		Overn Dec	ides Numeric	Page	20	
eport column Summary func: Field Name IHTRUD IHNRUR IHLRUR IMNSS IMNSE IMNBB IMNBB IMNBB IMNBB	tions: 1-Tota Summary	IB summary 1, 2-Aver column spacing 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2	RUS Delivered to Adjacent System M Query/400 functions (continued) age, 3-Minimum, 4-Maxin Column Headings H - Service Time to Deliver RU to Adjacent System H - RUS Received from Adjacent System H - Length of RUS Received from Adjacent System Medium Priority Sessions Started Medium Priority Sessions Ended M - Begin Bracket Request Units M - End Bracket Request Units M - Session-level Send Pacing Waits M - Session-level Send Pacing	num, 5- Len 11 11 11 11 11 11 11 11	I Dec Pos 0 0 0 0 0 0 0 0 0 0 0 0 0	Null		Overn Dec	ides Numeric	Page	20	

Figure 177. SNA\_ALL Query Definition, Part 10

			M Query/400		1	1/27/	96	14:56:	16	Page	21		
			functions (continued)		_			_					
			age, 3-Minimum, 4-Maxi	mum, 5-				0verr					
Field		Column				Null			Numeric				
Name			Column Headings	Len		Cap	Len	Pos	Editing				
IMIPWT	:	2	M - Internal	11	0								
			Session-level										
			Pacing Wait Time										
IMIPNW	:	2	M - Internal	11	0								
			Session-level										
		-	Pacing Waits										
IMQNRE	2	2	M - RUs	11	0								
			Entering										
		-	Transmission Queue										
IMQLRE	i i i i i i i i i i i i i i i i i i i	2	M - Length of	11	0								
			RUs Entering										
THOND			Transmission Queue										
IMQNRL		2	M - RUs	11	0								
			Leaving Transmission										
			Queue										
IMQLRL	2	2	M - Length of	11	0								
			RUs Leaving										
THOTOS		2	Transmission Queue										
IMQTRR	1	2	M - Transmission Queue	11	0								
			Wait Time										
IMNRUD		2	M - RUS	11	0								
IMAKUD		2	Delivered to	11	0								
			Adjacent System										
IMLRUD		2	Mujacent System M - Length of	11	0								
THEROD	4	-	RUs Delivered	11	0								
			to Adjacent System										
IMTRUD		2	M - Service TIme	11	0								
THIRD	4	-	to Deliver RU	11	0								
			to Adjacent System										
IMNRUR					0								
THINKOK		2	M - RUs Received from	11	0								
THINKOK		2	Received from	11	U								
THINKOK			Received from Adjacent System	11		1/27/	16	14.56.	16	Pago	22		
		IB	Received from Adjacent System M Query/400	11		1/27/	96	14:56:	16	Page	22		
Report column	formatting and	IB summary	Received from Adjacent System M Query/400 functions (continued)		1		96			Page	22		
eport column Summary fun	formatting and string a	IB summary , 2-Aver	Received from Adjacent System M Query/400		1 -Count		96	0verr	ides	Page	22		
Report column Summary fun Field	formatting and s ctions: 1-Total Summary	IB summary , 2-Aver Column	Received from Adjacent System M Query/400 functions (continued) age, 3-Minimum, 4-Maxi	mum, 5-	1 -Count Dec	Null		Overr Dec	ides Numeric	Page	22		
teport column Summary fun Field Name	formatting and ctions: 1-Total Summary Functions S	IB summary , 2-Aver Column	Received from Adjacent System M Query/400 functions (continued) age, 3-Minimum, 4-Maxi Column Headings		1 -Count			Overr Dec	ides	Page	22		
Report column Summary fun Field	formatting and ctions: 1-Total Summary Functions S	IB summary , 2-Aver Column Spacing	Received from Adjacent System M Query/400 functions (continued) age, 3-Minimum, 4-Maxi	mum, 5. Len	1 -Count Dec Pos	Null		Overr Dec	ides Numeric	Page	22		
teport column Summary fun Field Name	formatting and ctions: 1-Total Summary Functions S	IB summary , 2-Aver Column Spacing	Received from Adjacent System M Query/400 functions (continued) age, 3-Minimum, 4-Maxi Column Headings M - Length of RUs Received	mum, 5. Len	1 -Count Dec Pos	Null		Overr Dec	ides Numeric	Page	22		
teport column Summary fun Field Name	formatting and ctions: 1-Total Summary Functions S	IB summary , 2-Aver Column Spacing	Received from Adjacent System M Query/400 functions (continued) age, 3-Minimum, 4-Maxi Column Headings M - Length of	mum, 5. Len	1 -Count Dec Pos	Null		Overr Dec	ides Numeric	Page	22		
leport column Summary fun Field Name IMLRUR	formatting and ctions: 1-Total Summary Functions S	IB summary , 2-Aver Column Spacing 2	Received from Adjacent System M Query/400 functions (continued) age, 3-Minimum, 4-Maxi Column Headings M - Length of RUS Received from Adjacent System	mum, 5- Len 11	Count Dec Pos 0	Null		Overr Dec	ides Numeric	Page	22		
leport column Summary fun Field Name IMLRUR	formatting and ctions: 1-Total Summary Functions S	IB summary , 2-Aver Column Spacing 2	Received from Adjacent System M Query/400 functions (continued) age, 3-Minimum, 4-Maxi Column Headings M - Length of RUS Received from Adjacent System Low	mum, 5- Len 11	Count Dec Pos 0	Null		Overr Dec	ides Numeric	Page	22		
leport column Summary fun Field Name IMLRUR	formatting and ctions: 1-Total Summary ( Functions :	IB summary , 2-Aver Column Spacing 2	Received from Adjacent System M Query/400 functions (continued) age, 3-Minimum, 4-Maxi Column Headings M - Length of RUS Received from Adjacent System Low Priority Sessions	mum, 5- Len 11	Count Dec Pos 0	Null		Overr Dec	ides Numeric	Page	22		
Report column Summary fun Field Name IMLRUR ILNSS	formatting and ctions: 1-Total Summary ( Functions :	IB summary , 2-Aver Column Spacing 2	Received from Adjacent System M Query/400 functions (continued) age, 3-Minimum, 4-Maxi Column Headings M - Length of RUS Received from Adjacent System Low Priority Sessions Started	mum, 5- Len 11 11	-Count Dec Pos O	Null		Overr Dec	ides Numeric	Page	22		
Report column Summary fun Field Name IMLRUR ILNSS	formatting and ctions: 1-Total Summary ( Functions :	IB summary , 2-Aver Column Spacing 2	Received from Adjacent System M Query/400 functions (continued) age, 3-Minimum, 4-Maxi Column Headings M - Length of RUS Received from Adjacent System Low Priority Sessions Started Low	mum, 5- Len 11 11	-Count Dec Pos O	Null		Overr Dec	ides Numeric	Page	22		
Report column Summary fun Field Name IMLRUR ILNSS	formatting and ctions: 1-Total Summary ( Functions :	IB summary , 2-Aver Column Spacing 2	Received from Adjacent System M Query/400 functions (continued) age, 3-Minimum, 4-Maxi Column Headings M - Length of RUS Received from Adjacent System Low Priority Sessions Started Low Priority Sessions	mum, 5- Len 11 11	-Count Dec Pos O	Null		Overr Dec	ides Numeric	Page	22		
teport column Summary fun Field Name IMLRUR ILNSS ILNSE	formatting and ctions: 1-Total Summary ( Functions :	IB summary , 2-Aver Column Spacing 2 2 2	Received from Adjacent System M Query/400 functions (continued) age, 3-Minimum, 4-Maxi Column Headings M - Length of RUS Received from Adjacent System Low Priority Sessions Started Low Priority Sessions Ended	mum, 5- Len 11 11	-Count Dec Pos 0 0	Null		Overr Dec	ides Numeric	Page	22		
teport column Summary fun Field Name IMLRUR ILNSS ILNSE	formatting and ctions: 1-Total Summary ( Functions :	IB summary , 2-Aver Column Spacing 2 2 2	Received from Adjacent System M Query/400 functions (continued) age, 3-Minimum, 4-Maxi Column Headings M - Length of RUS Received from Adjacent System Low Priority Sessions Started Low Priority Sessions Ended L - Begin	mum, 5- Len 11 11	-Count Dec Pos 0 0	Null		Overr Dec	ides Numeric	Page	22		
teport column Summary fun Field Name IMLRUR ILNSS ILNSE	formatting and ctions: 1-Total Summary ( Functions : ;	IB summary , 2-Aver Column Spacing 2 2 2	Received from Adjacent System M Query/400 functions (continued) age, 3-Minimum, 4-Maxi Column Headings M - Length of RUs Received from Adjacent System Low Priority Sessions Started Low Priority Sessions Ended L - Begin Bracket	mum, 5- Len 11 11	-Count Dec Pos 0 0	Null		Overr Dec	ides Numeric	Page	22		
teport column Summary fun Field Name IMLRUR ILNSS ILNSE ILNBB	formatting and ctions: 1-Total Summary ( Functions : ;	IB summary , 2-Aver Column Spacing 2 2 2	Received from Adjacent System M Query/400 functions (continued) age, 3-Minimum, 4-Maxi Column Headings M - Length of RUS Received from Adjacent System Low Priority Sessions Started Low Priority Sessions Ended L - Begin Bracket Request Units	mum, 5- Len 11 11 11	I Dec Pos 0 0 0	Null		Overr Dec	ides Numeric	Page	22		
teport column Summary fun Field Name IMLRUR ILNSS ILNSE ILNBB	formatting and ctions: 1-Total Summary ( Functions : ;	IB summary , 2-Aver Column Spacing 2 2 2	Received from Adjacent System M Query/400 functions (continued) age, 3-Minimum, 4-Maxi Column Headings M - Length of RUS Received from Adjacent System Low Priority Sessions Started Low Priority Sessions Ended L - Begin Bracket Request Units L - End	mum, 5- Len 11 11 11	I Dec Pos 0 0 0	Null		Overr Dec	ides Numeric	Page	22		
teport column Summary fun Field Name IMLRUR ILNSS ILNSE ILNBB	formatting and ctions: 1-Total Summary ( Functions : ;	IB summary , 2-Aver Column Spacing 2 2 2	Received from Adjacent System M Query/400 functions (continued) age, 3-Minimum, 4-Maxi Column Headings M - Length of RUs Received from Adjacent System Low Priority Sessions Started Low Priority Sessions Ended L - Begin Bracket Request Units L - End Bracket	mum, 5- Len 11 11 11	I Dec Pos 0 0 0	Null		Overr Dec	ides Numeric	Page	22		
teport column Summary fun Field Name IMLRUR ILNSS ILNSE ILNBB ILNBB	formatting and ctions: 1-Total Summary ( Functions : ;	IB summary , 2-Aver Column Spacing 2 2 2 2	Received from Adjacent System M Query/400 functions (continued) age, 3-Minimum, 4-Maxi Column Headings M - Length of RUS Received from Adjacent System Low Priority Sessions Started Low Priority Sessions Ended L - Begin Bracket Request Units L - End Bracket Request Units	mum, 5. Len 11 11 11 11	I Dec Pos 0 0 0 0	Null		Overr Dec	ides Numeric	Page	22		
teport column Summary fun Field Name IMLRUR ILNSS ILNSE ILNBB ILNBB	formatting and ctions: 1-Total Summary ( Functions : ;	IB summary , 2-Aver Column Spacing 2 2 2 2	Received from Adjacent System M duery/400 functions (continued) age, 3-Minimum, 4-Maxi Column Headings M - Length of RUS Received from Adjacent System Low Priority Sessions Started Low Priority Sessions Ended L - Begin Bracket Request Units L - End Bracket Request Units L - Sesion-level	mum, 5. Len 11 11 11 11	I Dec Pos 0 0 0 0	Null		Overr Dec	ides Numeric	Page	22		
teport column Summary fun Field Name IMLRUR ILNSS ILNSE ILNBB ILNBB	formatting and ctions: 1-Total Summary ( Functions : ;	IB summary , 2-Aver Column Spacing 2 2 2 2	Received from Adjacent System M Query/400 functions (continued) age, 3-Minimum, 4-Maxi Column Headings M - Length of RUs Received from Adjacent System Low Priority Sessions Started Low Priority Sessions Ended L - Begin Bracket Request Units L - End Bracket Request Units L - Session-level Send Pacing	mum, 5. Len 11 11 11 11	I Dec Pos 0 0 0 0	Null		Overr Dec	ides Numeric	Page	22		
teport column Summary fun Field Name IMLRUR ILNSS ILNSE ILNBB ILNBB ILNBB	formatting and ctions: 1-Total Summary ( Functions : ;	IB summary , 2-Aver Column Spacing 2 2 2 2 2 2 2	Received from Adjacent System M Query/400 functions (continued) age, 3-Minimum, 4-Maxi Column Headings M - Length of RUS Received from Adjacent System Low Priority Sessions Started Low Priority Sessions Ended L - Begin Bracket Request Units L - End Bracket Request Units L - End Bracket Request Units L - Session-level Send Pacing Wait Time	mum, 5. Len 11 11 11 11 11	) Dec Pos 0 0 0 0 0 0 0	Null		Overr Dec	ides Numeric	Page	22		
teport column Summary fun Field Name IMLRUR ILNSS ILNSE ILNBB ILNBB ILNBB	formatting and ctions: 1-Total Summary ( Functions : ;	IB summary , 2-Aver Column Spacing 2 2 2 2 2 2 2	Received from Adjacent System M duery/400 functions (continued) age, 3-Minimum, 4-Maxi Column Headings M - Length of RUS Received from Adjacent System Low Priority Sessions Started Low Priority Sessions Ended L - Begin Bracket Request Units L - End Bracket Request Units L - Session-level Send Pacing Wait Time L - Session-level	mum, 5. Len 11 11 11 11 11	) Dec Pos 0 0 0 0 0 0 0	Null		Overr Dec	ides Numeric	Page .	22		
teport column Summary fun Field Name IMLRUR ILNSS ILNSE ILNBB ILNBB ILNBB	formatting and ctions: 1-Total Summary ( Functions : ; ; ;	IB summary , 2-Aver Column Spacing 2 2 2 2 2 2 2	Received from Adjacent System M duery/400 functions (continued) age, 3-Minimum, 4-Maxi Column Headings M - Length of RUS Received from Adjacent System Low Priority Sessions Started Low Priority Sessions Ended L - Begin Bracket Request Units L - End Bracket Request Units L - Session-level Send Pacing Wait Time L - Session-level	mum, 5. Len 11 11 11 11 11	) Dec Pos 0 0 0 0 0 0 0	Null		Overr Dec	ides Numeric	Page	22		
teport column Summary fun Field Name IMLRUR ILNSS ILNSE ILNBB ILNBB ILNBB ILSPWT ILSPNW	formatting and ctions: 1-Total Summary ( Functions : ; ; ;	IB summary , 2-Aver Spacing 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2	Received from Adjacent System M duery/400 functions (continued) age, 3-Minimum, 4-Maxi Column Headings M - Length of RUS Received from Adjacent System Low Priority Sessions Started Low Priority Sessions Ended L - Begin Bracket Request Units L - End Bracket Request Units L - End Bracket Request Units L - Session-level Send Pacing Waits	mum, 5. Len 11 11 11 11 11 11	J Dec Pos 0 0 0 0 0 0 0 0	Null		Overr Dec	ides Numeric	Page	22		
teport column Summary fun Field Name IMLRUR ILNSS ILNSE ILNBB ILNBB ILNBB ILSPWT ILSPNW	formatting and ctions: 1-Total Summary ( Functions : ; ; ;	IB summary , 2-Aver Spacing 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2	Received from Adjacent System M duery/400 functions (continued) age, 3-Minimum, 4-Maxi Column Headings M - Length of RUS Received from Adjacent System Low Priority Sessions Started Low Priority Sessions Ended L - Begin Bracket Request Units L - End Bracket Request Units L - Session-level Send Pacing Wait Time L - Session-level Send Pacing Waits L - Session-level	mum, 5. Len 11 11 11 11 11 11	J Dec Pos 0 0 0 0 0 0 0 0	Null		Overr Dec	ides Numeric	Page .	22		
teport column Summary fun Field Name IMLRUR ILNSS ILNSE ILNBB ILNBB ILNBB ILSPWT ILSPNW	formatting and ctions: 1-Total Summary ( Functions : : : : :	IB summary , 2-Aver Spacing 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2	Received from Adjacent System M duery/400 functions (continued) age, 3-Minimum, 4-Maxi Column Headings M - Length of RUS Received from Adjacent System Low Priority Sessions Started Low Priority Sessions Ended L - Begin Bracket Request Units L - End Bracket Request Units L - Session-level Send Pacing Waits L - Session-level Send Pacing	mum, 5. Len 11 11 11 11 11 11	J Dec Pos 0 0 0 0 0 0 0 0	Null		Overr Dec	ides Numeric	Page	22		
teport column Summary fun Field Name IMLRUR ILNSS ILNSE ILNBB ILNBB ILSPWT ILSPNW ILSPPW	formatting and ctions: 1-Total Summary ( Functions : : : : :	IB summary , 2-Aven Spacing 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2	Received from Adjacent System M duery/400 functions (continued) age, 3-Minimum, 4-Maxi Column Headings M - Length of RUS Received from Adjacent System Low Priority Sessions Started Low Priority Sessions Ended L - Begin Bracket Request Units L - End Bracket Request Units L - End Bracket Request Units L - Session-level Send Pacing Waits L - Session-level Send Pacing Waits L - Session-level Send Pacing Waits	mum, 5- Len 11 11 11 11 11 11 11	1 Dec Pos 0 0 0 0 0 0 0 0 0 0	Null		Overr Dec	ides Numeric	Page	22		
teport column Summary fun Field Name IMLRUR ILNSS ILNSE ILNBB ILNBB ILSPWT ILSPNW ILSPPW	formatting and ctions: 1-Total Summary ( Functions : : : : :	IB summary , 2-Aven Spacing 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2	Received from Adjacent System M duery/400 functions (continued) age, 3-Minimum, 4-Maxi Column Headings M - Length of RUS Received from Adjacent System Low Priority Sessions Started Low Priority Sessions Ended L - Begin Bracket Request Units L - End Bracket Request Units L - Session-level Send Pacing Waits L - Session-level Send Pacing Potential Waits L - Session-level Send Pacing	mum, 5- Len 11 11 11 11 11 11 11	1 Dec Pos 0 0 0 0 0 0 0 0 0 0	Null		Overr Dec	ides Numeric	Page	22		
teport column Summary fun Field Name IMLRUR ILNSS ILNSE ILNBB ILLNBB ILLSPWT ILLSPNW ILLSPPW ILLSPWS	formatting and ctions: 1-Total Summary ( Functions : : : : : : : : : : : : : : : : : : :	IB summary , 2-Aven Spacing 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2	Received from Adjacent System M duery/400 functions (continued) age, 3-Minimum, 4-Maxi Column Headings M - Length of RUS Received from Adjacent System Low Priority Sessions Started Low Priority Sessions Ended L - Begin Bracket Request Units L - End Bracket Request Units L - End Bracket Request Units L - Session-level Send Pacing Waits L - Session-level Send Pacing Waits L - Session-level Send Pacing Waits L - Session-level Send Pacing Waits L - Session-level Send Pacing Woltaki L - Session-level Send Pacing Window Size	mum, 5- Len 11 11 11 11 11 11 11	1 Dec Pos 0 0 0 0 0 0 0 0 0 0	Null		Overr Dec	ides Numeric	Page	22		
teport column Summary fun Field Name IMLRUR ILNSS ILNSE ILNBB ILNBB ILSPWT ILSPNW ILSPPW	formatting and ctions: 1-Total Summary ( Functions : : : : : : : : : : : : : : : : : : :	IB summary , 2-Aven Spacing 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2	Received from Adjacent System M duery/400 functions (continued) age, 3-Minimum, 4-Maxi Column Headings M - Length of RUS Received from Adjacent System Low Priority Sessions Started Low Priority Sessions Ended L - Begin Bracket Request Units L - End Bracket Request Units L - Session-level Send Pacing Wait Time L - Session-level Send Pacing Potential Waits L - Session-level Send Pacing Potential Waits L - Session-level Send Pacing Potential Waits L - Session-level Send Pacing Potential Waits L - Session-level Send Pacing Window Size L - Internal	mum, 5- Len 11 11 11 11 11 11 11 11	J -Count Dec Pos 0 0 0 0 0 0 0 0 0 0 0 0 0	Null		Overr Dec	ides Numeric	Page	22		
teport column Summary fun Field Name IMLRUR ILNSS ILNSE ILNBB ILLNBB ILLSPWT ILLSPNW ILLSPPW ILLSPWS	formatting and ctions: 1-Total Summary ( Functions : : : : : : : : : : : : : : : : : : :	IB summary , 2-Aven Spacing 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2	Received from Adjacent System M duery/400 functions (continued) age, 3-Minimum, 4-Maxi Column Headings M - Length of RUS Received from Adjacent System Low Priority Sessions Started Low Priority Sessions Ended L - Begin Bracket Request Units L - End Bracket Request Units L - Session-level Send Pacing Wait Time L - Session-level Send Pacing Vaits L - Session-level Send Pacing Vaits L - Session-level Send Pacing Vaits L - Session-level	mum, 5- Len 11 11 11 11 11 11 11 11	J -Count Dec Pos 0 0 0 0 0 0 0 0 0 0 0 0 0	Null		Overr Dec	ides Numeric	Page	22		
teport column Summary fun Field Name IMLRUR ILNSS ILNSE ILNBB ILNBB ILSPWT ILSPNW ILSPPW ILSPPW ILSPWS ILIPWT	formatting and ctions: 1-Total Summary ( Functions : : : : : : : : : : : : : : : : : : :	IB summary , 2-Aver Spacing 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2	Received from Adjacent System M duery/400 functions (continued) age, 3-Minimum, 4-Maxi Column Headings M - Length of RUS Received from Adjacent System Low Priority Sessions Started Low Priority Sessions Ended L - Begin Bracket Request Units L - End Bracket Request Units L - End Bracket Request Units L - Session-level Send Pacing Waits L - Session-level Send Pacing Potential Waits L - Session-level Send Pacing Window Size L - Internal Session-level Pacing Wait Time	num, 5- Len 11 11 11 11 11 11 11 11 11	J Dec Pos 0 0 0 0 0 0 0 0 0 0 0 0 0 0	Null		Overr Dec	ides Numeric	Page	22		
teport column Summary fun Field Name IMLRUR ILNSS ILNSE ILNBB ILLNBB ILLSPWT ILLSPNW ILLSPPW ILLSPWS	formatting and ctions: 1-Total Summary ( Functions : : : : : : : : : : : : : : : : : : :	IB summary , 2-Aven Spacing 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2	Received from Adjacent System M (Jerey/400 functions (continued) age, 3-Minimum, 4-Maxi Column Headings M - Length of RUS Received from Adjacent System Low Priority Sessions Started Low Priority Sessions Ended L - Begin Bracket Request Units L - End Bracket Request Units L - Session-level Send Pacing Wait Time L - Session-level Send Pacing Potential Waits L - Session-level Send Pacing Potential Waits L - Session-level Send Pacing Window Size L - Internal Session-level Pacing Wait Time L - Internal	mum, 5- Len 11 11 11 11 11 11 11 11	J -Count Dec Pos 0 0 0 0 0 0 0 0 0 0 0 0 0	Null		Overr Dec	ides Numeric	Page -	22		
teport column Summary fun Field Name IMLRUR ILNSS ILNSE ILNBB ILNBB ILSPWT ILSPNW ILSPPW ILSPPW ILSPWS ILIPWT	formatting and ctions: 1-Total Summary ( Functions : : : : : : : : : : : : : : : : : : :	IB summary , 2-Aver Spacing 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2	Received from Adjacent System M duery/400 functions (continued) age, 3-Minimum, 4-Maxi Column Headings M - Length of RUS Received from Adjacent System Low Priority Sessions Started Low Priority Sessions Ended L - Begin Bracket Request Units L - End Bracket Request Units L - End Bracket Request Units L - Session-level Send Pacing Waits L - Session-level Send Pacing Potential Waits L - Session-level Send Pacing Window Size L - Internal Session-level Pacing Wait Time	num, 5- Len 11 11 11 11 11 11 11 11 11	J Dec Pos 0 0 0 0 0 0 0 0 0 0 0 0 0 0	Null		Overr Dec	ides Numeric	Page	22		

Figure 178. SNA\_ALL Query Definition, Part 11

			M Query/400		1	1/27/9	96	14:56:	16	Page	23	
			functions (continued)									
			age, 3-Minimum, 4-Maxir	1um, 5-				0verr				
Field	Summary	Column			Dec	Null		Dec	Numeric			
Name	Functions	Spacing	Column Headings	Len	Pos	Cap	Len	Pos	Editing			
ILQNRE		2	L – RUs	11	0							
			Entering									
			Transmission Queue									
ILQLRE		2	L - Length of	11	0							
			RUs Entering									
			Transmission Queue									
ILQNRL		2	L – RUs	11	0							
			Leaving Transmission									
			Queue									
ILQLRL		2	L - Length of	11	0							
			RUs Leaving									
			Transmission Queue									
ILQTRR		2	L -	11	0							
			Transmission Queue									
			Wait Time									
ILNRUD		2	L - RUS	11	0							
			Delivered to									
			Adjacent System									
ILLRUD		2	L - Length of	11	0							
			RUs Delivered									
			to Adjacent System									
ILTRUD		2	L - Service Time	11	0							
			to Deliver RU									
			to Adjacent System									
ILNRUR		2	L - RUs	11	0							
		-	Received from		-							
			Adjacent System									
ILLRUR		2	L - Length of	11	0							
1 LLNON		-	RUs Received									
			from Adjacent System									
		TR	M Query/400		1	1/27/9	6	14.56.	16	Page	24	
Selected output	attributes							1	10	. uge	2.	
Output type .			Display									
Form of output												
Line wrapping												
erne mupping	* * * * *		OF QUERY PRI	ΝТ	* *	* * *						

Figure 179. SNA\_ALL Query Definition, Part 12

## E.2 SNA\_CON

5716QU1	V3R6M	0 950929	TR	M Query/40	0	SVSTE	MO 1 1	1/27/96	; .	15:05:41	Page	1	
						31316	HUI I	1/2//90	, .	15.05.41	rage	1	
Query t	ext			SNA #	f of connect	ions, se	ssion	ns and s	star	t/end br.			
Query C	CSID			37									
		geid											
		yid											
		he decimal s				/ ***							
		quence		Hexad	ecimai								
Process		ng		Voc (	dofault)								
		imal data er											
		stitution wa			cruure,								
		ing for all											
Special													
*** /	All re	cords select	ed by defau	lt ***									
Selected													
	File		brary	Member	Record								
T01	QAPMS	NA QP	FRDATA	SNAOVERIP		\R							
Decult fi	i a 1 d a		1 BI	M Query/40	0		1	1/2//96	) .	15:05:41	Page	2	
Result fi Name		Expression			Column Hea	ding		Len	Doc				
SESSTR		(ennss+ehnss	+emnss+elns	s+	Total	unig		9	4				
SESSIN		innss+ihnss+			Session			,	4				
					Start								
SESEND		(ennse+ehnse	+emnse+elns	e+	Total			9	4				
		innse+ihnse+	imnse+ilnse	)	Session								
					End								
BGNBRK		(ennbb+ehnbb			Begin			9	4				
		innbb+ihnbb+	1mnbb+ilnbb	)	Bracket								
ENDBRK		(enneb+ehneb	+omnob+olco	h+	RUs End			q	4				
LNDRKK		(enneb+enneb inneb+ihneb+			End Bracket			Э	4				
			es · r meb	,	RUs								
DATE		substr(DTETI	M,3,2)    '/	2 H	Date								
		substr(DTETI											
TIME		substr(DTETI		· 11	Time								
		substr(DTETI											
Ordering Field	ot se	lected field		/ Dwl-	Field								
Name		Sort	Ascending, Descending		Text								
SCTLNM		10	A		Controller [	escrint	ion M	lame					
DATE		10			concronier e	, cocript		iume.					
TIME													
SNLBU					Connections	Establi	shed	with Re	emote	e System			
SESSTR													
SESEND													
BGNBRK ENDBRK													
LINDAN			TRI	M Query/40	0		1	1/27/96	5	15:05:41	Page	3	
Report co	olumn	formatting a						, , , ,			30	-	
		tions: 1-To			imum, 4-Maxi	imum, 5-	Count	:		Overrides			
Field		Summary	Column					Nu11		Dec Numeric			
Name		Function	s Spacing		adings	Len	Pos	Cap	Len	Pos Editing			
SCTLNM			1	Cont		10							
				Desc									
DATE			2	Name Date		5							
TIME			2	Date Time		5							
SNLBU		1	5	Connectio	ns	11	0						
		-	-	Establish			5						
				Remote Sy									
SESSTR		1	5	Total		9	4		4	1			
				Session									
				Start									
SESEND		1	5	Total		9	4		4	1			
				Session									
BGNBRK		1	5	End Begin		9	4		4	1			
DUNDKK		1	J	Bracket		Э	4		4	1			
				RUs									
ENDBRK		1	5	End		9	4		4	1			
				Bracket									
				RUs									
Report br		C	Durali										
Break			Break										
	Page No	Summaries Yes	ICAL										
	No	No											
_													

Figure 180. SNA\_CON Query Definition, Part 1

		IBM Quer	v/400	11/27/96	15:05:41	Page	4	
Selected output	attributes							
Output type .			rinter					
Form of outpu	t	1	)etail					
Line wrapping			0					
Printer Output								
Printer devic	e	'	PRINT					
Report size								
Length			51 (default)					
Width		1	32					
Report start	line		6 (default)					
Report end li	ne		47 (default)					
Report line s	pacing		ingle space					
	ion	!	lo					
Printer Spooled								
			(Defaults to value in					
			(Defaults to value in	print file, QPQU	JPRFIL)			
			1					
			(Defaults to value in	print file, QPQU	JPRFIL)			
Cover Page								
	age	!	0					
Cover page	title					_	_	
		IBM Quer	·y/400	11/27/96	15:05:41	Page	5	
Page headings a		,						
	d page heading .		es					
Page headin	y sion Summary - al	1 SNA conti						
Page footin	•	I SNA CONCI	oriers					
Database file o								
			551					
For a new fil								
			I IBCRTAUT					
Text about			Libolinoi					
			session start/end, bra	cket ban/end. co	onnect str			
	ion			,,				
Output file rec	ord format							
	length		62					
Field list:								
Field	Begin Len	Dec Null	Data Type	Text				
SCTLNM	1 10		Character	Controller Desc	ription Name			
DATE	11 5		Character	substr(DTETIM,3	3,2)    '/'	substr(D	TETIM,5,2	
TIME	16 5		Character	substr(DTETIM,7	',2)    ':'	substr(D	TETIM,9,2	
SNLBU	21 11	0	Packed decimal	Connections Est	tablished with	Remote Syste	m	
SESSTR	27 9	4	Zoned decimal	(ennss+ehnss+em	nnss+elnss+	innss+ih	nss+imnss	
		IBM Quer	y/400	11/27/96	15:05:41	Page	6	
	ord format (conti	nued)						
Field list:								
Field	Begin Len		Data Type	Text				
SESEND	36 9	4	Zoned decimal	(ennse+ehnse+en			nse+imnse	
BGNBRK	45 9	4	Zoned decimal	(ennbb+ehnbb+en			nbb+imnbb	
ENDBRK	54 9	4	Zoned decimal	(enneb+ehneb+en	nneb+elneb+	inneb+ih	neb+imneb	
	**** EN	ID OF	QUERY PRINT	* * * * *				

Figure 181. SNA\_CON Query Definition, Part 2

#### E.3 SNA\_IPAC

```
5716QU1 V3R6M0 950929
                         IBM Query/400
                                                SYSTEM01 11/27/96 15:05:59
                                                                                  1
                                                                             Page
 Collating sequence . . . . . . . . . Hexadecimal
 Special conditions
*** All records selected by default ***
Selected files
 ID File
TO1 QAPMSNA
                  Librarv
                                         Record Format
                             Member
                  QPFRDATA
                            SNAOVERIP1
                                        QAPMSNAR
                           IBM Query/400
                                                       11/27/96 15:05:59
                                                                             Page 2
Result fields
 Name
          Expression
                                       Column Heading
                                                         Len Dec
           (enipwt/1000)/(enipnw+0.001)
 ENIPCW
                                      EP NET
                                      Int PAC
                                      wait
EP HIGH
           (ehipwt/1000)/(ehipnw+0.001)
 EHIPCW
                                      Int PAC
                                      wait
EP MED
 EMIPCW
           (emipwt/1000)/(emipnw+0.001)
                                      Int PAC
                                       wait
           (elipwt/1000)/(elipnw+0.001)
                                      EP LOW
 ELIPCW
                                      Int PAC
                                      wait
 INIPCW
           (inipwt/1000)/(inipnw+0.001)
                                      IMN NET
                                      Int PAC
                                       wait
                                      IMN HIGH
Int PAC
 IHIPCW
           (ihipwt/1000)/(ihipnw+0.001)
                                      wait
                                      IMN MED
Int PAC
 IMIPCW
           (imipwt/1000)/(imipnw+0.001)
                                       wait
                                      IMN LOW
           (ilipwt/1000)/(ilipnw+0.001)
 ILIPCW
                                       wait
           substr(DTETIM,3,2) || '/' ||
 DATE
                                      Date
           substr(DTETIM,5,2)
           substr(DTETIM,7,2) || ':' ||
 TIME
                                      Time
           substr(DTETIM,9,2)
```

Figure 182. SNA\_IPAC Query Definition, Part 1

dering of sele		18/	1 Query/400		1	1/27/90	5 1	15:05:59		Page	3
Field	Sort		/ Break Field								
Name		Descending	g Level Text								
SCTLNM	10	A	1 Control	ler Descript	ion N	ame					
DATE											
TIME											
ENIPCW											
EHIPCW											
EMIPCW											
ELIPCW											
INIPCW											
IHIPCW											
IMIPCW											
ILIPCW											
port column fo	ormatting and	d summary '	functions								
			age, 3-Minimum, 4	-Maximum, 5	Count			Override	s		
Field	Summary	Column	,	, -		Nu11		Dec Nu			
Name			Column Headings	len	Pos		len	Pos Ed			
SCTLNM	. uncerons	0	Controller	10	103	oup		.03 LU			
JULENIN		v		10							
			Description								
		_	Name								
DATE		2	Date	5							
TIME		2	Time	5							
ENIPCW	4	2	EP NET	17	3						
			Int PAC								
			wait								
EHIPCW	4	2	EP HIGH	17	3						
			Int PAC								
			wait								
EMIPCW	4	2	EP MED	17	3						
		-	Int PAC	17	5						
			wait								
						1/07/04		F 05 50		D	
			1 Query/400		1	1/27/96	5 1	5:05:59		Page	4
		d summary	1 Query/400 functions (contin							Page	4
Summary funct	ions: 1-Tota	d summary al, 2-Avera	1 Query/400		Count			Override		Page	4
Summary functi Field	ions: 1-Tota Summary	d summary al, 2-Avera Column	4 Query/400 functions (contin age, 3-Minimum, 4	-Maximum, 5	Count Dec	Null		Override Dec Nu	meric	Page	4
Summary functi Field Name	ions: 1-Tota	d summary al, 2-Avera Column Spacing	4 Query/400 functions (contin age, 3-Minimum, 4 Column Headings	-Maximum, 5	Count Dec Pos	Null		Override	meric	Page	4
Summary functi Field	ions: 1-Tota Summary	d summary al, 2-Avera Column	4 Query/400 functions (contin age, 3-Minimum, 4	-Maximum, 5	Count Dec	Null		Override Dec Nu	meric	Page	4
Summary functi Field Name	ions: 1-Tota Summary Functions	d summary al, 2-Avera Column Spacing	4 Query/400 functions (contin age, 3-Minimum, 4 Column Headings	l-Maximum, 5 Len	Count Dec Pos	Null		Override Dec Nu	meric	Page	4
Summary functi Field Name	ions: 1-Tota Summary Functions	d summary al, 2-Avera Column Spacing	4 Query/400 functions (contin age, 3-Minimum, 4 Column Headings EP LOW	l-Maximum, 5 Len	Count Dec Pos	Null		Override Dec Nu	meric	Page	4
Summary functi Field Name	ions: 1-Tota Summary Functions	d summary al, 2-Avera Column Spacing	4 Query/400 functions (contin age, 3-Minimum, 4 Column Headings EP LOW Int PAC	l-Maximum, 5 Len	Count Dec Pos	Null		Override Dec Nu	meric	Page	4
Summary funct Field Name ELIPCW	ions: 1-Tota Summary Functions 4	d summary d al, 2-Avera Column Spacing 2	4 Query/400 functions (contin age, 3-Minimum, 4 Column Headings EP LOW Int PAC Wait IMN NET	-Maximum, 5 Len 17	Count Dec Pos 3	Null		Override Dec Nu	meric	Page	4
Summary funct Field Name ELIPCW	ions: 1-Tota Summary Functions 4	d summary d al, 2-Avera Column Spacing 2	4 Query/400 functions (contin gge, 3-Minimum, 4 Column Headings EP LOW Int PAC wait IMM NET Int PAC	-Maximum, 5 Len 17	Count Dec Pos 3	Null		Override Dec Nu	meric	Page	4
Summary funct: Field Name ELIPCW INIPCW	ions: 1-Tota Summary Functions 4 4	d summary al, 2-Avera Column Spacing 2 2	4 Query/400 functions (contin age, 3-Minimum, 4 Column Headings EP LOW Int PAC wait INN NET Int PAC wait	L-Maximum, 5. Len 17 17	Count Dec Pos 3	Null		Override Dec Nu	meric	Page	4
Summary funct Field Name ELIPCW	ions: 1-Tota Summary Functions 4	d summary d al, 2-Avera Column Spacing 2	4 Query/400 functions (contin age, 3-Minimum, 4 Column Headings EP LOW Int PAC wait IMN NET Int PAC wait IMN HIGH	-Maximum, 5 Len 17	Count Dec Pos 3	Null		Override Dec Nu	meric	Page	4
Summary funct: Field Name ELIPCW INIPCW	ions: 1-Tota Summary Functions 4 4	d summary al, 2-Avera Column Spacing 2 2	4 Query/400 functions (contin age, 3-Minimum, 4 Column Headings EP LOW Int PAC wait Int PAC wait INN NET Int PAC wait INN HIGH Int PAC	L-Maximum, 5. Len 17 17	Count Dec Pos 3	Null		Override Dec Nu	meric	Page	4
Summary funct: Field Name ELIPCW INIPCW IHIPCW	ions: 1-Tota Summary Functions 4 4	d summary f al, 2-Avera Column Spacing 2 2 2	4 Query/400 functions (contin age, 3-Minimum, 4 Column Headings EP LOW Int PAC wait INN NET Int PAC wait IMN HIGH Int PAC wait	I-Maximum, 5 Len 17 17	Count Dec Pos 3 3	Null		Override Dec Nu	meric	Page	4
Summary funct: Field Name ELIPCW INIPCW	ions: 1-Tota Summary Functions 4 4	d summary al, 2-Avera Column Spacing 2 2	4 Query/400 functions (contin age, 3-Minimum, 4 Column Headings EP LOW Int PAC wait IMN NET INT PAC wait IMN HIGH Int PAC wait IMN MED	L-Maximum, 5. Len 17 17	Count Dec Pos 3	Null		Override Dec Nu	meric	Page	4
Summary funct: Field Name ELIPCW INIPCW IHIPCW	ions: 1-Tota Summary Functions 4 4	d summary f al, 2-Avera Column Spacing 2 2 2	4 Query/400 functions (contin age, 3-Minimum, 4 Column Headings EP LOW Int PAC wait INN NET Int PAC wait IMN HIGH Int PAC wait	I-Maximum, 5 Len 17 17	Count Dec Pos 3 3	Null		Override Dec Nu	meric	Page	4
Summary funct: Field Name ELIPCW INIPCW IHIPCW	ions: 1-Tota Summary Functions 4 4	d summary f al, 2-Avera Column Spacing 2 2 2	4 Query/400 functions (contin age, 3-Minimum, 4 Column Headings EP LOW Int PAC wait IMN NET INT PAC wait IMN HIGH Int PAC wait IMN MED	I-Maximum, 5 Len 17 17	Count Dec Pos 3 3	Null		Override Dec Nu	meric	Page	4
Summary funct: Field Name ELIPCW INIPCW IHIPCW	ions: 1-Tota Summary Functions 4 4	d summary f al, 2-Avera Column Spacing 2 2 2	4 Query/400 functions (contin age, 3-Minimum, 4 Column Headings EP LOW Int PAC wait INM NET Int PAC wait INM HIGH Int PAC wait INM MED Int PAC	I-Maximum, 5 Len 17 17	Count Dec Pos 3 3	Null		Override Dec Nu	meric	Page	4
Summary funct: Field Name ELIPCW INIPCW IHIPCW IMIPCW	ions: 1-Tota Summary Functions 4 4 4 4	d summary al, 2-Avera Column Spacing 2 2 2 2	4 Query/400 functions (contin age, 3-Minimum, 4 Column Headings EP LOW Int PAC wait IMN NET INT PAC wait IMN HIGH Int PAC wait IMN MED Int PAC wait IMN MED Int PAC	I-Maximum, 5- Len 17 17 17 17	Count Dec Pos 3 3 3 3	Null		Override Dec Nu	meric	Page	4
Summary funct: Field Name ELIPCW INIPCW IHIPCW IMIPCW	ions: 1-Tota Summary Functions 4 4 4 4	d summary al, 2-Avera Column Spacing 2 2 2 2	4 Query/400 functions (contin age, 3-Minimum, 4 Column Headings EP LOW Int PAC wait IMN NET Int PAC wait IMN HIGH Int PAC wait IMN MED Int PAC wait IMN MED Int PAC wait IMN LOW INT PAC	I-Maximum, 5- Len 17 17 17 17	Count Dec Pos 3 3 3 3	Null		Override Dec Nu	meric	Page	4
Summary funct: Field Name ELIPCW INIPCW IHIPCW ILIPCW	ions: 1-Tota Summary Functions 4 4 4 4	d summary al, 2-Avera Column Spacing 2 2 2 2	4 Query/400 functions (contin age, 3-Minimum, 4 Column Headings EP LOW Int PAC wait IMN NET INT PAC wait IMN HIGH Int PAC wait IMN MED Int PAC wait IMN MED Int PAC	I-Maximum, 5- Len 17 17 17 17	Count Dec Pos 3 3 3 3	Null		Override Dec Nu	meric	Page	4
Summary funct: Field Name ELIPCW INIPCW IHIPCW IMIPCW ILIPCW port breaks	ions: 1-Tota Summary Functions 4 4 4 4	d summary 4 1, 2-Aver: Column 2 2 2 2 2 2	4 Query/400 functions (contin age, 3-Minimum, 4 Column Headings EP LOW Int PAC wait IMN NET Int PAC wait IMN HIGH Int PAC wait IMN MED Int PAC wait IMN MED Int PAC wait IMN LOW INT PAC	I-Maximum, 5- Len 17 17 17 17	Count Dec Pos 3 3 3 3	Null		Override Dec Nu	meric	Page	4
Summary funct: Field Name ELIPCW INIPCW IHIPCW ILIPCW JLIPCW port breaks Break New 1	ions: 1-Tota Summary Functions 4 4 4 4 4 4 5uppress Bi	d summary al, 2-Averi Column Spacing 2 2 2 2 2 2 2 2 2	4 Query/400 functions (contin age, 3-Minimum, 4 Column Headings EP LOW Int PAC wait IMN NET Int PAC wait IMN HIGH Int PAC wait IMN MED Int PAC wait IMN MED Int PAC wait IMN LOW INT PAC	I-Maximum, 5- Len 17 17 17 17	Count Dec Pos 3 3 3 3	Null		Override Dec Nu	meric	Page	4
Summary funct: Field Name ELIPCW INIPCW IHIPCW ILIPCW port breaks Break New 1 Level Page 1	ions: 1-Tota Summary Functions 4 4 4 4 4 4 5 Suppress Br Summaries To	d summary al, 2-Averi Column Spacing 2 2 2 2 2 2 2 2 2	4 Query/400 functions (contin age, 3-Minimum, 4 Column Headings EP LOW Int PAC wait IMN NET Int PAC wait IMN HIGH Int PAC wait IMN MED Int PAC wait IMN MED Int PAC wait IMN LOW INT PAC	I-Maximum, 5- Len 17 17 17 17	Count Dec Pos 3 3 3 3	Null		Override Dec Nu	meric	Page	4
Summary funct Field Name ELIPCW INIPCW IHIPCW IMIPCW JLIPCW Port breaks Break New S Break New S 20 No N	ions: 1-Tota Summary Functions 4 4 4 4 4 5 Suppress Bi Summaries To Yes	d summary al, 2-Averi Column Spacing 2 2 2 2 2 2 2 2 2	4 Query/400 functions (contin age, 3-Minimum, 4 Column Headings EP LOW Int PAC wait IMN NET Int PAC wait IMN HIGH Int PAC wait IMN MED Int PAC wait IMN MED Int PAC wait IMN LOW INT PAC	I-Maximum, 5- Len 17 17 17 17	Count Dec Pos 3 3 3 3	Null		Override Dec Nu	meric	Page	4
Summary funct: Field Name ELIPCW INIPCW IHIPCW ILIPCW JUPCW Port breaks Break New 2 Level Page 2 0 No 1 1 No 1	ions: 1-Tota Summary Functions 4 4 4 4 4 5 Suppress Bi Summaries To Yes No	d summary al, 2-Averi Column Spacing 2 2 2 2 2 2 2 2 2	4 Query/400 functions (contin age, 3-Minimum, 4 Column Headings EP LOW Int PAC wait IMN NET Int PAC wait IMN HIGH Int PAC wait IMN MED Int PAC wait IMN MED Int PAC wait IMN LOW INT PAC	I-Maximum, 5- Len 17 17 17 17	Count Dec Pos 3 3 3 3	Null		Override Dec Nu	meric	Page	4
Summary funct Field Name ELIPCW INIPCW IHIPCW IMIPCW JLIPCW Port breaks Break New S Break New S 20 No N	ions: 1-Tota Summary Functions 4 4 4 4 4 5 Suppress Bi Summaries To Yes No	d summary al, 2-Averi Column Spacing 2 2 2 2 2 2 2 2 2	4 Query/400 functions (contin age, 3-Minimum, 4 Column Headings EP LOW Int PAC wait IMN NET Int PAC wait IMN HIGH Int PAC wait IMN MED Int PAC wait IMN MED Int PAC wait IMN LOW INT PAC	I-Maximum, 5- Len 17 17 17 17	Count Dec Pos 3 3 3 3	Null		Override Dec Nu	meric	Page	4
Summary funct: Field Name ELIPCW INIPCW IHIPCW ILIPCW JUPCW Port breaks Break New 2 Level Page 2 0 No 1 1 No 1	ions: 1-Tota Summary Functions 4 4 4 4 4 4 5 Suppress Bi Summaries To Yes Yo a attributes	d summary al, 2-Averi column Spacing 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2	4 Query/400 functions (contin age, 3-Minimum, 4 Column Headings EP LOW Int PAC wait IMN NET Int PAC wait IMN HIGH Int PAC wait IMN MED Int PAC wait IMN MED Int PAC wait IMN LOW Int PAC wait	I-Maximum, 5- Len 17 17 17 17	Count Dec Pos 3 3 3 3	Null		Override Dec Nu	meric	Page	4
Summary funct: Field Name ELIPCW INIPCW IHIPCW ILIPCW Bort breaks Break New 1 Level Page 1 0 No 1 1 No 1 lected output	ions: 1-Tota Summary Functions 4 4 4 4 4 4 5 Suppress Bi Summaries To Fes No attributes 	d summary 4 1, 2-Aver: Column 2 2 2 2 2 2 2 2 2 2 2 2 2	4 Query/400 Functions (contin age, 3-Minimum, 4 Column Headings EP LOW Int PAC wait INM NET Int PAC wait INM NEGH Int PAC wait INM MED Int PAC wait INM LOW Int PAC wait Printer	I-Maximum, 5- Len 17 17 17 17	Count Dec Pos 3 3 3 3	Null		Override Dec Nu	meric	Page	4
Summary funct: Field Name ELIPCW INIPCW IHIPCW IHIPCW ILIPCW ILIPCW Port breaks Break New S Leak New S 20 No N 1 No N 1ected output	ions: 1-Tota Summary Functions 4 4 4 4 4 4 4 5 Suppress Bi Summaries To Yes No attributes 	d summary al, 2-Avera Column Spacing 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2	4 Query/400 functions (contin age, 3-Minimum, 4 Column Headings EP LOW Int PAC wait IMN NET Int PAC wait IMN HIGH Int PAC wait IMN MED Int PAC wait IMN MED Int PAC wait Printer Detail	I-Maximum, 5- Len 17 17 17 17	Count Dec Pos 3 3 3 3	Null		Override Dec Nu	meric	Page	4

Figure 183. SNA\_IPAC Query Definition, Part 2

			IBM Query	/400	11/27/96	15:05:59	Page	5
Printer Output							- 1	
Printer device	e		*P	RINT				
Report size								
			5	l (default)				
Width								
Report start								
Report end lir								
Report line sp								
Print definit				igic space				
Printer Spooled								
			(1	ofaulto to valuo	in print file, QP(			
					in print file, QPO			
Copies					in princ file, Qr	(UPRFIL)		
					in aniat file on			
			(1	eidults to value	in print file, QP	(UPRFIL)		
Cover Page								
Print cover p Cover page	-		Ye	5				
Page headings a	nd footings	5						
Print standard	d page head	ling	Ye	5				
Page heading	g							
Page footing	q							
	5		IBM Query	/400	11/27/96	15:05:59	Page	6
Database file o	utput						-	
File			SE	52A				
Library			CO	IMDTA				
Member								
Data in file								
For a new file								
Authority .			*I	IBCRTAUT				
Text about				bonnior				
the file			Se	ssion Traffic -	Part 1 of 2			
Print definit								
Output file rec								
Output record				92				
Field list:	. engen							
Field	Begin	Len Dec	Null	)ata Type	Text			
SCTLNM	Begin 1	10		Character	Controller Des	cription Name		
DATE	11	5		Character		3,2)    '/'	ouhota	(DIFTIN E 2
TIME	11	5		.naracter Character				(DTETIM,5,2
ENIPCW	21	5 17 3		Jaracter Packed decimal		(opinnul0_001)	SUDStr	(DTETIM,9,2
	30	17 3		Packed decimal		(enipnw+0.001)		
EHIPCW	30 39	1/ 3		Packed decimal Packed decimal		(ehipnw+0.001)		
EMIPCW						(emipnw+0.001)		
ELIPCW	48	17 3		Packed decimal		(elipnw+0.001)		
INIPCW	57	17 3		Packed decimal		(inipnw+0.001)		
IHIPCW	66	17 3		Packed decimal		(ihipnw+0.001)		
IMIPCW	75	17 3		Packed decimal		(imipnw+0.001)		
ILIPCW	84	17 3		Packed decimal		(ilipnw+0.001)		
	* * * * *	END	0 F Q	UERY PRI	NT ****			

Figure 184. SNA\_IPAC Query Definition, Part 3

## E.4 SNA\_PAC1

57160U1 V	3R6M0 9509	29	IBM Query/400	SYS	STEM01	11/27/96	15:06:12	Page	1	
									-	
				verage pacing res	sponse	time				
				this query ***						
Collatin	g sequence		Hexade	cimal						
Processi	ng options									
Use ro	unding		Yes (o	lefault)						
Ignore	decimal da	ta errors	No (de	fault)						
Ignore	substituti	on warnings .	Yes							
Use co	llating for	all compares	No							
Special	conditions									
*** A1	1 records s	elected by def	ault ***							
Selected f										
ID F	ile	Library	Member	Record Forma	nt					
T01 Q	APMSNA	QPFRDATA	TEST1307	QAPMSNAR						
			IBM Query/400			11/27/96	15:06:12	Page	2	
Result fie										
Name	Express			Column Heading		Len D	ec			
ENAVWT	(enspwt	/1000)/(enspnw	+0.001)	EP NET						
				Pacing						
				Wait						
EHAVWT	(ehspwt	/1000)/(ehspnw	+0.001)	EP HIGH						
				Pacing						
				Wait						
EMAVWT	(emspwt	/1000)/(emspnw	+0.001)	EP MED						
				Pacing						
E1 4101E		(1000) (( )		Wait						
ELAVWT	(elspwt	/1000)/(elspnw	+0.001)	EP LOW						
				Pacing						
TNAVUT	(	(1000) ((;		Wait						
INAVWT	(inspwt	/1000)/(inspnw	+0.001)	INM NET						
				Pacing						
IHAVWT	(ihe put	/1000)/(ihspnw		Wait INM HIGH						
TUNAN	(Inspwc	/1000)/(Inspin	+0.001)	Pacing						
				Wait						
IMAVWT	(imsnwt	/1000)/(imspnw	+0 001)	INM MED						
100101	( mspwc	, 1000) / ( iiispiiw		Pacing						
				Wait						
ILAVWT	(ilspwt	/1000)/(ilspnw	(+0.001)	INM LOW						
	(sp#c	,, , , , , , , , , , , , , , , , ,		Pacing						
				Wait						
DATE	substr(	DTETIM,3,2)	'/' II	Date						
TIME			':' II	Time						
TIME	substr(	DTETIM,5,2) DTETIM,7,2)    DTETIM,9,2)	':' II	Time						

Figure 185. SNA\_PAC1 Query Definition, Part 1

		IBM	1 Query/400		1	1/27/9	6 1	15:06:12	Page	3	
	lected fields										
Field			/ Break Field								
Name			g Level Text								
SCTLNM	10	A	1 Control	ler Descript	tion M	lame					
DATE											
TIME											
ENAVWT											
EHAVWT											
EMAVWT											
ELAVWT											
INAVWT											
IHAVWT											
IMAVWT											
ILAVWT											
eport column	formatting and	d summary f	functions								
Summary func	tions: 1-Tota	al, 2-Avera	age, 3-Minimum, 4	-Maximum, 5	-Count			Overrides			
Field	Summary	Column			Dec	Null		Dec Numeric			
Name			Column Headings	Len		Cap	Len	Pos Editing			
SCTLNM			Controller	10							
			Description								
			Name								
DATE			Date	5							
TIME			Time	5							
ENAVWT	4	2	EP NET	17	3						
			Pacing	17	5						
			Wait								
EHAVWT	4		EP HIGH	17	3						
LINGTH	-	L	Pacing	17	5						
			Wait								
FMAVWT	4	2	EP MED	17	3						
EMAVWT	4	2	EP MED Pacing	17	3						
EMAVWT	4		Pacing	17	3						
EMAVWT	4		Pacing Wait	17		1/27/0	6 1	15:06:12	Рапе	4	
		IBM	Pacing Wait 4 Query/400			1/27/9	6 ]	15:06:12	Page	4	
eport column	formatting and	IBM d summary 1	Pacing Wait 4 Query/400 functions (contin	ued)	1				Page	4	
eport column Summary func	formatting and tions: 1-Tota	IBM d summary f al, 2-Avera	Pacing Wait 4 Query/400	ued)	1 -Count			Overrides		4	
eport column Summary func Field	formatting and tions: 1-Tota Summary	IBM d summary 1 al, 2-Avera Column	Pacing Wait 4 Query/400 functions (contin age, 3-Minimum, 4	ued) -Maximum, 5	1 -Count Dec	Null		Overrides Dec Numeric		4	
eport column Summary func Field Name	formatting and tions: 1-Tota Summary Functions	IBM d summary n al, 2-Avera Column Spacing	Pacing Wait 4 Query/400 functions (contin age, 3-Minimum, 4 Column Headings	ued) -Maximum, 5 <sup>.</sup> Len	1 -Count Dec Pos			Overrides		4	
eport column Summary func Field	formatting and tions: 1-Tota Summary	IBM d summary 1 al, 2-Avera Column	Pacing Wait 4 Query/400 functions (contin age, 3-Minimum, 4 Column Headings EP LOW	ued) -Maximum, 5	1 -Count Dec	Null		Overrides Dec Numeric		4	
eport column Summary func Field Name	formatting and tions: 1-Tota Summary Functions	IBM d summary f al, 2-Avera Column Spacing 2	Pacing Wait 4 Query/400 functions (contin age, 3-Minimum, 4 Column Headings EP LOW Pacing	ued) -Maximum, 5 <sup>.</sup> Len	1 -Count Dec Pos	Null		Overrides Dec Numeric		4	
eport column Summary func Field Name ELAVWT	formatting and tions: 1-Tota Summary Functions 4	IBM d summary f al, 2-Avera Column Spacing 2	Pacing Wait 4 Query/400 functions (contin gge, 3-Minimum, 4 Column Headings EP LOW Pacing Wait	ued) -Maximum, 5 Len 17	-Count Dec Pos 3	Null		Overrides Dec Numeric		4	
eport column Summary func Field Name	formatting and tions: 1-Tota Summary Functions	IBM d summary f al, 2-Avera Column Spacing 2	Pacing Wait 4 Query400 functions (contin age, 3-Minimum, 4 Column Headings EP LOW Pacing Wait INM NET	ued) -Maximum, 5 <sup>.</sup> Len	1 -Count Dec Pos	Null		Overrides Dec Numeric		4	
eport column Summary func Field Name ELAVWT	formatting and tions: 1-Tota Summary Functions 4	IBM d summary f al, 2-Avera Column Spacing 2 2	Pacing Wait 4 Query/400 functions (contin age, 3-Minimum, 4 Column Headings EP LOW Pacing Wait INM NET Pacing	ued) -Maximum, 5 Len 17	-Count Dec Pos 3	Null		Overrides Dec Numeric		4	
leport column Summary func Field Name ELAVWT INAVWT	formatting an tions: 1-Tota Summary Functions 4 4	IBM d summary f al, 2-Avera Column Spacing 2 2	Pacing Wait 4 Query/400 functions (contin age, 3-Minimum, 4 Column Headings EP LOW Pacing Wait INN NET Pacing Wait Wait	ued) -Maximum, 5 Len 17	-Count Dec Pos 3	Null		Overrides Dec Numeric		4	
eport column Summary func Field Name ELAVWT	formatting and tions: 1-Tota Summary Functions 4	IBM d summary f al, 2-Avera Column Spacing 2 2	Pacing Wait 4 Query/400 functions (contin age, 3-Minimum, 4 Column Headings EP LOW Pacing Wait INM NET Pacing Wait INM HIGH	ued) -Maximum, 5 Len 17	-Count Dec Pos 3	Null		Overrides Dec Numeric		4	
leport column Summary func Field Name ELAVWT INAVWT	formatting an tions: 1-Tota Summary Functions 4 4	IBM d summary 1 al, 2-Avera Column Spacing 2 2 2	Pacing Wait 4 Query400 functions (contin age, 3-Minimum, 4 Column Headings EP LOW Pacing Wait INN NET Pacing Wait INN HET Pacing Wait INN HIGH Pacing	ued) -Maximum, 5 Len 17	-Count Dec Pos 3	Null		Overrides Dec Numeric		4	
eport column Summary func Field Name ELAVWT INAVWT IHAVWT	formatting and tions: 1-Tot Summary Functions 4 4 4	IBM d summary f al, 2-Avera Column Spacing 2 2 2	Pacing Wait 4 Query/400 functions (contin age, 3-Minimum, 4 Column Headings EP LOW Pacing Wait INN NET Pacing Wait INN HIGH Pacing Wait Wait	ued) -Maximum, 5- Len 17 17	-Count Dec Pos 3 3	Null		Overrides Dec Numeric		4	
leport column Summary func Field Name ELAVWT INAVWT	formatting an tions: 1-Tota Summary Functions 4 4	IBM d summary 1 al, 2-Avera Column Spacing 2 2 2	Pacing Wait 4 Query/400 functions (contin age, 3-Minimum, 4 Column Headings EP LOW Pacing Wait INM NET Pacing Wait INM HIGH Pacing Wait INM MED	ued) -Maximum, 5 Len 17	-Count Dec Pos 3	Null		Overrides Dec Numeric		4	
eport column Summary func Field Name ELAVWT INAVWT IHAVWT	formatting and tions: 1-Tot Summary Functions 4 4 4	IBM d summary 1 al, 2-Avera Column Spacing 2 2 2 2 2	Pacing Wait 4 Query/400 functions (contin age, 3-Minimum, 4 Column Headings EP LOW Pacing Wait INM NET Pacing Wait INM HIGH Pacing Wait INM MED Pacing	ued) -Maximum, 5- Len 17 17	-Count Dec Pos 3 3	Null		Overrides Dec Numeric		4	
eport column Summary func Field Name ELAVWT INAVWT IHAVWT IMAVWT	formatting and tions: 1-Tot Summary Functions 4 4 4	IBM d summary 1 al, 2-Avera Column Spacing 2 2 2 2 2	Pacing Wait 4 Query/400 functions (contin age, 3-Minimum, 4 Column Headings EP LOW Pacing Wait INN NET Pacing Wait INN HIGH Pacing Wait INN MED Pacing Wait UNN MED Pacing Wait	ued) -Maximum, 5- Len 17 17 17 17	I Dec Pos 3 3 3 3	Null		Overrides Dec Numeric		4	
eport column Summary func Field Name ELAVWT INAVWT IHAVWT	formatting and tions: 1-Tot Summary Functions 4 4 4	IBM d summary 1 al, 2-Avera Column Spacing 2 2 2 2 2	Pacing Wait 4 Query/400 functions (contin age, 3-Minimum, 4 Column Headings EP LOW Pacing Wait INM NET Pacing Wait INM HIGH Pacing Wait INM MED Pacing Wait INM MED Pacing Wait INM MED	ued) -Maximum, 5- Len 17 17	-Count Dec Pos 3 3	Null		Overrides Dec Numeric		4	
eport column Summary func Field Name ELAVWT INAVWT IHAVWT IMAVWT	formatting and tions: 1-Tot Summary Functions 4 4 4	IBM d summary 1 al, 2-Avera Column Spacing 2 2 2 2 2	Pacing Wait 4 Query/400 functions (contin age, 3-Minimum, 4 Column Headings EP LOW Pacing Wait INM NET Pacing Wait INM HIGH Pacing Wait INM MED Pacing Wait INM MED Pacing Wait INM LOW Pacing	ued) -Maximum, 5- Len 17 17 17 17	I Dec Pos 3 3 3 3	Null		Overrides Dec Numeric		4	
eport column Summary func Field Name ELAVWT INAVWT IMAVWT ILAVWT	formatting and tions: 1-Tot Summary Functions 4 4 4	IBM d summary 1 al, 2-Avera Column Spacing 2 2 2 2 2	Pacing Wait 4 Query/400 functions (contin age, 3-Minimum, 4 Column Headings EP LOW Pacing Wait INM NET Pacing Wait INM HIGH Pacing Wait INM MED Pacing Wait INM MED Pacing Wait INM MED	ued) -Maximum, 5- Len 17 17 17 17	I Dec Pos 3 3 3 3	Null		Overrides Dec Numeric		4	
eport column Summary func Field Name ELAVWT INAVWT IMAVWT ILAVWT ILAVWT	formatting an tions: 1-Tota Summary Functions 4 4 4 4	IBM d summary 1 al, 2-Avera Column Spacing 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2	Pacing Wait 4 Query/400 functions (contin age, 3-Minimum, 4 Column Headings EP LOW Pacing Wait INM NET Pacing Wait INM HIGH Pacing Wait INM MED Pacing Wait INM MED Pacing Wait INM LOW Pacing	ued) -Maximum, 5- Len 17 17 17 17	I Dec Pos 3 3 3 3	Null		Overrides Dec Numeric		4	
eport column Summary func Field Name ELAVWT INAVWT IHAVWT ILAVWT ILAVWT eport breaks Break New	formatting an tions: 1-Tota Summary Functions 4 4 4 4 4 5 Suppress Bi	IBM d summary 1 al, 2-Avera Column Spacing 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2	Pacing Wait 4 Query/400 functions (contin age, 3-Minimum, 4 Column Headings EP LOW Pacing Wait INM NET Pacing Wait INM HIGH Pacing Wait INM MED Pacing Wait INM MED Pacing Wait INM LOW Pacing	ued) -Maximum, 5- Len 17 17 17 17	I Dec Pos 3 3 3 3	Null		Overrides Dec Numeric		4	
eport column Summary func Field Name ELAVWT INAVWT IHAVWT ILAVWT ILAVWT eport breaks Break New Level Page	formatting and tions: 1-Totk Summary Functions 4 4 4 4 4 4 5 Suppress Br Summaries To	IBM d summary 1 al, 2-Avera Column Spacing 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2	Pacing Wait 4 Query/400 functions (contin age, 3-Minimum, 4 Column Headings EP LOW Pacing Wait INM NET Pacing Wait INM HIGH Pacing Wait INM MED Pacing Wait INM MED Pacing Wait INM LOW Pacing	ued) -Maximum, 5- Len 17 17 17 17	I Dec Pos 3 3 3 3	Null		Overrides Dec Numeric		4	
eport column Summary func Field Name ELAVWT INAVWT IHAVWT ILAVWT ILAVWT eport breaks Break New Level Page 0 No	formatting and tions: 1-Tota Summary Functions 4 4 4 4 4 4 4 5 Suppress Br Suppress Br Summaries To Yes	IBM d summary 1 al, 2-Avera Column Spacing 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2	Pacing Wait 4 Query/400 functions (contin age, 3-Minimum, 4 Column Headings EP LOW Pacing Wait INM NET Pacing Wait INM HIGH Pacing Wait INM MED Pacing Wait INM MED Pacing Wait INM LOW Pacing	ued) -Maximum, 5- Len 17 17 17 17	I Dec Pos 3 3 3 3	Null		Overrides Dec Numeric		4	
eport column Summary func Field Name ELAVWT INAVWT IHAVWT ILAVWT ILAVWT eport breaks Break New Level Page	formatting and tions: 1-Totk Summary Functions 4 4 4 4 4 4 5 Suppress Br Summaries To	IBM d summary 1 al, 2-Avera Column Spacing 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2	Pacing Wait 4 Query/400 functions (contin age, 3-Minimum, 4 Column Headings EP LOW Pacing Wait INM NET Pacing Wait INM HIGH Pacing Wait INM MED Pacing Wait INM MED Pacing Wait INM LOW Pacing	ued) -Maximum, 5- Len 17 17 17 17	I Dec Pos 3 3 3 3	Null		Overrides Dec Numeric		4	
eport column Summary func Field Name ELAVWT INAVWT IHAVWT ILAVWT ILAVWT eport breaks Break New Level Page 0 No	formatting and tions: 1-Totk Summary Functions 4 4 4 4 4 4 5 Suppress Bi Summaries To Yes No	IBM d summary 1 al, 2-Avera Column Spacing 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2	Pacing Wait 4 Query/400 functions (contin age, 3-Minimum, 4 Column Headings EP LOW Pacing Wait INM NET Pacing Wait INM HIGH Pacing Wait INM MED Pacing Wait INM MED Pacing Wait INM LOW Pacing	ued) -Maximum, 5- Len 17 17 17 17	I Dec Pos 3 3 3 3	Null		Overrides Dec Numeric		4	
eport column Summary func Field Name ELAVWT INAVWT IHAVWT ILAVWT ILAVWT Break New Level Page 0 No 1 No	formatting and tions: 1-Totk Summary Functions 4 4 4 4 4 4 5 Suppress Bi Summaries To Yes No	IBM d summary m 1, 2-Avera Column Spacing 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2	Pacing Wait 4 Query/400 functions (contin age, 3-Minimum, 4 Column Headings EP LOW Pacing Wait INN MET Pacing Wait INN HIGH Pacing Wait INN MED Pacing Wait INN LOW Pacing Wait	ued) -Maximum, 5- Len 17 17 17 17	I Dec Pos 3 3 3 3	Null		Overrides Dec Numeric		4	
eport column Summary func Field Name ELAVWT INAVWT IHAVWT ILAVWT ILAVWT eport breaks Break New Level Page 0 No 1 No elected outpu	formatting and tions: 1-Totk Summary Functions 4 4 4 4 4 4 4 5 Suppress Bi Summaries Tot Yes No t attributes	IBM d summary 1 al, 2-Avera Column Spacing 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2	Pacing Wait 4 Query/400 functions (contin age, 3-Minimum, 4 Column Headings EP LOW Pacing Wait INM NET Pacing Wait INM HIGH Pacing Wait INM MED Pacing Wait INM LOW Pacing Wait	ued) -Maximum, 5- Len 17 17 17 17	I Dec Pos 3 3 3 3	Null		Overrides Dec Numeric		4	

Figure 186. SNA\_PAC1 Query Definition, Part 2

			IB	M Query/400		1	1/27/96	15:06:12	Page	5	
Printer Output						-					
Printer device				*PRINT							
Report size											
Length				51 (d	efault)						
Width				300							
Report start 1	ine			6							
Report end lin	ie			60							
Report line sp	bacing			Single	space						
Print definiti	ion			No							
Printer Spooled	Output										
Spool the outp	out			(Defau	lts to value	in print f	ile, QPQU	JPRFIL)			
Form type				(Defau	lts to value	in print f	ile, QPQU	JPRFIL)			
Copies				1							
Hold				(Defau	lts to value	in print f	ile, QPQU	JPRFIL)			
Cover Page											
Print cover pa Cover page t			• • •	Yes							
Page headings ar											
Print standard				Yes							
Page heading											
Page footing											
. age rooting	,		ŢR	M Query/400		1	1/27/96	15:06:12	Page	6	
Database file ou	utput					•	_, _, , , , , , , , , , , , , , , , , ,		, uge	-	
File				SES2A							
Library					Ą						
Member											
Data in file					e file						
For a new file					-						
Authority .				*LIBCR	TAUT						
Text about											
the file				Session	n Traffic - F	Part 1 of 2					
Print definiti											
Output file reco											
Output record	length .			92							
Field list:	-										
Field	Begin	Len	Dec	Null Data	Туре	Text					
SCTLNM	1	10		Chara	acter	Contro	ller Desc	ription Name	2		
DATE	11	5		Chara	acter	substr	(DTETIM,3	,2)    '/'	subst	r(DTETIM,5,2	
TIME	16	5		Chara	acter	substr	(DTETIM,7	,2)    ':'	subst	r(DTETIM,9,2	
ENAVWT	21	17	3	Packe	ed decimal	(enspw	t/1000)/(	enspnw+0.001	1)		
EHAVWT	30	17	3	Packe	ed decimal	(ehspw	t/1000)/(	ehspnw+0.001	1)		
EMAVWT	39	17	3	Packe	ed decimal	(emspw	t/1000)/(	emspnw+0.001	1)		
ELAVWT	48	17	3		ed decimal	(elspw	t/1000)/(	elspnw+0.001	1)		
INAVWT	57	17	3		ed decimal	(inspw	t/1000)/(	inspnw+0.001	)		
IHAVWT	66	17	3		ed decimal	(ihspw	t/1000)/(	ihspnw+0.001	)		
IMAVWT	75	17	3	Packe	ed decimal	(imspw	t/1000)/(	imspnw+0.001	1)		
ILAVWT	84	17	3	Packe	ed decimal			ilspnw+0.001	)		
	* * * * *	Е	N D	0 F QUE	RY PRI	NT **	* * *				

Figure 187. SNA\_PAC1 Query Definition, Part 3

#### E.5 SNA\_PAC2

```
5716QU1 V3R6M0 950929
                         IBM Query/400
                                                SYSTEM01 11/27/96 16:50:25
                                                                              Page
                                                                                  1
 Collating sequence . . . . . . . . . Hexadecimal
 Special conditions
*** All records selected by default ***
Selected files
 ID File
TO1 QAPMSNA
                  Librarv
                              Member
                                         Record Format
                  QPFRDATA
                            TEST1307
                                         QAPMSNAR
                           IBM Query/400
                                                       11/27/96 16:50:25
                                                                             Page 2
Result fields
 Name
          Expression
                                       Column Heading
                                                         Len Dec
           (enspnw*100)/(ensppw+0.001)
 ENPCWT
                                       EP NET
                                       % time
                                       PAC wt
 EHPCWT
           (ehspnw*100)/(ehsppw+0.001)
                                       EP HIGH
                                       % time
                                      PAC wt
EP MED
 EMPCWT
           (emspnw*100)/(emsppw+0.001)
                                       % time
                                       PAC wt
           (elspnw*100)/(elsppw+0.001)
                                       EP LOW
 ELPCWT
                                       % time
                                       PAC wt
 INPCWT
           (inspnw*100)/(insppw+0.001)
                                       IMN NET
                                       % time
                                       PAC wt
 IHPCWT
           (ihspnw*100)/(ihsppw+0.001)
                                       IMN HIGH
                                       % time
                                       PAC wt
 IMPCWT
           (imspnw*100)/(imsppw+0.001)
                                      IMN MED
% time
                                       PAC wt
           substr(DTETIM,3,2) || '/' ||
 DATE
                                      Date
           substr(DTETIM,5,2)
 TIME
           substr(DTETIM,7,2) || ':' ||
                                       Time
           substr(DTETIM.9.2)
 ILPCWT
           (ilspnw*100)/(ilsppw+0.001)
                                       IMN LOW
                                       % time
                                       PAC wt
```

Figure 188. SNA\_PAC2 Query Definition, Part 1

doning of c		IBN	M Query/4	00		1	1/27/9	6 3	16:50:	25	Page	3
	elected fields					-	,.				3-	-
Field	Sort	Ascending	/ Break	Field								
Name		Descending										
SCTLNM	10	A	1	Controller	Descript	ion N	amo					
DATE	10	n	1	controller	bescript	TOIL 1	anc					
TIME												
ENPCWT												
EHPCWT												
EMPCWT												
ELPCWT												
INPCWT												
IHPCWT												
IMPCWT												
ILPCWT												
	formatting an											
	tions: 1-Tot		age, 3-Mi	nimum, 4-Ma	ximum, 5·				0verr			
Field	Summary	Column					Null		Dec	Numeric		
Name	Functions	Spacing				Pos	Cap	Len	Pos	Editing		
SCTLNM		0	Controll		10							
			Descript	ion								
			Name									
DATE		2	Date		5							
TIME		2	Time		5							
ENPCWT		2	EP NET		20	3						
			% time									
			PAC wt									
EHPCWT		2	EP HIGH		20	3						
			% time									
			PAC wt									
EMPCWT		2	EP MED		20	3						
			% time									
			PAC wt									
		IB		00		1	1/27/9	6 3	16:50:	25	Page	4
eport column	formatting an		M Query/4		)	1	1/27/9	6	16:50:	25	Page	4
	formatting an tions: 1-Tot	d summary	M Query/4 functions	(continued				6	16:50:		Page	4
	tions: 1-Tot	d summary	M Query/4 functions	(continued		Count		6	0verr		Page	4
Summary fund	tions: 1-Tot Summary	d summary al, 2-Avera	M Query/4 functions age, 3-Mi	(continued nimum, 4-Ma		Count	Null		Overr Dec	ides	Page	4
Summary fund Field Name	tions: 1-Tot Summary	d summary al, 2-Avera Column Spacing	M Query/4 functions age, 3-Mi Column H	(continued nimum, 4-Ma	ximum, 5- Len	Count Dec	Null		Overr Dec	ides Numeric	Page	4
Summary fund Field	tions: 1-Tot Summary	d summary al, 2-Avera Column	M Query/4 functions age, 3-Mi	(continued nimum, 4-Ma	ximum, 5-	Count Dec Pos	Null		Overr Dec	ides Numeric	Page	4
Summary fund Field Name	tions: 1-Tot Summary	d summary al, 2-Avera Column Spacing	M Query/4 functions age, 3-Mi Column H EP LOW	(continued nimum, 4-Ma	ximum, 5- Len	Count Dec Pos	Null		Overr Dec	ides Numeric	Page	4
Summary fund Field Name	tions: 1-Tot Summary	d summary al, 2-Avera Column Spacing	M Query/4 functions age, 3-Mi Column H EP LOW % time	(continued nimum, 4-Ma	ximum, 5- Len	Count Dec Pos	Null		Overr Dec	ides Numeric	Page	4
Summary fund Field Name ELPCWT	tions: 1-Tot Summary	d summary al, 2-Avera Column Spacing 2	M Query/4 functions age, 3-Mi Column H EP LOW % time PAC wt IMN NET	(continued nimum, 4-Ma	ximum, 5- Len 20	Count Dec Pos 3	Null		Overr Dec	ides Numeric	Page	4
Summary fund Field Name ELPCWT	tions: 1-Tot Summary	d summary al, 2-Avera Column Spacing 2	M Query/4 functions age, 3-Mi Column H EP LOW % time PAC wt IMN NET % time	(continued nimum, 4-Ma	ximum, 5- Len 20	Count Dec Pos 3	Null		Overr Dec	ides Numeric	Page	4
Summary fund Field Name ELPCWT INPCWT	tions: 1-Tot Summary	d summary al, 2-Avera Column Spacing 2 2	M Query/4 functions age, 3-Mi Column H EP LOW % time PAC wt IMN NET % time PAC wt	(continued nimum, 4-Ma	ximum, 5- Len 20 20	Count Dec Pos 3	Null		Overr Dec	ides Numeric	Page	4
Summary fund Field Name ELPCWT	tions: 1-Tot Summary	d summary al, 2-Avera Column Spacing 2	M Query/4 functions age, 3-Mi Column H EP LOW % time PAC wt IMN NET % time PAC wt IMN HIGH	(continued nimum, 4-Ma	ximum, 5- Len 20	Count Dec Pos 3	Null		Overr Dec	ides Numeric	Page	4
Summary fund Field Name ELPCWT INPCWT	tions: 1-Tot Summary	d summary al, 2-Avera Column Spacing 2 2	M Query/4 functions age, 3-Mi Column H EP LOW % time PAC wt IMN NET % time PAC wt IMN HIGH % time	(continued nimum, 4-Ma	ximum, 5- Len 20 20	Count Dec Pos 3	Null		Overr Dec	ides Numeric	Page	4
Summary fund Field Name ELPCWT INPCWT IHPCWT	tions: 1-Tot Summary	d summary al, 2-Avera Column Spacing 2 2 2	M Query/4 functions age, 3-Mi Column H EP LOW % time PAC wt IMN NET % time PAC wt IMN HIGH % time PAC wt	(continued nimum, 4-Ma	ximum, 5- Len 20 20 20	Count Dec Pos 3 3	Null		Overr Dec	ides Numeric	Page	4
Summary fund Field Name ELPCWT INPCWT	tions: 1-Tot Summary	d summary al, 2-Avera Column Spacing 2 2	M Query/4 functions age, 3-Mi Column H EP LOW % time PAC wt IMN NET % time PAC wt IMN HIGH % time PAC wt IMN MED	(continued nimum, 4-Ma	ximum, 5- Len 20 20	Count Dec Pos 3	Null		Overr Dec	ides Numeric	Page	4
Summary fund Field Name ELPCWT INPCWT IHPCWT	tions: 1-Tot Summary	d summary al, 2-Avera Column Spacing 2 2 2	M Query/4 functions age, 3-Mi Column H EP LOW & time PAC wt IMN NET % time PAC wt IMN HIGH % time PAC wt IMN MED % time	(continued nimum, 4-Ma	ximum, 5- Len 20 20 20	Count Dec Pos 3 3	Null		Overr Dec	ides Numeric	Page	4
Summary fund Field Name ELPCWT INPCWT IHPCWT IMPCWT	tions: 1-Tot Summary	d summary al, 2-Avera Column Spacing 2 2 2 2	M Query/4 functions age, 3-Mi Column H EP LOW % time PAC wt IMN NET % time PAC wt IMN HIGH % time PAC wt IMN MED % time	(continued nimum, 4-Ma	ximum, 5- Len 20 20 20	Count Dec Pos 3 3 3	Null		Overr Dec	ides Numeric	Page	4
Summary fund Field Name ELPCWT INPCWT IHPCWT	tions: 1-Tot Summary	d summary al, 2-Avera Column Spacing 2 2 2	M Query/4 functions age, 3-Mi Column H EP LOW % time PAC wt IMN NED % time PAC wt IMN MED % time PAC wt IMN MED % LIME PAC wt IMN LOW	(continued nimum, 4-Ma	ximum, 5- Len 20 20 20	Count Dec Pos 3 3	Null		Overr Dec	ides Numeric	Page	4
Summary fund Field Name ELPCWT INPCWT IHPCWT IMPCWT	tions: 1-Tot Summary	d summary al, 2-Avera Column Spacing 2 2 2 2	M Query/4 functions age, 3-Mi Column H EP LOW % time PAC wt IMN NET % time PAC wt IMN HIGH % time PAC wt IMN MED % time PAC wt IMN LOW % time	(continued nimum, 4-Ma	ximum, 5- Len 20 20 20	Count Dec Pos 3 3 3	Null		Overr Dec	ides Numeric	Page	4
Summary fund Field Name ELPCWT INPCWT IMPCWT ILPCWT	tions: 1-Tot Summary	d summary al, 2-Avera Column Spacing 2 2 2 2	M Query/4 functions age, 3-Mi Column H EP LOW % time PAC wt IMN NED % time PAC wt IMN MED % time PAC wt IMN MED % LIME PAC wt IMN LOW	(continued nimum, 4-Ma	ximum, 5- Len 20 20 20	Count Dec Pos 3 3 3	Null		Overr Dec	ides Numeric	Page	4
Summary fund Field Name ELPCWT INPCWT IHPCWT ILPCWT ILPCWT eport breaks	ttions: 1-Tot Summary Functions	d summary 4 a), 2-Aver: Column Spacing 2 2 2 2 2 2 2	M Query/4 functions age, 3-Mi Column H EP LOW % time PAC wt IMN NET % time PAC wt IMN HIGH % time PAC wt IMN MED % time PAC wt IMN LOW % time	(continued nimum, 4-Ma	ximum, 5- Len 20 20 20	Count Dec Pos 3 3 3	Null		Overr Dec	ides Numeric	Page	4
Summary fund Field Name ELPCWT INPCWT IHPCWT ILPCWT ILPCWT Sport breaks Break New	tions: 1-Tot Summary Functions Suppress B	d summary al, 2-Averi Column Spacing 2 2 2 2 2 2 2 2 2	M Query/4 functions age, 3-Mi Column H EP LOW % time PAC wt IMN NET % time PAC wt IMN HIGH % time PAC wt IMN MED % time PAC wt IMN LOW % time	(continued nimum, 4-Ma	ximum, 5- Len 20 20 20	Count Dec Pos 3 3 3	Null		Overr Dec	ides Numeric	Page	4
Summary fund Field Name ELPCWT INPCWT IHPCWT ILPCWT ILPCWT Port breaks Break New Level Page	tions: 1-Tot Summary Functions Suppress B Summaries T	d summary al, 2-Averi Column Spacing 2 2 2 2 2 2 2 2 2	M Query/4 functions age, 3-Mi Column H EP LOW % time PAC wt IMN NET % time PAC wt IMN HIGH % time PAC wt IMN MED % time PAC wt IMN LOW % time	(continued nimum, 4-Ma	ximum, 5- Len 20 20 20	Count Dec Pos 3 3 3	Null		Overr Dec	ides Numeric	Page	4
Summary fund Field Name ELPCWT INPCWT IHPCWT ILPCWT ILPCWT Eport breaks Break New Level Page 0 No	tions: 1-Tot Summary Functions Suppress B Summaries T Yes	d summary al, 2-Averi Column Spacing 2 2 2 2 2 2 2 2 2	M Query/4 functions age, 3-Mi Column H EP LOW % time PAC wt IMN NET % time PAC wt IMN HIGH % time PAC wt IMN MED % time PAC wt IMN LOW % time	(continued nimum, 4-Ma	ximum, 5- Len 20 20 20	Count Dec Pos 3 3 3	Null		Overr Dec	ides Numeric	Page	4
Summary fund Field Name ELPCWT INPCWT IHPCWT ILPCWT ILPCWT Export breaks Break New Level Page 0 No 1 No	tions: 1-Tot Summary Functions Suppress B Summaries T Yes No	d summary al, 2-Averi Column Spacing 2 2 2 2 2 2 2 2 2	M Query/4 functions age, 3-Mi Column H EP LOW % time PAC wt IMN NET % time PAC wt IMN HIGH % time PAC wt IMN MED % time PAC wt IMN LOW % time	(continued nimum, 4-Ma	ximum, 5- Len 20 20 20	Count Dec Pos 3 3 3	Null		Overr Dec	ides Numeric	Page	4
Summary fund Field Name ELPCWT INPCWT IHPCWT ILPCWT ILPCWT Port breaks Break New Level Page 0 No 1 No	tions: 1-Tot Summary Functions Suppress B Summaries T Yes No t attributes	d summary d al, 2-Averi Column 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2	M Query/4 functions age, 3-Mi Column H EP LOW PAC wt IMN NET % time PAC wt IMN HIGH % time PAC wt IMN MED % time PAC wt IMN LOW % time	(continued nimum, 4-Ma eadings	ximum, 5- Len 20 20 20	Count Dec Pos 3 3 3	Null		Overr Dec	ides Numeric	Page	4
Summary fund Field Name ELPCWT INPCWT IHPCWT ILPCWT ILPCWT Export breaks Break New Level Page 0 No 1 No elected outpu Output type	tions: 1-Tot Summary Functions Suppress B Summaries T Yes No et attributes 	d summary 4 a), 2-Aver: Column Spacing 2 2 2 2 2 2 2 2 2 2 2 2 2	M Query/4 functions age, 3-Mi Column H EP LOW % time PAC wt IMN HIGH % time PAC wt IMN HIGH % time PAC wt IMN LOW % time PAC wt Prin	(continued nimum, 4-Ma eadings ter	ximum, 5- Len 20 20 20	Count Dec Pos 3 3 3	Null		Overr Dec	ides Numeric	Page	4
Summary fund Field Name ELPCWT INPCWT IHPCWT ILPCWT ILPCWT Eport breaks Break New Level Page 0 No 1 No Pleted outpu Output type Form of outp	Suppress B Summary Functions Summaries T Yes No It attributes 	d summary al, 2-Averi Column Spacing 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2	M Query/4 functions age, 3-Mi Column H EP LOW % time PAC wt IMN NIGN % time PAC wt IMN HIGN % time PAC wt IMN LOW % time PAC wt Prin Deta	(continued nimum, 4-Ma eadings ter	ximum, 5- Len 20 20 20	Count Dec Pos 3 3 3	Null		Overr Dec	ides Numeric	Page	4
Summary func Field Name ELPCWT INPCWT INPCWT ILPCWT ILPCWT JLPCCWT JLPCC	tions: 1-Tot Summary Functions Suppress B Summaries T Yes No et attributes 	d summary al, 2-Averi Column Spacing 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2	M Query/4 functions age, 3-Mi Column H EP LOW % time PAC wt IMN NIGN % time PAC wt IMN HIGN % time PAC wt IMN LOW % time PAC wt Prin Deta	(continued nimum, 4-Ma eadings ter	ximum, 5- Len 20 20 20	Count Dec Pos 3 3 3	Null		Overr Dec	ides Numeric	Page	4

Figure 189. SNA\_PAC2 Query Definition, Part 2

			IBM Que	ry/400	11/27/96	16:50:25	Page	5
Printer Output	t			-				
	ice			*PRINT				
Report size								
Length .				51 (default)				
•								
Report start	line			6				
	ine							
				Single space				
	ition			* 1				
Printer Spoole								
				(Defaults to value	in print file. OPO	UPRETL)		
				(Defaults to value				
				(Defaults to value	in print file OPO	UPRETI )		
Cover Page				(benaules to value	in print rite, QPQ	un ni ilj		
•	page			Vec				
Cover page	1 +			165				
Page headings		5						
Print standa	ard page head	ling		Yes				
Page headi		<b>J</b>						
Page footi								
			IBM Que	rv/400	11/27/96	16:50:25	Page	6
Database file	output							
				SES2A				
Library .				COMMDTA				
-								
For a new fi								
				*I IBCRTAUT				
Text about								
				Session Traffic - P	art 1 of 2			
	ition							
Output file re	ecord format							
	rd length .			108				
Field list:	5							
Field	Begin	Len De	c Null	Data Type	Text			
SCTLNM	1	10		Character	Controller Des	cription Name		
DATE	11	5		Character	substr(DTETIM,		substr	(DTETIM,5,2
TIME	16	5		Character	substr(DTETIM,			(DTETIM,9,2
ENPCWT	21		3	Packed decimal	(enspnw*100)/(		545561	
EHPCWT	32		3	Packed decimal	(ehspnw*100)/(			
EMPCWT	43		3	Packed decimal	(emspnw*100)/(			
ELPCWT	54		3	Packed decimal	(elspnw*100)/(			
INPCWT	65		3	Packed decimal	(inspnw*100)/(			
IHPCWT	76		3	Packed decimal	(ihspnw*100)/(			
IMPCWT	87		3	Packed decimal	(imspnw*100)/(			
ILPCWT	98		3	Packed decimal	(ilspnw*100)/(			
TELOWI	* * * * *	END	0 F	QUERY PRI				
		LNU	υr	QUENT PRI				

Figure 190. SNA\_PAC2 Query Definition, Part 3

## E.6 SNA\_PAC3

5716QU1	V3R6M0 9509	929 II	3M Query/400	SYST	EM01 11/27/96	15:06:22	Page	1
				erage pacing wind	ow size			
Query (	CSID		37					
***	is the dec	imal separator ch	naracter for	this query ***				
Process	sing options							
Use i	rounding .		Yes (d	efault)				
Ignor	re decimal da	ata errors	No (de	fault)				
Ignor	re substituti	ion warnings	Yes					
Use d	collating for	r all compares .	No					
Special	l conditions							
*** /	All records s	selected by defau	ilt ***					
Selected	files							
ID	File	Library	Member	Record Format				
T01	QAPMSNA	QPFRDATA	SNAOVERIP1	QAPMSNAR				
		IE	M Query/400		11/27/96	15:06:22	Page	2
Result f	ields							
Name	Express	sion		Column Heading	Len De	ec		
ENWNSZ	(enspws	s)/(ensppw+0.001)		EP NET				
				PAC win				
				size				
EHWNSZ	(ehspws	s)/(ehsppw+0.001)		EP HIGH				
				PAC win				
				size				
EMWNSZ	(emspws	s)/(emsppw+0.001)		EP MED				
				PAC win				
				size				
ELWNSZ	(elspws	s)/(elsppw+0.001)		EP LOW				
				PAC win				
				size				
INWNSZ	(inspws	s)/(insppw+0.001)		IMN NET				
				PAC win				
				size				
IHWNSZ	(ihspws	s)/(ihsppw+0.001)		IMN HIGH				
				PAC win				
	<i>.</i> .			size				
IMWNSZ	(imspws	s)/(imsppw+0.001)		IMN MED				
				PAC win				
111007	(41)	.) ////		size				
ILWNSZ	(11spws	s)/(ilsppw+0.001)		IMN LOW				
				PAC win				
DATE	autor a	(DTETIN 2 0) 11 /		size				
DATE		(DTETIM,3,2)    '	/ 11	Date				
TIME		(DTETIM,5,2) (DTETIM,7,2)    ′	.7 .11	Time				
1140		(DTETIM,7,2)    (DTETIM,9,2)	· 11	i i me				
	Substr	(DICITE, 9,2)						

Figure 191. SNA\_PAC3 Query Definition, Part 1

		IB	1 Query/400		1	1/27/9	6 1	15:06:2	2	Page	3	
	lected fields											
Field			Break Field									
Name			g Level Text									
SCTLNM	10	A	1 Control	ler Descript	ion M	lame						
DATE												
TIME												
ENWNSZ												
EHWNSZ												
EMWNSZ												
ELWNSZ												
INWNSZ												
IHWNSZ												
IMWNSZ												
ILWNSZ												
	e		~									
	formatting and											
			age, 3-Minimum, 4	I-Maximum, 5-				Overri				
Field	Summary	Column				Null			Numeric			
Name	Functions		Column Headings	Len	Pos	Cap	Len	Pos	Editing			
SCTLNM		0	Controller	10								
			Description									
			Name									
DATE		2	Date	5								
TIME		2	Time	5								
ENWNSZ	4	2	EP NET	17	3							
		-	PAC win	17	J							
			size									
FULINE 7	4	~			-							
EHWNSZ	4	2	EP HIGH	17	3							
			PAC win									
		_	size									
EMWNSZ	4	2	EP MED	17	3							
			PAC win									
			size									
			1 Query/400		1	1/27/9	6 1	15:06:2	2	Page	4	
		d summary	4 Query/400 functions (contir				6 1			Page	4	
Summary func		d summary	1 Query/400				6 1	15:06:2 Overri		Page	4	
		d summary	4 Query/400 functions (contir		-Count		6 1	Overri		Page	4	
Summary func	tions: 1-Tota Summary	d summary al, 2-Avera Column	4 Query/400 functions (contir		-Count Dec	Null		Overri Dec	des	Page	4	
Summary func Field	tions: 1-Tota Summary	d summary al, 2-Avera Column	4 Query/400 functions (contir age, 3-Minimum, 4	-Maximum, 5-	-Count Dec	Null		Overri Dec	des Numeric	Page	4	
Summary func Field Name	tions: 1-Tota Summary Functions	d summary al, 2-Avera Column Spacing	4 Query/400 functions (contir age, 3-Minimum, 4 Column Headings	l-Maximum, 5- Len	-Count Dec Pos	Null		Overri Dec	des Numeric	Page	4	
Summary func Field Name	tions: 1-Tota Summary Functions	d summary al, 2-Avera Column Spacing	4 Query/400 functions (contir age, 3-Minimum, 4 Column Headings EP LOW PAC win	l-Maximum, 5- Len	-Count Dec Pos	Null		Overri Dec	des Numeric	Page	4	
Summary func Field Name ELWNSZ	tions: 1-Tota Summary Functions 4	d summary al, 2-Avera Column Spacing 2	4 Query/400 functions (contir age, 3-Minimum, 4 Column Headings EP LOW PAC win size	4-Maximum, 5- Len 17	-Count Dec Pos 3	Null		Overri Dec	des Numeric	Page	4	
Summary func Field Name	tions: 1-Tota Summary Functions	d summary al, 2-Avera Column Spacing	4 Query/400 functions (contir age, 3-Minimum, 4 Column Headings EP LOW PAC win size IMN NET	l-Maximum, 5- Len	-Count Dec Pos	Null		Overri Dec	des Numeric	Page	4	
Summary func Field Name ELWNSZ	tions: 1-Tota Summary Functions 4	d summary al, 2-Avera Column Spacing 2	4 Query/400 functions (contir gge, 3-Minimum, 4 Column Headings EP LOW PAC win size IMN NET PAC win	4-Maximum, 5- Len 17	-Count Dec Pos 3	Null		Overri Dec	des Numeric	Page	4	
Summary func Field Name ELWNSZ INWNSZ	tions: 1-Tota Summary Functions 4 4	d summary al, 2-Avera Column Spacing 2 2	4 Query/400 functions (contir age, 3-Minimum, 4 Column Headings EP LOW PAC win size IMN NET PAC win size	L-Maximum, 5- Len 17 17	-Count Dec Pos 3	Null		Overri Dec	des Numeric	Page	4	
Summary func Field Name ELWNSZ	tions: 1-Tota Summary Functions 4	d summary al, 2-Avera Column Spacing 2	4 Query/400 functions (contir age, 3-Minimum, 4 Column Headings EP LOW PAC win size IMN NET PAC win size IMN HIGH	4-Maximum, 5- Len 17	-Count Dec Pos 3	Null		Overri Dec	des Numeric	Page	4	
Summary func Field Name ELWNSZ INWNSZ	tions: 1-Tota Summary Functions 4 4	d summary al, 2-Avera Column Spacing 2 2	4 Query/400 functions (contir age, 3-Minimum, 4 Column Headings EP LOW PAC win size IMN NET PAC win size IMN HIGH PAC win	L-Maximum, 5- Len 17 17	-Count Dec Pos 3	Null		Overri Dec	des Numeric	Page	4	
Summary func Field Name ELWNSZ INWNSZ IHWNSZ	tions: 1-Tota Summary Functions 4 4	d summary al, 2-Avera Column Spacing 2 2 2	4 Query/400 functions (contir age, 3-Minimum, 4 Column Headings EP LOW PAC win size IMN NET PAC win size IMN HIGH PAC win size	I-Maximum, 5- Len 17 17 17	-Count Dec Pos 3 3	Null		Overri Dec	des Numeric	Page	4	
Summary func Field Name ELWNSZ INWNSZ	tions: 1-Tota Summary Functions 4 4	d summary al, 2-Avera Column Spacing 2 2	4 Query/400 functions (contir age, 3-Minimum, 4 Column Headings EP LOW PAC win size IMN NET PAC win size IMN HIGH PAC win	L-Maximum, 5- Len 17 17	-Count Dec Pos 3	Null		Overri Dec	des Numeric	Page	4	
Summary func Field Name ELWNSZ INWNSZ IHWNSZ	tions: 1-Tota Summary Functions 4 4	d summary al, 2-Avera Column Spacing 2 2 2	4 Query/400 functions (contir age, 3-Minimum, 4 Column Headings EP LOW PAC win size IMN NET PAC win size IMN HIGH PAC win size	I-Maximum, 5- Len 17 17 17	-Count Dec Pos 3 3	Null		Overri Dec	des Numeric	Page	4	
Summary func Field Name ELWNSZ INWNSZ IHWNSZ	tions: 1-Tota Summary Functions 4 4	d summary al, 2-Avera Column Spacing 2 2 2	4 Query/400 functions (contir age, 3-Minimum, 4 Column Headings EP LOW PAC win size IMN NET PAC win size IMN HIGH PAC win size IMN HIGH PAC win size IMN MED	I-Maximum, 5- Len 17 17 17	-Count Dec Pos 3 3	Null		Overri Dec	des Numeric	Page	4	
Summary func Field Name ELWNSZ INWNSZ IHWNSZ	tions: 1-Tota Summary Functions 4 4	d summary al, 2-Avera Column Spacing 2 2 2	4 Query/400 functions (contin age, 3-Minimum, 4 Column Headings EP LOW PAC win size IMN NET PAC win size IMN HIGH PAC win size IMN MED PAC win	I-Maximum, 5- Len 17 17 17	-Count Dec Pos 3 3	Null		Overri Dec	des Numeric	Page	4	
Summary func Field Name ELWNSZ INWNSZ IHWNSZ	tions: 1-Tota Summary Functions 4 4 4 4	d summary al, 2-Avera Column Spacing 2 2 2 2	4 Query/400 functions (contir age, 3-Minimum, 4 Column Headings EP LOW PAC win size IMN NET PAC win size IMN MED PAC win size IMN MED PAC win size IMN MED PAC win size	I-Maximum, 5- Len 17 17 17 17	-Count Dec Pos 3 3 3	Null		Overri Dec	des Numeric	Page	4	
Summary func Field Name ELWNSZ INWNSZ IHWNSZ	tions: 1-Tota Summary Functions 4 4 4 4	d summary al, 2-Avera Column Spacing 2 2 2 2	4 Query/400 functions (contin age, 3-Minimum, 4 Column Headings EP LOW PAC win size IMN NET PAC win size IMN HIGH PAC win size IMN MED PAC win size IMN MED PAC win size IMN LOW PAC win	I-Maximum, 5- Len 17 17 17 17	-Count Dec Pos 3 3 3	Null		Overri Dec	des Numeric	Page	4	
Summary func Field Name ELWNSZ INWNSZ IMWNSZ IMWNSZ ILWNSZ	tions: 1-Tota Summary Functions 4 4 4 4	d summary al, 2-Avera Column Spacing 2 2 2 2	4 Query/400 functions (contir age, 3-Minimum, 4 Column Headings EP LOW PAC win size IMN NET PAC win size IMN MED PAC win size IMN MED PAC win size IMN MED PAC win size	I-Maximum, 5- Len 17 17 17 17	-Count Dec Pos 3 3 3	Null		Overri Dec	des Numeric	Page	4	
Summary func Field Name ELWNSZ INWNSZ IHWNSZ ILWNSZ eport breaks	tions: 1-Tota Summary Functions 4 4 4 4 4	d summary 1, 2-Averi column Spacing 2 2 2 2 2	4 Query/400 functions (contin age, 3-Minimum, 4 Column Headings EP LOW PAC win size IMN NET PAC win size IMN HIGH PAC win size IMN MED PAC win size IMN MED PAC win size IMN LOW PAC win	I-Maximum, 5- Len 17 17 17 17	-Count Dec Pos 3 3 3	Null		Overri Dec	des Numeric	Page	4	
Summary func Field Name ELWNSZ INWNSZ IHWNSZ ILWNSZ ILWNSZ Eport breaks Break New	tions: 1-Tota Summary Functions 4 4 4 4 4 4 5 Suppress B	d summary 1, 2-Aver: Column Spacing 2 2 2 2 2 2 2 2	4 Query/400 functions (contin age, 3-Minimum, 4 Column Headings EP LOW PAC win size IMN NET PAC win size IMN HIGH PAC win size IMN MED PAC win size IMN MED PAC win size IMN LOW PAC win	I-Maximum, 5- Len 17 17 17 17	-Count Dec Pos 3 3 3	Null		Overri Dec	des Numeric	Page	4	
Summary fund Field Name ELWNSZ INWNSZ IHWNSZ ILWNSZ ILWNSZ eport breaks Break New Level Page	tions: 1-Tota Summary Functions 4 4 4 4 4 4 4 5 uppress Br Summaries Te	d summary 1, 2-Aver: Column Spacing 2 2 2 2 2 2 2 2	4 Query/400 functions (contin age, 3-Minimum, 4 Column Headings EP LOW PAC win size IMN NET PAC win size IMN HIGH PAC win size IMN MED PAC win size IMN MED PAC win size IMN LOW PAC win	I-Maximum, 5- Len 17 17 17 17	-Count Dec Pos 3 3 3	Null		Overri Dec	des Numeric	Page	4	
Summary func Field Name ELWNSZ INWNSZ IHWNSZ ILWNSZ ILWNSZ Break New Level Page 0 No	tions: 1-Tota Summary Functions 4 4 4 4 4 4 5 Suppress Br Summaries To Yes	d summary 1, 2-Aver: Column Spacing 2 2 2 2 2 2 2 2	4 Query/400 functions (contin age, 3-Minimum, 4 Column Headings EP LOW PAC win size IMN NET PAC win size IMN HIGH PAC win size IMN MED PAC win size IMN MED PAC win size IMN LOW PAC win	I-Maximum, 5- Len 17 17 17 17	-Count Dec Pos 3 3 3	Null		Overri Dec	des Numeric	Page	4	
Summary func Field Name ELWNSZ INWNSZ IHWNSZ ILWNSZ ILWNSZ Eeport breaks Break New Level Page 0 No	tions: 1-Tota Summary Functions 4 4 4 4 4 4 5 Suppress Br Summaries Te Yes No	d summary 1, 2-Aver: Column Spacing 2 2 2 2 2 2 2 2	4 Query/400 functions (contin age, 3-Minimum, 4 Column Headings EP LOW PAC win size IMN NET PAC win size IMN HIGH PAC win size IMN MED PAC win size IMN MED PAC win size IMN LOW PAC win	I-Maximum, 5- Len 17 17 17 17	-Count Dec Pos 3 3 3	Null		Overri Dec	des Numeric	Page	4	
Summary func Field Name ELWNSZ INWNSZ IHWNSZ ILWNSZ ILWNSZ Break New Level Page 0 No	tions: 1-Tota Summary Functions 4 4 4 4 4 4 5 Suppress Br Summaries Te Yes No	d summary 1, 2-Aver: Column Spacing 2 2 2 2 2 2 2 2	4 Query/400 functions (contin age, 3-Minimum, 4 Column Headings EP LOW PAC win size IMN NET PAC win size IMN HIGH PAC win size IMN MED PAC win size IMN MED PAC win size IMN LOW PAC win	I-Maximum, 5- Len 17 17 17 17	-Count Dec Pos 3 3 3	Null		Overri Dec	des Numeric	Page	4	
Summary fund Field Name ELWNSZ INWNSZ IHWNSZ ILWNSZ ILWNSZ Break New Level Page 0 No 1 No	tions: 1-Tota Summary Functions 4 4 4 4 4 4 5 Suppress Br Summaries Te Yes No	d summary 1, 2-Aver: column Spacing 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2	4 Query/400 functions (contir age, 3-Minimum, 4 Column Headings EP LOW PAC win size IMN NET PAC win size IMN HIGH PAC win size IMN MED PAC win size IMN MED PAC win size	I-Maximum, 5- Len 17 17 17 17	-Count Dec Pos 3 3 3	Null		Overri Dec	des Numeric	Page	4	
Summary func Field Name ELWNSZ INWNSZ IHWNSZ ILWNSZ ILWNSZ Eeport breaks Break New Level Page 0 No 1 No elected outpu Output type	tions: 1-Tota Summary Functions 4 4 4 4 4 4 4 4 5 Suppress Br Summaries Te Yes No t attributes 	d summary 1, 2-Averi al, 2-Averi Spacing 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2	4 Query/400 Functions (contin age, 3-Minimum, 4 Column Headings EP LOW PAC win size IMN NET PAC win size IMN HIGH PAC win size IMN MED PAC win size IMN LOW PAC win size	I-Maximum, 5- Len 17 17 17 17	-Count Dec Pos 3 3 3	Null		Overri Dec	des Numeric	Page	4	
Summary func Field Name ELWNSZ INWNSZ IHWNSZ ILWNSZ ILWNSZ Eeport breaks Break New Level Page 0 No 1 No elected outpu Output type Form of outp	tions: 1-Tota Summary Functions 4 4 4 4 4 4 4 5 Suppress Bi Summaries Te Yes No t attributes	d summary 1, 2-Aver: 1, 2-Aver: Column Spacing 2 2 2 2 2 2 2 2 2 2 2 2 2	4 Query/400 functions (contir age, 3-Minimum, 4 Column Headings EP LOW PAC win size IMN NET PAC win size IMN HIGH PAC win size IMN MED PAC win size IMN LOW PAC win size Printer Detail	I-Maximum, 5- Len 17 17 17 17	-Count Dec Pos 3 3 3	Null		Overri Dec	des Numeric	Page	4	

Figure 192. SNA\_PAC3 Query Definition, Part 2

		TI	3M Query/400	11/27/96 15:06:22	Page 5	
Printer Output				,,		
Printer devic			*PRINT			
Report size						
Length			51 (default)			
Width			300			
Report start	line		6			
Report end li	ne		60			
Report line s	spacing		Single space			
Print definit			No			
Printer Spooled						
				in print file, QPQUPRFIL)		
				in print file, QPQUPRFIL)		
Copies						
			(Defaults to value	in print file, QPQUPRFIL)		
Cover Page						
Print cover p Cover page	-		Yes			
Page headings a	and footings					
Print standar	rd page head	ing	Yes			
Page headin	-					
Page footin	ng					
		I	3M Query/400	11/27/96 15:06:22	Page 6	
Database file o						
File						
-			COMMDTA			
Member						
			Replace file			
For a new fil			*I IDCDTAUT			
Authority . Text about			*LIBCRTAUT			
			Session Traffic - P	bout 1 of 2		
Print definit				art 1 01 2		
Output file rec			10			
Output record			92			
Field list:	· · · · · ·					
Field	Begin	Len Dec	Null Data Type	Text		
SCTLNM	1	10	Character	Controller Description Name		
DATE	11	5	Character	substr(DTETIM,3,2)    '/'	substr(DTETIM,5,2	
TIME	16	5	Character	substr(DTETIM,7,2)    ':'	substr(DTETIM,9,2	
ENWNSZ	21	17 3	Packed decimal	(enspws)/(ensppw+0.001)		
EHWNSZ	30	17 3	Packed decimal	(ehspws)/(ehsppw+0.001)		
EMWNSZ	39	17 3	Packed decimal	(emspws)/(emsppw+0.001)		
ELWNSZ	48	17 3	Packed decimal	(elspws)/(elsppw+0.001)		
INWNSZ	57	17 3	Packed decimal	(inspws)/(insppw+0.001)		
IHWNSZ	66	17 3	Packed decimal	(ihspws)/(ihsppw+0.001)		
IMWNSZ	75	17 3	Packed decimal	(imspws)/(imsppw+0.001)		
ILWNSZ	84	17 3	Packed decimal	(ilspws)/(ilsppw+0.001)		
	* * * * *	END	OF QUERY PRI	NT ****		

Figure 193. SNA\_PAC3 Query Definition, Part 3

# E.7 SNA\_LIN

5716QU1 V3F	16M0 950929 IBM Query/40	0 SYSTEMO1	11/27/96	15:06:34	Page 1	
Query		IN				
Library						
Query text		ine transmission time				
Query CCSI	D					
Query lang	uage id					
Query cour	try id					
*** . is	the decimal separator character fo	r this query ***				
Collating	sequence Hexad	ecimal				
Processing						
	ding Yes (					
-	lecimal data errors No (d	efault)				
	ubstitution warnings Yes					
	ating for all compares No					
Special co						
	records selected by default ***					
Selected fil ID Fil		Record Format				
	MSNA QPFRDATA SNAOVERIP					
TOT QAP	IBM Query/40		11/27/96	15:06:34	Page 2	
Result field			11/2//50	15.00.54	ruge 2	
Name	Expression	Column Heading	Len D	ec		
DATE	substr(DTETIM, 3, 2)    '/'	Date				
	substr(DTETIM,5,2)					
TIME	substr(DTETIM,7,2)    ':'	Time				
	substr(DTETIM,9,2)					
TOTLRUD	enlrud + ehlrud + emlrud + ellrud	Total length RU				
	+ inlrud + ihlrud + imlrud +	delivered				
	illrud					
TOTNRUD	ennrud + ehnrud + emnrud + elnrud					
	+ innrud + ihnrud + imnrud +	delivered				
	ilnrud					
AVGRULEND	TOTLRUD / (TOTNRUD + 0.00001)	Avg RU				
		length delivered				
TOTLRUR	enlrur + ehlrur + emlrur + ellrur					
TOTEROR	+ inlrur + ihlrur + imlrur +	received				
	illrur	receiveu				
TOTNRUR	ennrur + ehnrur + emnrur + elnrur	Total length RU				
	+ innrur + ihnrur + imnrur +	received				
	ilnrur					
AVGRULENR	TOTLRUR / (TOTNRUR + 0.00001)	Avg RU				
		length				
		received				
ENLTTM	(entrud/1000)/(ennrud+0.001)	EN NET				
		LT RU				
		dlv tim				
EHLTTM	(ehtrud/1000)/(ehnrud+0.001)	EN HIGH				
		LT RU				
		dlv tim				
EMLITM	(emtrud/1000)/(emnrud+0.001)					
<b>ELLITIM</b>	(altrud/1000)/(alprud+0_001)					
CLLIIM	(errrud/1000)/(ernrud+0.001)					
		G.V 6100				
		LT RU dlv tim EN HIGH LT RU				

Figure 194. SNA\_LIN Query Definition, Part 1

		IBM	Query/	100		1	1/27/96	1	5:06:34	ļ	Page	3	
	(continued)												
Name	Expression				n Heading		Len	Dec					
INLTTM	(intrud/1000)	/(innrud+0.	001)	INM N LT RU									
				dlv t									
IHLTTM	(ihtrud/1000)	/(ihnrud+0.	001)	INM H LT RU									
				dlv t									
IMLTTM	(imtrud/1000)	/(imnrud+0.	001)	INM M LT RU									
				dlv t									
ILLTTM	(iltrud/1000)	/(ilnrud+0.	001)	INM L LT RU									
				dlv t	im								
rdering of s	elected fields												
Field	Sort	Ascending/											
Name		Descending											
SCTLNM	10	A	1		ler Descrip		lame						
SLINNM			1	Line De	scription N	Name							
DATE													
TIME													
AVGRULEND													
AVGRULENR													
ENLTTM													
EHLTTM													
EMLTTM													
ELLTTM													
INLTTM													
IHLTTM													
IMLTTM													
ILLTTM													
eport column Summary fun Field	n formatting an nctions: 1-Tot Summary	d summary f al, 2-Avera Column	ge, 3-M	s inimum, 4	-Maximum, !	5-Count Dec	Null			ies Iumeric	Page	4	
eport column Summary fun	ctions: 1-Tot Summary	d summary f al, 2-Avera Column Spacing	unction ge, 3-M	s inimum, 4 Headings	-Maximum, ! Ler 10	5-Count Dec n Pos	Null		Overric Dec M	ies	Page	4	
eport column Summary fun Field Name	ctions: 1-Tot Summary	d summary f al, 2-Avera Column Spacing O	unction ge, 3-M Column H	s inimum, 4 Headings ler	Ler	5-Count Dec n Pos	Null		Overric Dec M	ies Iumeric	Page	4	
eport column Summary fun Field Name	ctions: 1-Tot Summary	d summary f al, 2-Avera Column Spacing O	unction ge, 3-M Column H Control Descrip	s inimum, 4 Headings ler	Ler	5-Count Dec n Pos D	Null		Overric Dec M	ies Iumeric	Page	4	
eport column Summary fun Field Name SCTLNM	ctions: 1-Tot Summary	d summary f al, 2-Avera Column Spacing O 2	unction: ge, 3-M Column H Control Descrip Name Line Descrip	s inimum, 4 Headings Ler tion	Ler 10	5-Count Dec n Pos D	Null		Overric Dec M	ies Iumeric	Page	4	
eport column Summary fun Field Name SCTLNM SLINNM	ctions: 1-Tot Summary	d summary f al, 2-Avera Column Spacing O	unction: ge, 3-M Column H Control Descrip Name Line Descrip Name	s inimum, 4 Headings Ler tion	Ler 10	5-Count Dec 1 Pos 0	Null		Overric Dec M	ies Iumeric	Page	4	
eport column Summary fun Field Name SCTLNM SLINNM DATE	ctions: 1-Tot Summary	d summary f al, 2-Avera Column Spacing O 2 2	unctions ge, 3-M Column H Control Descrip Name Line Descrip Name Date	s inimum, 4 Headings Ler tion	Ler 1( 1(	5-Count Dec 1 Pos D	Null		Overric Dec M	ies Iumeric	Page	4	
eport column Summary fun Field Name SCTLNM SLINNM DATE TIME	ctions: 1-Tot Summary	d summary f al, 2-Avera Column Spacing O 2 2 2	unction: ge, 3-M Column H Control Descrip Name Line Descrip Name Dascrip Name Date Time	s inimum, 4 Headings Ler tion	Ler 1( 1( 5	5-Count Dec 1 Pos 0 5 5	Null	Len	Overric Dec M Pos E	ies Iumeric	Page	4	
eport column Summary fun Field Name SCTLNM SLINNM DATE	ctions: 1-Tot Summary	d summary f al, 2-Avera Column Spacing 0 2 2 2 2 2 2 2	unctions ge, 3-M Column H Control Descrip Name Line Descrip Name Date	s inimum, 4 Headings ter tion	Ler 1( 1(	5-Count Dec 1 Pos 0 5 5	Null		Overric Dec M	ies Iumeric	Page	4	
eport column Summary fun Field Name SCTLNM SLINNM DATE TIME	ctions: 1-Tot Summary	d summary f al, 2-Avera Column Spacing 0 2 2 2 2 2 2 2 2	unction: ge, 3-M Column H Control Descrip Name Line Descrip Name Date Time Avg RU length	s inimum, 4 Headings ter tion	Ler 1( 1( 5	5-Count Dec 1 Pos 0 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5	Null	Len	Overric Dec M Pos E	ies Iumeric	Page	4	
eport column Summary fun Field Name SCTLNM SLINNM DATE TIME AVGRULEND	ctions: 1-Tot Summary	d summary f al, 2-Avera Column Spacing 0 2 2 2 2 2 2 2 2 2 2 2	unction: ge, 3-M Column H Control Descrip Name Date Time Avg RU length deliver Avg RU length	s inimum, 4 Headings ler tion tion	Ler 10 10 28	5-Count Dec 1 Pos 0 5 5 5 5 5 5 5	Null	Len 18	Overrid Dec M Pos F	ies Iumeric	Page	4	
eport column Summary fun Field Name SCTLNM SLINNM DATE TIME AVGRULEND	ctions: 1-Tot Summary	d summary f al, 2-Avera Column Spacing 0 2 2 2 2 2 2 2 2 2 2	unction: ge, 3-M Column H Control Descrip Name Date Time Avg RU length deliver Avg RU length received	s inimum, 4 Headings ler tion tion	Ler 10 10 28	5-Count Dec 1 Pos 0 5 5 5 5 5 5 5	Null	Len 18	Overrid Dec M Pos F	ies Iumeric	Page	4	
eport column Summary fun Field Name SCTLNM SLINNM DATE TIME AVGRULEND	ctions: 1-Tot Summary	d summary f al, 2-Avera Column Spacing 0 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2	unction: ge, 3-M Column I Control Descrip Name Line Descrip Name Date Time Avg RU length deliver Avg RU length receiveu EN NET	s inimum, 4 Headings ler tion tion	Ler 10 10 28	5-Count Dec 1 Pos 0 5 5 5 3 5 3 5	Null	Len 18	Overrid Dec M Pos F	ies Iumeric	Page	4	
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eport column Summary fun Field Name SCTLNM SLINNM DATE TIME AVGRULENR ENLTTM	ctions: 1-Tot Summary Functions	d summary f al, 2-Avera Column Spacing 0 2 2 2 2 2 2 2 2 2 2 2 2 2 2	unction: ge, 3-M Column I Control Descrip Name Descrip Name Date Time Avg RU length deliver Avg RU length receive EN NET LT RU dlv tim	s inimum, 4 Headings ler tion tion	Ler 10 10 28 28	5-Count Dec 1 Pos 0 5 5 5 3 5 3 5	Null	Len 18	Overrid Dec M Pos F	ies Iumeric	Page	4	
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eport column Summary fun Field Name SCTLNM SLINNM DATE TIME AVGRULENR ENLTTM	ctions: 1-Tot Summary Functions 4	d summary f al, 2-Avera Column Spacing 0 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2	unction: ge, 3-M Column H Control Descrip Name Date Time Date Time Date Time deliver Avg RU length deliver Avg RU length receive EN NET LT RU dlv tim EN HIGH LT RU	s inimum, 4 Headings ler Lion Lion	Ler 1( 9 28 28 17	5-Count Dec 1 Pos 5 5 3 5 3 5 3 5 7 3	Null	Len 18	Overrid Dec M Pos F	ies Iumeric	Page	4	
eport column Summary fun Field Name SCTLNM SLINNM DATE TIME AVGRULEND AVGRULENR ENLITM EHLITM	ctions: 1-Tot Summary Functions 4	d summary f al, 2-Avera Column Spacing 0 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2	unction: ge, 3-M Column I Control Descrip Name Date Date Date Time Avg RU length deliver Avg RU length receive EN NET LT RU dlv tim EN HIGH LT RU dlv tim	s inimum, 4 Headings ler Lion Lion	Ler 10 21 21 17	5-Count Dec Pos 0 0 5 5 5 3 5 5 3 5 7 3 7 3 7 3	Null	Len 18	Overrid Dec M Pos F	ies Iumeric	Page	4	
eport column Summary fun Field Name SCTLNM SLINNM DATE TIME AVGRULENR ENLTTM	ctions: 1-Tot Summary Functions 4	d summary f al, 2-Avera Column Spacing 0 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2	unction: ge, 3-M Column H Control Descrip Name Date Time Date Time Date Time deliver Avg RU length deliver Avg RU length receive EN NET LT RU dlv tim EN HIGH LT RU	s inimum, 4 Headings ler Lion Lion	Ler 1( 9 28 28 17	5-Count Dec Pos 0 0 5 5 5 3 5 5 3 5 7 3 7 3 7 3	Null	Len 18	Overrid Dec M Pos F	ies Iumeric	Page	4	
eport column Summary fun Field Name SCTLNM SLINNM DATE TIME AVGRULEND AVGRULENR ENLITM EHLITM	ctions: 1-Tot Summary Functions 4	d summary f al, 2-Avera Column Spacing 0 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2	unction: ge, 3-M Column I Control Descrip Name Line Descrip Name Descrip Name Descrip Name Descrip Name Descrip Name Line Hige Ling H div Ling H G diver Ling H G diver Ling H G diver Ling H G diver Ling H G diver Ling H G diver Ling H G diver Ling H G diver Ling H G diver Ling H G diver Ling H G diver Ling H G diver Ling H G diver Ling H G diver Ling H G diver Ling H G diver Ling H G diver Ling H G diver Ling H diver Ling Ling H diver Ling H Ling	s inimum, 4 Headings ler Lion Lion	Ler 10 21 21 17	5-Count Dec Pos 0 0 5 5 5 3 5 5 3 5 7 3 7 3 7 3	Null	Len 18	Overrid Dec M Pos F	ies Iumeric	Page	4	
eport column Summary fun Field Name SCTLNM SLINNM DATE TIME AVGRULEND AVGRULENR ENLITM EHLITM	ctions: 1-Tot Summary Functions 4 4 4	d summary f al, 2-Avera Column 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2	unction. ge, 3-M Column I Control D Descrip D Desc	s inimum, 4 Headings ler Lion Lion	Ler 10 24 24 11 11	5-Count Dec Dec 5 5 3 5 5 3 5 7 3 5 7 3 7 3 7 3 7 3	Null	Len 18	Overrid Dec M Pos F	ies Iumeric	Page	4	
eport column Summary fun Field Name SCTLNM SLINNM DATE TIME AVGRULEND AVGRULENR ENLITM EHLITM	ctions: 1-Tot Summary Functions 4	d summary f al, 2-Avera Column 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2	unction: ge, 3-M Column I Control Descrip Name Line Descrip Name Descrip Name Descrip Name Descrip Name Descrip Name Line Hige Ling H deliver erceives EN NET LT RU dlv tim EN HIGH LT RU dlv tim EN MED LT RU	s inimum, 4 Headings ler Lion Lion	Ler 10 21 21 17	5-Count Dec 1 Pos 0 0 5 5 5 3 5 5 3 5 5 3 5 7 3 7 3 7 3 7 3	Null	Len 18	Overrid Dec M Pos F	ies Iumeric	Page	4	
eport column Summary fun Field Name SCTLNM SLINNM DATE TIME AVGRULEND AVGRULENR ENLITM EHLITM	ctions: 1-Tot Summary Functions 4 4 4	d summary f al, 2-Avera Column Spacing 0 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2	unction: ge, 3-M Column l Control Descrip Name Line Date Descrip Name Avg RU Descrip Name Avg RU Length Avg RU Length Avg RU Length Avg RU Length Len	s inimum, 4 Headings ler Lion Lion	Ler 10 24 24 11 11	5-Count Dec Dec 5 5 3 5 5 3 5 7 3 5 7 3 7 3 7 3 7 3	Null	Len 18	Overrid Dec M Pos F	ies Iumeric	Page	4	
eport column Summary fun Field Name SCTINM SLINNM DATE TIME AVGRULEND AVGRULENR ENLITM EHLITM ELLITM	ctions: 1-Tot Summary Functions 4 4 4	d summary f al, 2-Avera Column 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2	unction: ge, 3-M Column h Control Descripp Name Descripp Name Date Date Time Avg RU length Mag RU length deliver Name Len NeT LT RU dlv tim EN HIGH LT RU LT RU	s inimum, 4 Headings ler Lion Lion	Ler 10 24 24 11 11	5-Count Dec Dec 5 5 3 5 3 5 3 5 7 3 7 3 7 3 7 3 7 3 7 3	Null	Len 18	Overrid Dec M Pos F	ies Iumeric	Page	4	
eport column Summary fun Field Name SCTLNM SLINNM DATE TIME AVGRULEND AVGRULENR ENLITM EHLITM	ctions: 1-Tot Summary Functions 4 4 4 4	d summary f al, 2-Avera Column Spacing 0 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2	unction: ge, 3-M Column In Controll Descrip Name Line Descrip Name Date Date Time Avg RU Descrip Name Control Control Descrip Name Control Descrip Control Descrip Name Control D	s inimum, 4 Headings ler Lion Lion	Ler 10 24 24 11 11 11	5-Count Dec Dec 5 5 3 5 3 5 3 5 7 3 7 3 7 3 7 3 7 3 7 3	Null	Len 18	Overrid Dec M Pos F	ies Iumeric	Page	4	
eport column Summary fun Field Name SCTINM SLINNM DATE TIME AVGRULEND AVGRULENR ENLITM EHLITM ELLITM	ctions: 1-Tot Summary Functions 4 4 4 4	d summary f al, 2-Avera Column Spacing 0 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2	unction: ge, 3-M Column I Control Descrip Descrip Name Descrip Name Date Time Avg RU length Mag RU length Mag RU length deliver Name Control Name Control Name Date Control Name Descrip Name Date Descrip Name Date Date Date Date Date Date Date Dat	s inimum, 4 Headings ler Lion Lion	Ler 10 24 24 11 11 11	5-Count Dec Dec 5 5 3 5 3 5 3 5 7 3 7 3 7 3 7 3 7 3 7 3	Null	Len 18	Overrid Dec M Pos F	ies Iumeric	Page	4	
eport column Summary fun Field Name SCTINM SLINNM DATE TIME AVGRULEND AVGRULENR ENLITM EHLITM ELLITM	ctions: 1-Tot Summary Functions 4 4 4 4	d summary f al, 2-Avera Column 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2	unction: ge, 3-M Column l Control Descrip Name Line Date Date Descrip Name Date date date date date date date date d	s inimum, 4 Headings er tion tion	Ler 10 24 24 11 11 11	5-Count Dec 0 5 5 3 5 3 5 5 3 5 7 3 7 3 7 3 7 3 7 3 7	Null	Len 18	Overrid Dec M Pos F	ies Iumeric	Page	4	
eport column Summary fun Field Name SCTLNM SLINNM DATE TIME AVGRULEND AVGRULENR ENLITM EHLITM ELLITM INLITM	ctions: 1-Tot Summary Functions 4 4 4 4 4 4 4 4	d summary f al, 2-Avera Column 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2	unction: ge, 3-M Column In Controll Descrip Name Date Line Date Time Date Time Avg RU length deliver RV RU length deliver receive: EN NET LT RU div tim EN HIGK LT RU div tim EN HIGK LT RU div tim EN HOK LT RU div tim EN LT RU div tim EN LT RU div tim EN LT RU div tim EN RUS LT RU RUS LT RU RUS LT RU RUS RUS LT RUS RUS RUS RUS RUS RUS RUS RUS RUS RUS	s inimum, 4 Headings er tion tion	Ler 10 24 24 11 11 11 11	5-Count Dec 0 5 5 3 5 3 5 5 3 5 7 3 7 3 7 3 7 3 7 3 7	Null	Len 18	Overrid Dec M Pos F	ies Iumeric	Page	4	

Figure 195. SNA\_LIN Query Definition, Part 2

Ronant column		IB	M Query/400	11/27/96 15:06:34	Page 5
			functions (continued)		
•		-	age, 3-Minimum, 4-Maxi	-	
Field	Summary	Column	Column Handdana	Dec Null Dec Numeric	
Name	Functions 4		Column Headings INM MED	Len Pos Cap Len Pos Editing	
IMLTTM	4	2	INM MED LT RU	17 3	
			dlv tim		
ILLTTM	4	2	INM LOW	17 3	
ILLIIM	4	2	LT RU	17 3	
			dlv tim		
Report breaks					
Break New	Suppress Br	eak			
	Summaries Te				
0 No	Yes				
1 No	No				
Selected outpu	t attributes				
Output type			Printer		
Form of outp	ut		Detail		
	g				
		ΙB	M Query/400	11/27/96 15:06:34	Page 6
Printer Output					
	ce		*PRINT		
Report size					
			51 (default)		
	line				
	ine				
			Single space		
	tion		NO		
Printer Spoole			(D.f. 1+- +1-	in aniat file ODOUDDETL)	
				ie in print file, QPQUPRFIL) Je in print file, QPQUPRFIL)	
				le in print life, (PQOPKFIL)	
				ue in print file, QPQUPRFIL)	
Cover Page			(belaules co valo	ie in prine rire, didorare,	
	page		Vec		
Cover page					
Page headings					
	rd page headin	a	Yes		
Page headi		·			
Page footi					
•	-	IB	M Query/400	11/27/96 15:06:34	Page 7
Database file	output				
			SES2A		
File			COMMDTA		
File Library .					
File Library . Member	· · · · · · · · · · · ·	· · · · · ·			
File Library . Member	· · · · · · · · · · · · · · · · · · ·	· · · · · ·	*FILE		
File Library . Member Data in file For a new fi		· · · · · ·	*FILE		
File Library . Member Data in file For a new fi Authority Text about		· · · · · ·	<ul> <li>. *FILE</li> <li>. Replace file</li> <li>. *LIBCRTAUT</li> </ul>		
File Library . Member Data in file For a new fi Authority Text about the file		· · · · · · · · · · · · · · · · · · ·	<ul> <li>. *FILE</li> <li>. Replace file</li> <li>. *LIBCRTAUT</li> <li>. Session Traffic -</li> </ul>	Part 1 of 2	
File Library . Member Data in file For a new fi Authority Text about the file Print defini		· · · · · · · · · · · · · · · · · · ·	<ul> <li>. *FILE</li> <li>. Replace file</li> <li>. *LIBCRTAUT</li> <li>. Session Traffic -</li> </ul>	Part 1 of 2	
File Library . Member Data in file For a new fi Authority Text about the file Print defini Output file re		· · · · · · · · · · · · · · · · · · ·	<ul> <li>. *FILE</li> <li>. Replace file</li> <li>. *LIBCRTAUT</li> <li>. Session Traffic -</li> <li>. No</li> </ul>	Part 1 of 2	
File Library . Member . Data in file For a new fi Authority Text about the file Print defini Output file re Output recor		· · · · · · · · · · · · · · · · · · ·	<ul> <li>. *FILE</li> <li>. Replace file</li> <li>. *LIBCRTAUT</li> <li>. Session Traffic -</li> <li>. No</li> </ul>	Part 1 of 2	
File Library . Member . Data in file For a new fi Authority Text about the file Print defini Output file re Output recor Field list:		· · · · · · · · · · · · · · · · · · ·	<ul> <li>. *FILE</li> <li>. Replace file</li> <li>. *LIBCRTAUT</li> <li>. Session Traffic -</li> <li>. No</li> <li>. 132</li> </ul>		
File Library . Member Data in file For a new fi Authority Text about the file Print defini Output file re Output recor Field list: Field	le: 		<ul> <li>. *FILE</li> <li>. Replace file</li> <li>. *LIBCRTAUT</li> <li>. Session Traffic -</li> <li>. No</li> <li>. 132</li> <li>Null Data Type</li> </ul>	Text	
File Library Data in file For a new fi Authority Text about the file Print defini Output file re Output recor Field list: Field SCTLMM	le: 		<ul> <li>. *FILE</li> <li>. Replace file</li> <li>. *LIBCRTAUT</li> <li>. Session Traffic -</li> <li>. No</li> <li>. 132</li> <li>Null Data Type Character</li> </ul>	Text Controller Description Name	
File Library Member Data in file For a new fi Authority Text about the file Print defini Output file ree Output recor Field list: Field SCILMM SLINNM	le: 		<ul> <li>. *FILE</li> <li>. Replace file</li> <li>. *LIBCRTAUT</li> <li>. Session Traffic -</li> <li>. No</li> <li>. 132</li> <li>Null Data Type Character Character</li> </ul>	Text Controller Description Name Line Description Name	
File Library Data in file For a new fi Authority Text about the file Print defini Output file re Output recor Field SCTLMM DATE			<ul> <li>. *FILE</li> <li>. Replace file</li> <li>. *LIBCRTAUT</li> <li>. Session Traffic -</li> <li>. No</li> <li>. 132</li> <li>Null Data Type Character Character Character</li> </ul>	Text Controller Description Name Line Description Name substr(DTETIM,3,2) [] '/'	substr(DTETIM,5,2
File Library Data in file For a new fi Authority Text about the file Print defini Output recor Field list: Field SCTLNM DATE TIME	le: 		<ul> <li>. *FILE</li> <li>. Replace file</li> <li>. *LIBCRTAUT</li> <li>. Session Traffic -</li> <li>. No</li> <li>. 132</li> <li>Null Data Type Character Character Character Character</li> </ul>	Text Controller Description Name Line Description Name substr(DTETIM,3,2)    '/'    substr(DTETIM,7,2)    ':'	substr(DTETIM,5,2 substr(DTETIM,9,2
File Library . Member . Data in file For a new fil Authority Text about the file Print defini Output file re Output recor Field list: Field SCTLMM SLINMM DATE TIME AVGRULEND	tion		<ul> <li>. *FILE</li> <li>. Replace file</li> <li>. *LIBCRTAUT</li> <li>. Session Traffic -</li> <li>. No</li> <li>. 132</li> <li>Null Data Type Character Character Character Character Packed decimal</li> </ul>	Text Controller Description Name Line Description Name substr(OTETIM,3,2)    '/'    substr(OTETIM,7,2)    ':'    TOTRUD / (TOTRRUD + 0.00001)	
File Library Data in file For a new fi Authority Text about the file Print defini Output file re Output recorr Field SCTLMM DATE TIME AVGRULEND AVGRULEND			<ul> <li>. *FILE</li> <li>. Replace file</li> <li>. *LIBCRTAUT</li> <li>. Session Traffic -</li> <li>. No</li> <li>. 132</li> <li>Null Data Type Character Character Character Character Packed decimal Packed decimal</li> </ul>	Text Controller Description Name Line Description Name substr(DTETIM,3,2)    '/'    substr(DTETIM,7,2)    ':'    TOTLRUD / (TOTNRUD + 0.00001) TOTLRUR / (TOTNRUR + 0.00001)	
File Library Data in file For a new fi Authority Text about Print defini Output recor Field list: Field SCTLMM DATE TIME AVGRULEND AVGRULEND	le: 		<ul> <li>*FILE</li> <li>Replace file</li> <li>*LIBCRTAUT</li> <li>Session Traffic -</li> <li>No</li> <li>132</li> <li>Null Data Type Character Character Character Character Packed decimal Packed decimal Packed decimal</li> </ul>	Text Controller Description Name Line Description Name substr(DTETIM,3,2)    '/'    substr(DTETIM,7,2)    '.'    TOTLRUD / (TOTNRUD + 0.00001) TOTLRUR / (TOTNRUR + 0.00001) (entrud/1000)/(ennrud+0.001)	
File Library Member Data in file For a new fil Authority Text about the file Print defini Output file re Output recor Field list: Field SCLIMM DATE TIME AVGRULEND AVGRULEND AVGRULENT EHLITM	tion		<ul> <li>. *FILE</li> <li>. Replace file</li> <li>. *LIBCRTAUT</li> <li>. Session Traffic -</li> <li>. No</li> <li>. 132</li> <li>Null Data Type Character Character Character Character</li> <li>Packed decimal Packed decimal Packed decimal</li> </ul>	Text Controller Description Name Line Description Name substr(OTETIM,3,2)    '/'    substr(OTETIM,7,2)    ':'    TOTLRUD / (TOTNRUD + 0.00001) TOTLRUR / (TOTNRUR + 0.00001) (entrud/1000)/(ennrud+0.001) (ehtrud/1000)/(ehnrud+0.001)	
File Library Data in file For a new fi Authority Text about the file Print defini Output file re Output recor Field SCTLMM DATE TIME AVGRULEND AVGRULEND AVGRULEND ENLITTM ENLITTM			<ul> <li>. *FILE</li> <li>. Replace file</li> <li>. *LIBCRTAUT</li> <li>. Session Traffic -</li> <li>. No</li> <li>. 132</li> <li>Null Data Type Character Character Character Character Packed decimal Packed decimal Packed decimal Packed decimal</li> </ul>	Text Controller Description Name Line Description Name substr(DTETIM,3,2)    '/'    substr(DTETIM,7,2)    ':'    TOTLRUD / (TOTNRUD + 0.00001) TOTLRUR / (TOTNRUR + 0.00001) (entrud/1000)/(ennrud+0.001) (emtrud/1000)/(emnrud+0.001)	
File Library Data in file For a new fi Authority Text about Print defini Output recor Field list: Field SCTLMM DATE TIME AVGRULEND AVGRULEND ENLITM ENLITM		en Dec 10 5 5 17 3 17 3 17 3 17 3	<ul> <li>*FILE</li> <li>Replace file</li> <li>*LIBCRTAUT</li> <li>Session Traffic -</li> <li>No</li> <li>132</li> <li>Null Data Type Character</li> <li>Character</li> <li>Character</li> <li>Character</li> <li>Packed decimal</li> </ul>	Text Controller Description Name Line Description Name substr(DTETIM,3,2)    '/'    substr(DTETIM,2)    '.'    TOTLRUD / (TOTNRUD + 0.00001) TOTLRUR / (TOTNRUR + 0.00001) (entrud/1000)/(ennrud+0.001) (entrud/1000)/(ennrud+0.001) (eltrud/1000)/(ennrud+0.001)	
File Library Data in file For a new fil Authority Text about the file Print defini Output file re Output recor Field list: Field SCLINM DATE TIME AVGRULEND AVGRULEND AVGRULENT ENLITM ENLITM	tion		<ul> <li>*FILE</li> <li>Replace file</li> <li>*LIBCRTAUT</li> <li>Session Traffic -</li> <li>No</li> <li>132</li> <li>Null Data Type Character Character Character Character</li> <li>Packed decimal Packed decimal Packed decimal Packed decimal Packed decimal</li> </ul>	Text Controller Description Name Line Description Name substr(OTETIM,3,2)    '/'    substr(OTETIM,7,2)    ':'    TOTLRUD / (TOTNRUD + 0.00001) TOTLRUB / (TOTNRUD + 0.00001) (entrud/1000) / (ennrud+0.001) (eltrud/1000) / (ennrud+0.001) (eltrud/1000) / (ennrud+0.001) (intrud/1000) / (innrud+0.001)	
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File Library Data in file For a new fi Authority Text about Print defini Output recor Field list: Field SCTLNM DATE TIME AVGRULENR ENLITM ENLITM ENLITM ELLITM INLITM			<ul> <li>*FILE</li> <li>Replace file</li> <li>*LIBCRTAUT</li> <li>Session Traffic -</li> <li>No</li> <li>132</li> <li>Null Data Type Character</li> <li>Character</li> <li>Character</li> <li>Character</li> <li>Packed decimal</li> </ul>	Text Controller Description Name Line Description Name substr(DTETIM,3,2)    '/'    substr(DTETIM,2)    '.'    TOTLRUD / (TOTNRUD + 0.00001) TOTLRUR / (TOTNRUR + 0.00001) (entrud/1000)/(ennrud+0.001) (entrud/1000)/(ennrud+0.001) (intrud/1000)/(innrud+0.001) (intrud/1000)/(innrud+0.001) (intrud/1000)/(innrud+0.001)	
File Library Data in file For a new fi Authority Text about Print defini Output file re Output recor Field SCTLMM DATE TIME AVGRULEND AVGRULEND AVGRULEND AVGRULENT ENLITTM ELLITTM INLITTM			<ul> <li>*FILE</li> <li>Replace file</li> <li>*LIBCRTAUT</li> <li>Session Traffic -</li> <li>No</li> <li>132</li> <li>Null Data Type Character Character Character</li> <li>Character</li> <li>Packed decimal Packed decimal</li> </ul>	Text Controller Description Name Line Description Name substr(OTETIM,3,2)    '/'    substr(OTETIM,7,2)    '.'    TOTLRUD / (TOTNRUD + 0.00001) (entrud/1000) / (ennrud+0.001) (entrud/1000) / (ennrud+0.001) (entrud/1000) / (ennrud+0.001) (intrud/1000) / (innrud+0.001) (intrud/1000) / (innrud+0.001) (intrud/1000) / (innrud+0.001) (intrud/1000) / (innrud+0.001)	substr(DTETIM,9,2
File Library Data in file For a new fi Authority Text about Print defini Output recor Field list: Field SCTLNM DATE TIME AVGRULENR ENLITM ENLITM ENLITM ELLITM INLITM			<ul> <li>*FILE</li> <li>Replace file</li> <li>*LIBCRTAUT</li> <li>Session Traffic -</li> <li>No</li> <li>132</li> <li>Null Data Type Character Character Character</li> <li>Character</li> <li>Character</li> <li>Packed decimal Packed decimal</li> <li>Packed decimal Packed decimal</li> <li>Packed decimal Packed decimal</li> <li>Packed decimal</li> </ul>	Text Controller Description Name Line Description Name substr(DTETIM,3,2)    '/'    substr(DTETIM,7,2)    ':'    TOTLRUB / (TOTNRUB + 0.00001) (ehtrud/1000)/(ehnrud+0.001) (ehtrud/1000)/(ehnrud+0.001) (intrud/1000)/(ehnrud+0.001) (intrud/1000)/(innrud+0.001) (intrud/1000)/(innrud+0.001) (intrud/1000)/(innrud+0.001) (intrud/1000)/(innrud+0.001) (intrud/1000)/(innrud+0.001) (intrud/1000)/(innrud+0.001) (intrud/1000)/(innrud+0.001)	

Figure 196. SNA\_LIN Qoery Definition, Part 3

## E.8 SNA\_TRQ

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5716QU1 V3R6	MO 950929 IBM Query/40	) SYSTEMO1	11/27/96	15:06:39	Page	1	
					3 -		
			4 i				
	SNA t	ransmission queue wait	time				
	age id						
	ry id						
*** . is Collating s	the decimal separator character for equence Hexad						
Processing							
	ing Yes (						
	cimal data errors No (d bstitution warnings Yes	efault)					
	ting for all compares No						
Special con							
*** All r Selected file	ecords selected by default ***						
ID File		Record Format					
T01 QAPM							
Result fields	IBM Query/40	)	11/27/96	15:06:39	Page	2	
Name	Expression	Column Heading	Len Deo	c			
DATE	substr(DTETIM,3,2)    '/'	Date					
TIME	substr(DTETIM,5,2) substr(DTETIM,7,2)    ':'	Time					
TINE	substr(DTETIM,9,2)	TTME					
ENTPQW	(enqtrr/1000)/(enqnr1+0.001)	EN NET					
		TPQ RU avg wt					
EHTPQW	(ehgtrr/1000)/(ehgnrl+0.001)	avg wt EN HIGH					
•		TPQ RU					
ENTROL	(	avg wt					
EMTPQW	(emqtrr/1000)/(emqnrl+0.001)	EN MED TPQ RU					
		avg wt					
ELTPQW	(elqtrr/1000)/(elqnrl+0.001)	EN LOW TPQ RU					
		avg wt					
INTPQW	(inqtrr/1000)/(inqnr1+0.001)	INM NET					
		TPQ RU avg wt					
IHTPQW	(ihqtrr/1000)/(ihqnr1+0.001)	INM HIGH					
		TPQ RU					
IMTPQW	(imqtrr/1000)/(imqnr1+0.001)	avg wt INM MED					
	(imqui / 1000)/ (imqui / 01001)	TPQ RU					
LI TROU	(i) - two (1000) ((i) - r - 1 + 0, 001)	avg wt					
ILTPQW	(ilqtrr/1000)/(ilqnrl+0.001)	INM LOW TPQ RU					
		avg wt					
TOTQLRE	enqlre + ehqlre + emqlre + elqlre + inglre + ihqlre + imqlre +	Total length RU entering					
	ilqlre	circering					
TOTQNRE	enqnre + ehqnre + emqnre + elqnre						
	+ inqnre + ihqnre + imqnre + ilqnre	entering					
	IBM Query/40	)	11/27/96	15:06:39	Page	3	
Result fields		Column Ha di					
Name AVGRULENE	Expression TOTQLRE / (TOTQNRE + 0.00001)	Column Heading Avg RU	Len Deo	C			
		length					
T070		entering					
TOTQLRL	enqlrl + ehqlrl + emqlrl + elqlrl + inqlrl + ihqlrl + imqlrl +	Total length RU leaving					
	ilqlrl						
TOTQNRL	enqnrl + ehqnrl + emqnrl + elqnrl						
	+ inqnrl + ihqnrl + imqnrl + ilqnrl	leaving					
AVGRULENL	TOTQLRL / (TOTQNRL + 0.00001)	Avg RU					
		length					
Ordering of s	elected fields	leaving					
Field	Sort Ascending/ Break						
Name SCTLNM	Priority Descending Level 10 A 1	Text Controller Description	Namo				
DATE	10 A 1	sonerorier bescription	Aune				
TIME							
AVGRULENE AVGRULENL							
ENTPQW							
EHTPQW							
EMTPQW ELTPQW							
INTPQW							
IHTPQW							
IMTPQW ILTPQW							
-							

Figure 197. SNA\_TRQ Query Definition, Part 1

.pore corumn l'	ormatting and		M Query/400 functions		1	1/27/	90 1	5:06:	2.2	Page	4
			age, 3-Minimum, 4-	Maximum, 5-	Count			0verr	ides		
Field	Summary	Column	• •			Null		Dec	Numeric		
Name	Functions		Column Headings	Len	Pos	Cap	Len	Pos	Editing		
SCTLNM		0	Controller	10							
			Description Name								
DATE		2	Date	5							
TIME		2	Time	5							
AVGRULENE		2	Avg RU	28	5		17	1			
			length								
			entering								
AVGRULENL		2	Avg RU	28	5		17	1			
			length leaving								
ENTPQW		2	EN NET	17	3						
2		-	TPQ RU		0						
			avg wt								
EHTPQW		2	EN HIGH	17	3						
			TPQ RU								
		_	avg wt								
EMTPQW		2	EN MED	17	3						
			TPQ RU avg wt								
ELTPQW		2	EN LOW	17	3						
			TPQ RU	-/	-						
			avg wt								
INTPQW		2	INM NET	17	3						
			TPQ RU								
THERDON		0	avg wt		~						
IHTPQW		2	INM HIGH TPQ RU	17	3						
			avg wt								
IMTPQW		2	INM MED	17	3						
			TPQ RU								
			avg wt								
			M Query/400		1	1/27/	96 1	5:06:	39	Page	5
			functions (continu		<b>.</b>			0			
Summary funct Field	Summary	Column	age, 3-Minimum, 4-	Maximum, 5-		Null		Overr	Numeric		
Name	Functions		Column Headings	Len		Cap	len		Editing		
ILTPQW	1 une e rons	2	INM LOW	17	3	cup	Len	103	Luiting		
			TPQ RU								
			avg wt								
port breaks											
Break New											
		eak									
Level Page	Summaries Te										
Level Page 3 O No 7	Summaries Te (es										
Level Page 3 O No 7 1 No 1	Summaries Te /es lo										
Level Page 2 0 No 2 1 No 1 Pected output	Summaries Te (es lo attributes	ext	Printer								
Level Page 2 0 No 2 1 No 1 Pected output Output type .	Summaries Te (es No attributes 	ext									
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Level Page 3 0 No 1 1 No 1 Plected output Uutput type . Form of output Line wrapping inter Output Printer device	Summaries Te (es No attributes 	••••••••••••••••••••••••••••••••••••••	Detail No								
Level Page 3 0 No 1 1 No 1 Plected output Output type . Form of output Line wrapping inter Output Printer device Report size	Summaries Te (es attributes  t	ext	Detail No *PRINT								
Level Page 3 0 No 1 1 No 1 1 ected output Output type . Form of outpur Line wrapping inter Output Printer device Report size Length .	Summaries Te (es attributes 		Detail No *PRINT 51 (default)								
Level Page : 0 No 1 1 No 1 1 cted output Output type . Form of output Line wrapping inter Output Printer device Report size Length	Summaries Te /es attributes 		Detail No *PRINT 51 (default) 300								
Level Page : 0 No 1 1 No 1 1ected output Output type . Form of output Line wrapping inter Output Printer device Report size Length Report start 1	Summaries Te fes No attributes 		Detail No *PRINT 51 (default) 300 6								
Level Page : 0 No 1 1 No 1 1 ected output Output type . Form of output Line wrapping inter Output Printer device Report size Width Report start 1 Report line sj	Summaries Te fes No attributes  attributes  attributes  attributes  attributes  attributes  attributes  attributes  attributes  attributes  attributes  attributes       		<ul> <li>. Detail</li> <li>. No</li> <li>. *PRINT</li> <li>. 51 (default)</li> <li>. 300</li> <li>. 6</li> <li>. 60</li> <li>. Single space</li> </ul>								
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Level Page 3 0 No 1 1 No 1 1 lected output Output type . Form of output Printer Output Printer device Report size Length . Width . Report line si Print definit	Summaries Te fes No attributes 		<ul> <li>. Detail</li> <li>. No</li> <li>. *PRINT</li> <li>. 51 (default)</li> <li>. 300</li> <li>. 6</li> <li>. 60</li> <li>. Single space</li> </ul>		1	1/27/	96 1	5:06:	39	Page	6
Level Page 2 0 No 1 1 No 1 lected output Output type . Form of output Line wrapping inter Output Printer devic. Report size Length Width Report start 1 Report start 1 Report time sj Print definit inter Spooled	Summaries Te fes 00 attributes 		Detail No *PRINT 51 (default) 300 6 60 Single space No M Query/400						39	Page	6
Level Page 3 0 No 1 1 No 1 lected output Output type Form of output Line wrapping inter Output Line wrapping inter Output Printer deut Report size Length Width Report end lin Report end lin Report line sy Printe definit inter Spooled Spool the outp	Summaries Te fes No attributes 		Detail No *PRINT 51 (default) 300 6 60 Single space No M Query/400 (Defaults to		int 1	file,	QPQUPF	(FIL)	39	Page	6
Level Page 0 No 1 No 1 Iour 1 lected output 0 output type . Form of output Printer Output Printer device Report size Length	Summaries Te fes No attributes  attributes  attributes  attribut  attribut  attribut  attribut  attribut  attributes       	ext	Detail No *PRINT 51 (default) 300 60 Single space No M Query/400 (Defaults to (Defaults to		int 1	file,	QPQUPF	RFIL)	39	Page	6
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Level Page 2 0 No 1 1 No 1 1 lected output Output type Form of output Line wrapping inter Output Line wrapping inter Output Report start 1 Report start 1 Report start 1 Report line spooled Spool the outp form type Copies	Summaries Te fes 40 attributes 	xxt	Detail No *PRINT 51 (default) 300 60 Single space No M Query/400 (Defaults to (Defaults to	value in pi	rint 1 rint 1	file, file,	QPQUPF QPQUPF	RFIL) RFIL)	39	Page	6
Level Page 0 No 1 No 1 No 1 elected output 0 output type . Form of output Form of output Printer Output Printer device. Report size Length	Summaries Teres	ext	Detail No *PRINT 51 (default) 300 6 Single space No M Query/400 (Defaults to 1 (Defaults to	value in pi	rint 1 rint 1	file, file,	QPQUPF QPQUPF	RFIL) RFIL)	39	Page	6
Level Page 2 0 No 1 1 No 1 1 lected output Output type Form of output Line wrapping inter Output Line wrapping inter Output Printer deut Report start 1 Report start 1 Report start 1 Report line s Report definit inter Spooled Spool the outp Form type Copies Wer Print cover put Cover page	Summaries Te fes No attributes 	ext	Detail No *PRINT 51 (default) 300 6 Single space No M Query/400 (Defaults to 1 (Defaults to	value in pi	rint 1 rint 1	file, file,	QPQUPF QPQUPF	RFIL) RFIL)	39	Page	6
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Level Page 2 0 No 1 1 No 1 1 Control C	Summaries         Term           Yes         No           attributes	xxt	Detail No *PRINT 51 (default) 300 60 Single space No M Query/400 (Defaults to 1 (Defaults to Yes	value in pi	rint 1 rint 1	file, file,	QPQUPF QPQUPF	RFIL) RFIL)	39	Page	6
Level Page 2 0 No 1 1 No 1 1 lected output Output type Form of output Line wrapping inter Output Line wrapping inter Output Width Report start 1 Report start 1 Report start 1 Report start 1 Report ine sp Print definit inter Spooled Spool the outp form type Covier page Print cover pi Cover page Print standare Page headings an	Summaries Te fes No attributes  e ine ine output output  Output output  age itle d footings I page headin g	xxt	Detail No *PRINT 51 (default) 300 60 Single space No M Query/400 (Defaults to 1 (Defaults to Yes	value in pi	rint 1 rint 1	file, file,	QPQUPF QPQUPF	RFIL) RFIL)	39	Page	6
Level Page 3 0 No 1 1 No 1 Plected output Output type . Form of output Line wrapping inter Output Printer device Report size Length Report start 1 Report end lin Report line sy Print definit Form type Copies Copies Ver Page Print cover p Cover page ge headings al Prage heading Page footing	Summaries Te fes No attributes 	xxt	Detail No *PRINT 51 (default) 300 60 Single space No M Query/400 (Defaults to 1 (Defaults to Yes	value in pi	rint 1 rint 1	file, file,	QPQUPF QPQUPF	RFIL) RFIL)	39	Page	6
Level Page 2 0 No 1 1 No 1 Pected output Output type Form of output Line wrapping inter Output Width Report size Length Width Report start 1 Report start 1 Report tend 1 Report tend 1 Report tend 1 Form type Copies Hold Ver Page Print cover page ge headings and Print standar Page heading Page heading Page heading	Summaries         Term           Yes         No           attributes	ext	Detail No *PRINT 51 (default) 300 6 Single space No M Query/400 (Defaults to (Defaults to (Defaults to (Defaults to (Defaults to Yes Yes	value in pi	rint 1 rint 1	file, file,	QPQUPF QPQUPF	RFIL) RFIL)	39	Page	б
Level Page 2 0 No 1 1 No 1 1 I No 1 1 1 I No 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1	Summaries Te fes No attributes  	ext	Detail No *PRINT 51 (default) 300 6 60 Single space No M Query/400 (Defaults to (Defaults to (Defaults to Yes Yes Yes	value in pi	rint 1 rint 1	file, file,	QPQUPF QPQUPF	RFIL) RFIL)	39	Page	6
Level Page 3 0 No 1 1 No 1 1 No 1 1 1 Interest of the second seco	Summaries Te fes No attributes 	ext	Detail No *PRINT 51 (default) 300 60 Single space No M Query/400 (Defaults to (Defaults to 1 (Defaults to Yes Yes SES2A COMMDTA	value in pi	rint 1 rint 1	file, file,	QPQUPF QPQUPF	RFIL) RFIL)	39	Page	6
Level Page 2 0 No 1 1 No 1 1 Control C	Summaries Te fes %0 attributes 	sxt	Detail No *PRINT 51 (default) 300 60 Single space No M Query/400 (Defaults to (Defaults to 1 (Defaults to Yes Yes SES2A COMMDTA	value in pi	rint 1 rint 1	file, file,	QPQUPF QPQUPF	RFIL) RFIL)	39	Page	6
Level Page 3 0 No 1 1 No 1 1 No 1 1 1 Internet of the second seco	Summaries Te fes No attributes 	ext	Detail No *PRINT 51 (default) 300 6 Single space No M Query/400 (Defaults to (Defaults to (Defaults to (Defaults to Yes Yes Yes SES2A COMMDTA . *FLLE Replace file	value in pi	rint 1 rint 1	file, file,	QPQUPF QPQUPF	RFIL) RFIL)	39	Page	6
Level Page 2 0 No 1 1 No 1 1 Control C	Summaries Te fes No attributes 	ext	Detail No *PRINT 51 (default) 300 6 Single space No M Query/400 (Defaults to (Defaults to (Defaults to (Defaults to Yes Yes Yes SES2A COMMDTA *FILE	value in pi	rint 1 rint 1	file, file,	QPQUPF QPQUPF	RFIL) RFIL)	39	Page	6
Level Page 0 No 1 No 1 Control No 1 Cont	Summaries Teres Veo attributes 	ext	Detail No *PRINT 51 (default) 300 6 Single space No M Query/400 (Defaults to (Defaults to (Defaults to (Defaults to Yes Yes Yes SES2A . COMMDTA . *FILE *LIBCRTAUT	value in pr	rint 1	file, file,	QPQUPF QPQUPF	RFIL) RFIL)	39	Page	6
Level Page 0 No 1 No 1 Control No 1 Control No 1 Control No 1 Control No 1 Control No 1 Control No No No No No No No No No No	Summaries Te fes No attributes 	ext	Detail No *PRINT 51 (default) 300 6 Single space No M Query/400 (Defaults to (Defaults to 1 (Defaults to Yes Yes Yes SES2A COMMDTA *FILE Replace file *LIBCRTAUT Session Traff	value in pr	rint 1	file, file,	QPQUPF QPQUPF	RFIL) RFIL)	39	Page	6

Figure 198. SNA\_TRQ Query Definition, Part 2

		IBM Query/400				11/27/96 15:06:39	Page 7	
Output file reco	ord format							
Output record	length .				122			
Field list:								
Field	Begin	Len	Dec	Null	Data Type	Text		
SCTLNM	1	10			Character	Controller Description Name		
DATE	11	5			Character	substr(DTETIM,3,2)    '/'	substr(DTETIM,5,2	
TIME	16	5			Character	substr(DTETIM,7,2)    ':'	substr(DTETIM,9,2	
AVGRULENE	21	28	5		Packed decimal	TOTQLRE / (TOTQNRE + 0.00001)		
AVGRULENL	36	28	5		Packed decimal	TOTQLRL / (TOTQNRL + 0.00001)		
ENTPQW	51	17	3		Packed decimal	(enqtrr/1000)/(enqnrl+0.001)		
EHTPQW	60	17	3		Packed decimal	(ehqtrr/1000)/(ehqnr1+0.001)		
EMTPQW	69	17	3		Packed decimal	(emqtrr/1000)/(emqnrl+0.001)		
ELTPQW	78	17	3		Packed decimal	(elqtrr/1000)/(elqnrl+0.001)		
INTPQW	87	17	3		Packed decimal	(inqtrr/1000)/(inqnr1+0.001)		
IHTPQW	96	17	3		Packed decimal	(ihqtrr/1000)/(ihqnrl+0.001)		
IMTPQW	105	17	3		Packed decimal	(imqtrr/1000)/(imqnr1+0.001)		
ILTPQW	114	17	3		Packed decimal	(ilqtrr/1000)/(ilqnrl+0.001)		
	* * * * *	F	ND	0 F	QUERY PRIN	T * * * * *		

Figure 199. SNA\_TRQ Query Definition, Part 3

## Appendix F. Integrated PC Server Query

#### F.1 Integrated PC Server Performance Monitor Data Queries

Figure 200 on page 346 shows the query definition when selecting "HPFS data" from Performance Monitor database file QAPMIOPD. Figure 201 on page 348 shows the query output for a specific collection of Integrated PC Server "HPFS data" from Performance Monitor database file QAPMIOPD. Refer to the *Work Management Guide* for field definitions. Field XIDTYP containing a "3" identifies HPFS data.

IBM Query/400 5763QU1 V3R1M0 940909 SYSNM116 3/13/95 16:53:36 Page 1 Library . . . . . . . . . . . . . . . DJOHNSON Query language id . . . . . . . . . . . . . ENU Query country id . . . . . . . . . . . . . . . . US  $^{\star\star\star}$  . is the decimal separator character for this query  $^{\star\star\star}$ Collating sequence . . . . . . . . . Hexadecimal Processing options Use rounding . . . . . . . . . . No Ignore decimal data errors . . . . No (default) Ignore substitution warnings . . . . Yes Use collating for all compares . . . Yes Selected files File Librarv Member Record Format ID T01 QAPMIOPD CPUTEST2 OAPMIOXR FSCITY2 Result fields Expression Column Heading Len Dec Name TOTALREADS XICTO1 + XICTO2 Total # 11 0 READS CACHEHITRD 100 \* XICTO1 / (XICTO1 + XICTO2) CACHE 5 2 HIT % READS TOTALWRITE XICTO3 + XICTO4 Total # 7 0 Writes CACHEHITWR 100 \* XICTO4 / (XICTO3 + XICTO4) 7 2 CACHE HIT WRITE Select record tests Value (Field, Numbers, or 'Characters') AND/OR Field Test XIDTYP '3' EQ AND 0 XICT01 GT AND XICT04 GT 0 IBM Query/400 3/13/95 16:53:36 Page 2 Ordering of selected fields Field Sort Ascending/ Break Field Name Priority Descending Level Text INTNUM Interval Number INTSEC Elapsed Interval Seconds XIIOPA IOP Bus Address XIDTYP Type of data in record TOTALREADS CACHEHITRD TOTALWRITE CACHEHITWR Counter 10 XICT10 XICT11 Counter 11 XICT01 Counter 01 XICT02 Counter 02 XICT03 Counter 03 XICT04 Counter 04 Report column formatting and summary functions Summary functions: 1-Total, 2-Average, 3-Minimum, 4-Maximum, 5-Count Overrides Field Summary Column Dec Null Dec Numeric Functions Spacing Column Headings Pos Cap Len Pos Editing Name Len INTNUM 0 Int 0 1 0 5 # INTSEC 7 0 5 1 0 Int Sec XIIOPA 1 IOP 3 0 Bus XIDTYP 1 1 Data Туре

Figure 200 (Part 1 of 2). QAPMIOPD File Query Definition - CACHE

TOTALREADS	1	0	Total #	11	0						
CACHEHITRD	2	0	READS CACHE	5	2		5	2			
			HIT % READS								
TOTALWRITE	1	0	Total # Writes	7	0						
CACHEHITWR	2	0	CACHE	7	2		7	2			
			HIT % WRITE								
XICT10	2	0	Files Opened	11	0		6	0			
XICT11	2	0	Files Closed	11	0		6	0			
XICT01	1	0	Read Reqs frm CACHE	11	0		11	0			
		IE	M Query/400		3/	13/95	16	5:53:36	Page	3	
		l summary	functions (continue			,					
Summary funct Field	ions: 1-Tota Summary	l, 2-Aver Column	age, 3-Minimum, 4-M		ount Dec N	ull	(	)verrides Dec Numeric			
Name			Column Headings		Pos C	ap L	en	Pos Editing			
XICT02	1	0	Read Reqs from DISK	11	0						
XICTO3	1	0	Write reqs from DISK	11	0						
XICT04	1	0	Write Reqs LAZY	11	0						
			Written								
Selected output	attributes										
Output type .			Printer								
Form of output	t		Detail								
Line wrapping											
Wrapping wid	1th		168								
Record on or	ne page		No								
Printer Output Printer device			PRT03								
Report size											
Report start											
Report end lir											
Report line sp	Dacing		Double space								
Print definit	ion		Yes								
Printer Spooled											
Spool the outp								>			
			(Defaults to v	value in pri	nt fil	e, QPQ	UPRI	·IL)			
Copies											
Hold		• • • • •	••• Tes								
Cover Page											
Print cover pa			Yes								
Cover page 8 Users L/		) - QAPMIO	)PD(HPFS) Read, Writ	e Cache, Fi	le Ope	n/Clos	e				
Page headings a	nd footings	IE	SM Query/400		3/	13/95	16	53:36	Page	4	
Print standard	d page headir	ıg	Yes								
Page heading		Sacha Stat	istics and File Ope								
LAN Server	, 100. 11113 0	ache stat	istics and rife ope	en/close							

Figure 200 (Part 2 of 2). QAPMIOPD File Query Definition - CACHE

						8		Server/400 QUERY NAME LIBRARY NA FILE QAPMIOPD DATE TIME	ME LIBRAF FSCITY	. HPFSCC . DJOHNS RY M Y2 C . 03/13/ . 16:53:	OOKO2 GON IEMBER SPUTEST2 95 37	FORMAT QAPMIOXR	le Open/Clos	56
									HFF\$386	Statisti	cs- Cook 02	-		
03/13/ Int		16:53: IOP	37		Total #	CACHE	L Total		400: HPFS Files	S Cache S Files		und File Ope	n/Close Write regs	PAGE 1 Write Regs
#		Bus	Data		READS	HIT %	Write						from DISK	LAZY
и	500	bus	Type		READS	READS	WITCO	WRITE		eroscu	TTIM CROTE	TTOM DISK	TTOM DISK	Written
1	301	2			95,347	87.41	6,9	33 100.00	995	975	83,351	11,996	0	6,933
2	298	2	3		232,309	95.12	3,1	36 100.00	3,969	3,974	220,981	11,328	0	3,136
3	298	2	3		222,045	93.72	7,5	37 99.98	3,980	3,995	208,117	13,928	1	7,536
		F	INAL T	OTALS										
			OTAL		549,701		17,6				512,449	37,252	1	17,605
			VG			92.08		99.99	2,981	2,981				
* * *	ΕN	D 0	FRE	PORT	* * *									

Figure 201. QAPMIOPD File Query Report - CACHE

Figure 202 on page 349 shows the query definition when selecting "CPU data" from Performance Monitor database file QAPMIOPD. Figure 203 on page 350 shows the query output for a specific collection of Integrated PC Server "CPU data" from Performance Monitor database file QAPMIOPD. Refer to the *Work Management Guide* for field definitions. Field XIDTYP containing a "2" identifies Integrated PC Server CPU data.

5763QU1 V3R1M0 940909 IBM Query/400 SYSNM116 3/22/95 13:59:07 1 Page Library . . . . . . . . . . . . . . . DJOHNSON Query language id . . . . . . . . . ENU Query country id . . . . . . . US \*\*\* . is the decimal separator character for this query \*\*\* Collating sequence . . . . . . . . . . . . Hexadecimal Processing options Use rounding . . . . . . . . . . No Ignore decimal data errors . . . . No (default) Ignore substitution warnings . . . Yes Use collating for all compares . . . Yes Selected files File ID Library Member Record Format T01 QAPMIOPD FSCITY2 BAP8WS64MB OAPMIOXR Result fields Len Dec Name Expression Column Heading CPU486INT ((XICT01 / 1000) / INTSEC) \* 100 486 CPU % 7 1 Utilization XICTOISECS XICTO1 / 1000 486 CPU 7 1 Seconds Select record tests AND/OR Field Test Value (Field, Numbers, or 'Characters') XIDTYP ′2′ E0 AND 0 XICT01 NE Ordering of selected fields Ascending/ Break Field Field Sort Name Priority Descending Level Text INTNUM Interval Number IBM Query/400 3/22/95 13:59:07 Page 2 Ordering of selected fields (continued) Field Sort Ascending/ Break Field Priority Descending Level Name Text XIIOPA IOP Bus Address XIDTYP Type of data in record IOP Type XITYPE Elapsed Interval Seconds INTSEC XICT01SECS CPU486INT Report column formatting and summary functions Summary functions: 1-Total, 2-Average, 3-Minimum, 4-Maximum, 5-Count Overrides Field Summary Column Dec Null Dec Numeric Column Headings Name Functions Spacing Len Pos Cap Len Pos Editing INTNUM 0 Int 5 0 1 0 # XIIOPA 1 IOP 3 0 Bus XIDTYP 1 Data 1 Type (0S/2)XITYPE 2 ÍOP 4 Type INTSEC 1 7 5 0 1 Interval 0 Seconds XICT01SECS 1 2 486 CPU 7 1 Seconds CPU486INT 2 2 486 CPU 7 1 4 1 Utilization (%)

Figure 202 (Part 1 of 2). QAPMIOPD File Query Definition - CPU

Selected output attributes Output type . . . . . . . . . . . . . Printer Form of output . . . . . . . . . . Detail Line wrapping . . . . . . . . . . . No 3/22/95 13:59:07 IBM Query/400 Page 3 Printer Output Printer device . . . . . . . . . . \* PRINT Report size Printer Spooled Output Spool the output  $\hdots$  . . . . . . . . . . Yes Hold . . . . . . . . . . . . . . . . Yes Cover Page Print cover page . . . . . . . . . . Yes Cover page title 8 Users Interconnected - FSIOP CPU Page headings and footings Print standard page heading . . . . . Yes Page heading 8 Interconnected LAN Server/400 Clients - FSIOP CPU Page footing

Figure 202 (Part 2 of 2). QAPMIOPD File Query Definition - CPU

						QUERY NAME LIBRARY NAM	Jsers Intercor CPL 4EDJC	J486COOK DHNSON		
						FILE QAPMIOPD	LIBRARY FSCITY2	MEMBE	к S64MB	FORMAT QAPMIOXR
						•	03/		304MD	VALINITORY
							13:			
						FSIO	P 486 CPU Util	ization	t Stati	stics
03/	22/95	13:59	:07 8	Interconnected	LAN	Server/400	Clients - FSI	OP CPU	PAGE	1
Int	IOP	Data	IOP	Interval		486 CPU	486 CPU			
#	Bus	Туре	Туре	Seconds		Seconds	Utilization			
		(OS/2)					(%)			
1	2	2	6506	298		93.8	31.4			
2	2	2	6506	296		131.4	44.4			
3	2	2	6506	299		120.6	40.3			
4	2	2	6506	197		47.1	23.9			
			FINAL	TOTALS						
			TOTAL	1,090		392.9				
			AVG				35.0			
* *	* E	ND 0	FRI	EPORT **	*					

Figure	203	QAPMIOPD	Filo	QUARV	Renart	- CPU
riguie	205.	QAFINIOFD	File	Query	кероп	- 0-0

## Appendix G. AnyNet Queries

This section contains query examples to help you measure the AnyNet performance. There is no consolidated information about AnyNet. The performance investigation for AnyNet is done by gathering both SNA and TCP/IP (Sockets) information.

#### G.1 Sockets over SNA Queries

The files QAPMSNA and QAPMJOBS are used.

This is the main field used to select records from QAPMSNA file:

SCTLNM Controller Description Name

These are the main fields used to select records from QAPMJOBS file:

JBSKSC Number of Socket Sends

JBSKRC Number of Socket Receives

Refer to Chapter 13, "AnyNet" on page 197 for a more detailed explanation.

### G.1.1 SNA Query

```
Collating sequence . . . . . . . . . Hexadecimal
  Processing options
   Selected files
  ID File
TO1 QAPMSNA
                 Library Member Record Fo
QPFRDATA IPOVERSNA2 QAPMSNAR
                                           Record Format
Result fields
          Expression
                                        Column Heading
                                                           Len Dec
  Name
            substr(DTETIM,3,2) || '/' ||
  DATE
                                     Date
            substr(DTETIM,5,2)
substr(DTETIM,7,2) || ':' ||
  TIME
                                     Time
            substr(DTETIM,9,2)
Select record tests
                        Test Value (Field, Numbers, or 'Characters')
  AND/OR Field
SCTLNM
                       EQ
                               ′MO5ETH′
Ordering of selected fields
              Sort Ascending/ Break Field
  Field
  Name
               Priority Descending Level Text
  TNTNUM
                                       Interval Number
  DATE
  TIME
  INTNUM
                                       Interval Number
  INTSEC
                                       Elapsed Interval Seconds
                                       Controller Description Name
Line Description Name
  SCTLNM
  SLINNM
  STSKNM
                                       T2 Station I/O Manager Task Name
  SLIOMT
                                       Line I/O Manager Task Name
The rest of the query as SNA_ALL in Appendix E.
```

Figure 204. SNA\_ALL Query for One Specific Controller Description

#### G.1.2 Sockets Jobs Query

```
Library . . . . . . . . . . . . . . ANYNET
 Query text . . . . . . . . . . . . . . . Selects Jobs where there is socket activity
 Collating sequence . . . . . . . . . Hexadecimal
 Processing options
   Use rounding . . . . . . . . . . . Yes (default)
Ignore decimal data errors . . . . No (default)
   Ignore substitution warnings . . . . Yes
   Use collating for all compares . . . Yes
Selected files
 TD
        File
                       Library
                                     Member
                                                    Record Format
                                 Menu.
PUREIP
 T01
        OAPMJOBS
                       OPFRDATA
                                                   OAPMJOBR
Result fields
                                                Column Heading
 Name
            Expression
                                                                        Len Dec
 DATE
             substr(DTETIM,3,2) || '/' ||
                                                Date
             substr(DTETIM,5,2)
substr(DTETIM,7,2) || ':' ||
 TIME
                                                Time
             substr(DTETIM,9,2)
Select record tests
 AND/OR Field
                            Test
                                     Value (Field, Numbers, or 'Characters')
          JBSKSC
                            NE
                                     0
  OR
          JBSKRC
                            NF
                                     0
Ordering of selected fields
 Field
                 Sort
                          Ascending/ Break Field
                 Priority Descending Level
 Name
                                              Text
 TNTNUM
                                              Interval Number
 DATE
 TIME
 INTSEC
                                              Elapsed Interval Seconds
                                               Number of Socket Sends
 JBSKSC
 JBSKRC
                                               Number of Socket Receives
 JBSSYS
                                              Subsystem Name
                                               Library Name
 JBSLIB
 .1RNAME
                                               Job Name
                                               Job User
 JBUSER
 JBNBR
                                               Job Number
 JBACCO
                                               Job Accounting Code
                                               Job Type
 JBTYPE
                                               Job Subtype
 JBSTYP
 JBTTYP
                                               Task type
 JBTTYE
                                               Task type extender
                                              Job Flag
S/36 Environment
 JBELAG
 JBS36E
 JBPOOL
                                               Job Pool
 JBPRTY
                                               Job Priority
 JBCPU
                                               CPU Milliseconds
 JBRSP
                                              Total Response Seconds
Timeslice in Milliseconds
 JBSLC
 JBNTR
                                               Interactive Transactions
 JBDBR
                                              Physical Database Reads
 JBNDB
                                               Physical Non Database Reads
 JBWRT
                                              Physical Writes
                                              Active to Wait Transitions
 JBAW
  JBWI
                                               Wait to Ineligible Transitions
 JBAI
                                              Active to Ineligible Transitions
                                               Lines to be Printed
 JBPLN
 JBPPG
                                               Pages to be Printed
                                              Files to be Printed
 JBPFL
 JBLWT
                                               Logical Database Writes
                                              Logical Database Reads
Miscellaneous Database Operations
 JBI RD
 JBDBU
 JBCPT
                                               Communications Puts
 JBCGT
                                              Communications Gets
 JBSPD
                                               Job Suspend Time
 JBRRT
                                               Job Reroute Time
 JBLND
                                              Line Description
 JBCUD
                                               Control Unit Description
 JB21 ND
                                               Secondary Line Description
 JB2CUD
                                               Secondary Control Unit
 JBNDW
                                               Synchronous Non Database Writes
 JBDBW
                                               Synchronous Database Writes
 JBANDW
                                               Asynchronous Non Database Writes
 JBADBW
                                               Asynchronous Database Writes
 JBANDR
                                              Asynchronous Non Database Reads
 JBADBR
                                               Asynchronous Database Reads
```

Figure 205. SOCK\_JOB Query, Part 1

Field	elected fields Sort	Ascending/	Break	Field
Name		Descending		
JBPW				Permanent Writes
JBPAGF				PAG Faults
JBOBIN				Binary Overflows
JBODEC				Decimal Overflows
JBOFLP				Floating Point Overflows
JBIPF				I/O Pending Faults
JBWIO				Waits For Asynchronous I/O
JBIRN				IOP Resource Name
JBDRN				Device Resource Name
JBPORT				Workstation Port Number
JBSTN				Workstation Station Number
JBPTSF				Pass-Through Source Flag
JBPTTF				Pass-Through Target Flag
JBEAF				Emulation Active Flag
JBPCSF				Client Access/400 Application Flag
JBDDMF				Target DDM Job Flag
JBMRTF				MRT Flag
JBROUT				Routing Entry Index
				Total Application Input Queuing Time
JBAIQT JBNAIQ				
				Application Queuing Transactions
JBRUT				Total Resource Usage Time
JBNRU				Resource Usage Transactions
JBQT				Total Queuing Time to Enter the MRT
JBMMT				Total Time Spent at MRTMAX Number of Entries Into the MRT
JBNEQT				
JBPUTN				Number of Puts
JBPUTA				Amount of Data Sent
JBGETN				Number of Gets
JBGETA				Amount of Data Received
JBPGIN				Number of Intervals Between First Put and CD
JBPGIL				Total Time Spent Between First Put and CD
JBGGIL				Total Time Spent Between First Gets
JBRTI				Number of REQIOs to Transmit Data
JBRRI				Number of REQIOs to Receive Data
JBSZWT				Total Seize/Wait Time in Milliseconds
JBSKBS				Number of Socket Bytes Sent
JBSKBR				Number of Socket Bytes Received
JBXRFR				Stream file reads
JBXRFW				Stream file writes
JBXSLR				File system symbolic link reads
JBXDYR				File system directory reads
JBDLCH				File system lookup cache hits
JBDLCM				File system lookup cache misses
JBSJNM				Submitter's job name
JBSJUS				Submitter's job user

Figure 206. SOCK\_JOB Query, Part 2

	formatting and		age, 3-Minimum, 4-Ma	vimum 5-	Count			Overr	ides	
Field	Summary	Column	age, 5-mmmum, 4-ma	× mum, 5-		Null			Numeric	
Name			Column Headings	len			lon		Editing	
INTNUM	Tuncerons	0	corumn neadrings	5	0	cup	LCII	103	Eureing	
11111011		0	Interval	5	0					
			Number							
DTETIM		2	Interval	12						
DIEIIN		2	Date	12						
			Time							
INTSEC		2	Elapsed	7	0					
1111020		-	Interval	,	0					
			Seconds							
JBSKSC		2		11	0					
			Socket							
			Sends							
JBSKRC		2		11	0					
			Socket							
			Receives							
JBSSYS		2		10						
			Subsystem							
			Name							
JBSLIB		2		10						
			Library							
			Name							
JBNAME		2		10						
			Job							

Figure 207. SOCK\_JOB Query, Part 3

JBUSER	2		10			
5555LN	2	Job	10			
		User				
JBNBR	2		6			
		Job Number				
JBACCO	2	Job	15			
		Accounting				
		Code	_			
JBTYPE	2	Job	1			
		Туре				
JBSTYP	2	1990	1			
		Job				
107710		Subtype				
JBTTYP	2	Task	2			
		Type				
JBTTYE	2	Task	2			
		Туре				
1051.40		Extender				
JBFLAG	2	Job	2			
		Flag				
JBS36E	2		1			
		S/36				
JBPOOL	2	Environment	2			
OBPOUL	2	Job	2			
		Pool				
JBPRTY	2		3			
		Job				
JBCPU	2	Priority	11	0		
00000	2	CPU	11	U		
		Milliseconds				
JBRSP	2	Total	15	3		
		Response				
JBSLC	2	Seconds Timeslice	11	0		
00000	2	in	11	0		
		Milliseconds				
JBNTR	2		11	0		
		Interactive				
JBDBR	2	Transactions Physical	11	0		
ODDDIN	-	Database		0		
		Reads				
JBNDB	2	Physical	11	0		
		Non Database				
JBWRT	2	Reads	11	0		
	L	Physical		v		
		Writes				
JBAW	2	Active	11	0		
		to Wait				
JBWI	2	Transitions Wait to	11	0		
	L	Ineligible	**	v		
		Transitions				
JBAI	2	Active to	11	0		
		Ineligible Transitions				
JBPLN	2	Lines	11	0		
	L	to be		v		
		Printed				
JBPPG	2	Pages	11	0		
		to be Printed				
JBPFL	2	Printed Files	11	0		
	L	to be		v		
		Printed				
JBLWT	2	Logical	11	0		
		Database Writes				
JBLRD	2	Writes Logical	11	0		
	L	Database		v		
		Reads				
JBDBU	2	Miscellaneous	11	0		
		Database Operations				
JBCPT	2	operations	11	0		
	-	Communications		-		
		Puts				

Figure 208. SOCK\_JOB Query, Part 4

JBCGT	2	Communications	11	0		
		Gets				
JBSPD	2	Job	11	0		
		Suspend				
JBRRT	2	Time Job	11	0		
JDKKI	2	Reroute	11	U		
		Time				
JBLND	2		10			
		Line				
JBCUD	2	Description Control	10			
00000	-	Unit	10			
		Description				
JB2LND	2	Secondary	10			
		Line Description				
JB2CUD	2	Secondary	10			
		Control				
		Unit				
JBNDW	2	Synchronous	11	0		
		Non Database Writes				
JBDBW	2	Synchronous	11	0		
		Database				
		Writes				
JBANDW	2	Asynchronous Non Database	11	0		
		Writes				
JBADBW	2	Asynchronous	11	0		
		Database				
		Writes				
JBANDR	2	Asynchronous Non Database	11	0		
		Reads				
JBADBR	2	Asynchronous	11	0		
		Database				
1000		Reads				
JBPW	2	Permanent	11	0		
		Writes				
JBPAGF	2		11	0		
		PAG				
JBOBIN	2	Faults	11	0		
JEODIN	2	Binary	11	U		
		Overflows				
JBODEC	2		11	0		
		Decimal Overflows				
JBOFLP	2	Floating	11	0		
000121	-	Point		0		
		Overflows				
JBIPF	2	I/0	11	0		
		Pending Faults				
JBWIO	2	Faults Waits For	11	0		
	-	Asynchronous		-		
		I/0				
JBIRN	2	IOP	10			
		Resource Name				
JBDRN	2	Device	10			
	-	Resource				
		Name				
JBPORT	2	Workstation Port	3	0		
		Port Number				
JBSTN	2	Workstation	3	0		
		Station				
		Number				
JBPTSF	2	Pass-Through Source	1	0		
		Source Flag				
JBPTTF	2	Pass-Through	1	0		
		Target				
		Flag				
JBEAF	2	Emulation	1	0		
		Active Flag				
JBPCSF	2	CA4	1	0		
		Application				
		Flag				

Figure 209. SOCK\_JOB Query, Part 5

JBDDMF	2	Target DDM Job	1	0		
		Flag				
JBMRTF	2		1	0		
		MRT				
JBROUT	2	Flag Routing	5	0		
JERUUT	2	Entry	5	U		
		Index				
JBAIQT	2	Total	11	0		
		Application Input				
		Queuing Time		_		
JBNAIQ	2	Application Queuing	11	0		
		Transactions				
JBRUT	2	Total	11	0		
		Resource				
		Usage Time				
JBNRU	2	Resource	11	0		
		Usage Transactions				
JBQT	2	Total	11	0		
0001	-	Queuing Time to		0		
		Enter the MRT				
JBMMT	2	Total Time	11	0		
		Spent				
JBNEQT	2	at MRTMAX Number of	11	0		
JENEQI	2	Entries Into	11	U		
		the MRT				
JBPUTN	2	Number	11	0		
		of				
		Puts				
JBPUTA	2	Amount of Data	11	0		
		Sent				
JBGETN	2	Number	11	0		
		of				
		Gets				
JBGETA	2	Amount	11	0		
		of Data Received				
JBPGIN	2	Number of Intervals	11	0		
		From First Put				
		to CD				
JBPGIL	2	Time From	11	0		
		First Put to CD				
JBGGIL	2	Total Time	11	0		
obduit	-	Spent Between		Ū		
		First Gets				
JBRTI	2	Number of	11	0		
		REQIOs to				
JBRRI	2	Transmit Data Number of	11	0		
ODKRI	2	Number of REQIOs to	11	U		
		Receive Data				
JBSZWT	2	Total	11	0		
		Seize/Wait				
105405		Time		0		
JBSKBS	2	Socket Bytes	11	0		
		Sent				
JBSKBR	2	Socket	11	0		
		Bytes				
		Received				
JBXRFR	2	Stream	11	0		
		File Reads				
JBXRFW	2	Stream	11	0		
	2	File		J.		
		Writes				
JBXSLR	2	File System	11	0		
		Symbolic Link				
JBXDYR	2	Reads File System	11	0		
UDADIK	2	File System Directory	11	U		
		Reads				
JBDLCH	2	File System	11	0		
		Lookup				
		Cache Hits				

Figure 210. SOCK\_JOB Query, Part 6

		Lookup Cache Misses	11	0
JBSJNM	2	Submitter Job Name	10	
JBSJUS	2	Submitter Job User	10	
JBSJNB	2	Submitter Job	6	

Figure 211. SOCK\_JOB Query, Part 7

\_

### G.2 APPC over TCP/IP Queries

The QAPMSNA and QAPMJOBS files are used.

This is the main field used to select records from QAPMSNA file:

SCTLNM Controller Description Name

These are the main fields used to select records from QAPMJOBS file:

- **JBCPT** Number of Socket Sends
- JBCGT Number of Socket Receives

Refer to Chapter 13, "AnyNet" on page 197 for a more detailed explanation.

### G.2.1 SNA Query

The same SNA Query listed in the previous section of this chapter can be used for APPC over TCP/IP.

### G.2.2 APPC Jobs Query

```
Collating sequence ..... Hexadecimal
Processing options
Use rounding .... Yes (default)
Ignore decimal data errors .... No (default)
Ignore substitution warnings .... Yes
Use collating for all compares ... Yes
Selected files
                      Library Member Record Fo
QPFRDATA SNAOVERIP1 QAPMJOBR
 ID File
TO1 QAPMJOBS
                                                           Record Format
Result fields
               Expression Column Heading
substr(DTETIM,7,2) || ':' || Date
            Expression
                                                                                 Len Dec
 Name
 DATE
               substr(DTETIM,9,2)
substr(DTETIM,7,2) || ':' ||
 TIME
                                                    Time
               substr(DTETIM,9,2)
Select record tests
 AND/OR Field
JBCPT
                                 Test Value (Field, Numbers, or 'Characters')
                                 NE
                                          0
  OR
          JBCGT
                                 NE
                                           0
Ordering of selected fields
                    Sort Ascending/ Break Field
Priority Descending Level Text
 Field
  Name
 INTNUM
                                                      Interval Number
 DATE
  TIME
                                                      Elapsed Interval Seconds
Subsystem Name
 INTSEC
  JBSSYS
  JBSLIB
                                                      Library Name
  JBNAME
                                                      Job Name
  JBUSER
                                                      Job User
  JBNBR
                                                      Job Number
  Follows the same as Sockets Jobs Query (SOCK_JOB) in this same chapter.
```

Figure 212. SNA\_JOB Query

### Appendix H. ISDN Queries

This appendix provides query definitions that can be used to examine X.25 environments. All of the queries use input from the OS/400 Performance Monitor and run with trace options. There are eight queries defined:

- NWI\_ALL
- NWI\_CALLS
- NWI\_ERRORS
- NWI\_IOP
- NWI\_LAPD
- IDLC-ALL
- · IDLC-IOP
- IDLC-UTIL

The NWI\_ALL and IDLC\_ALL queries are simple. They show you all of the values in the QAPMLAPD and QAPMIDLC files, respectively. The only thing you have to define is the file name and member name that contains the performance data. Most of the rest are defaults so it takes you only a few minutes to create these queries. Please note that there are several fields in the QAPMIDLC file so the print lines are longer than the maximum line length permitted by Query/400 (378 characters); therefore, the print lines in the IDLC\_ALL query are wrapped. Other queries might also have longer lines than your printer can handle so check the maximum print position (MPP) allowed by your printer and adjust the line length in the queries accordingly.

The NWI\_CALLS query shows you the number of incoming and outgoing calls and call errors.

The NWI\_ERRORS query shows you the D-channel utilization and the physical errors on the network interface.

The NWI\_IOP query shows you the IOP utilization by the network interface.

The NWI\_LAPD query shows you the most important performance values of the D-channel usage.

The IDLC\_IOP query shows you the IOP utilization by the network interface.

The IDLC\_UTIL query shows you the most important performance values of the B-channel usage.

## H.1 NWI\_ALL

	V3R6M0		IB1	4 Query/4 NWI	
Query t	text			All	NWI performance fields
					decimal
	sing opti				
				Yes	(default)
			ors		
			nings		
			ompares .		
	l conditi				
			d by defau	+ ***	
, Gelected		as sciecce	a by actua		
	File	Lib	rary	Member	Record Format
T01	QAPMLAPD		RDATA	Q9629810	
		ted fields		Q3023010	
Field	or seree	Sort	Ascending,	Brook	Field
Name			Descending		
INTNUM		20	A	JLEVEI	Interval number
DTETIM		20	A		
					Interval date and time: yymmddhhmmss Elapsed interval seconds
INTSEC					
IOPRN					IOP Resource Name
LDIOP					Reserved
LDTYPE		10			IOP Type
LDNWI		10	A	1	Network interface description
LDLSP					Line speed: in bits per second
LDPRCL					Protocol: always D-ISDN D channel data
LPLOFA					Loss of frame alignment
LPLECV					Local end code violation
LPDTSI					Detected access transmission error in
LPDTSO					Detected access transmission error out
LPFECV					Far end code violation
LPES					Errored seconds
LPSES					Severely errored seconds
LPCOL					Collision detect
				1 Query/4	00 11/17/96 20:10:03 Page 2
Ordering	of selec	ted fields	(continue	i)	
Field		Sort	Ascending	/ Break	Field
Name		Priority	Descending	g Level	Text
LLCRCE		-			Receive CRC errors
LLSFE					Short frame errors
LLORUN					Receive overrun
LLURUN					Transmit underrun
LLABRT					Aborts received
LLFRIE					Frames received in error
LSFRT					Retransmitted frames
LSSEQE					Sequence errors
LSFTRN					Frames transmitted
LSFRCV					Frames received
LSBTRN					Bytes transmitted
LSBRCV					Bytes received
LOTOC					Total outgoing calls
LQTOC					
					Retry for outgoing calls
LQTIC					Total incoming calls
LQRIC	,				Retry for incoming calls
LDCHLSI				e	S1 maintenance channel: 0-not active, 1-active
			d summary		dimment Manufacture Constant of the
	y functio			age, 3-Mi	nimum, 4-Maximum, 5-Count Overrides
Field		Summary	Column		Dec Null Dec Numeric
Name		Functions	Spacing	Column H	eadings Len Pos Cap Len Pos Editing
INTNUM			0		5 0
				Interval	
				Number	
DTETIM			2	Interval	12
				Date	
				and time	
INTSEC			2	Elapsed	7 0
				Interval	
				Seconds	
IOPRN			2	IOP	10
				Resource	
				Name	
LDIOP			2		1
				Reserved	
LDTYPE			2		4
LUIITE			-	IOP	7
LDNUT				Type	10
LDNWI			2	Network	10
				Interfac	
LDLSP				Descript	
			2		11 0
LDLSP					
LDL3P				Line Speed	

Figure 213. NWI\_ALL Query Definition, Part 1

	6		M Query/400	۲۰	1	1/17/9	6 2	20:10:	03	Page	3	
			functions (continue age, 3-Minimum, 4-M		Count			0	idee			
Summary func Field		Column	age, 3-Minimum, 4-M	1X1mum, 5-		Null		Overr	Numeric			
Name			Column Headings	len		Cap	len		Editing			
LDPRCL		2	····	1								
			Protocol									
PLOFA		2	Loss of	11	0							
			Frame									
			Alignment									
LPLECV		2	Local	11	0							
			End code Violation									
_PDTSI		2	Detected access	11	0							
_FD131		2	Transmission	11	0							
			Error in									
LPDTSO		2	Detected Access	11	0							
			Transmission									
			Error out									
_PFECV		2	Far	11	0							
			End code									
_PES		2	Violation	5	0							
Lr CJ		4	Errored	5	U							
			Seconds									
PSES		2	Severely	5	0							
			Errored	5	5							
			Seconds									
PCOL		2		11	0							
			Collision									
			Detect									
LCRCE		2	Receive	11	0							
			CRC									
LLSFE		2	Errors Short	11	0							
LJFE		4	Snort Frame	11	U							
			Errors									
LORUN		2		11	0							
			Receive		5							
			Overrun									
LLURUN		2		11	0							
			Transmit									
			Underrun									
LABRT		2		11	0							
			Aborts									
		2	Received Frames		~							
LLFRIE		2	Frames Received	11	0							
			in error									
LSFRT		2		11	0							
			Retransmitted									
			Frames									
		TD	M Query/400		1	1/17/9	6 2	20:10:	03	Page	4	
				4)								
	formatting and	summary			-							
Summary func	tions: 1-Total	summary I, 2-Aver	functions (continue) age, 3-Minimum, 4-M					0verr				
Summary func Field	tions: 1-Total Summary	summary I, 2-Aver Column	age, 3-Minimum, 4-M	aximum, 5-	Dec	Null	1	Dec	Numeric			
Summary func Field Name	tions: 1-Total Summary Functions	summary I, 2-Aver Column Spacing		aximum, 5- Len	Dec Pos		Len	Dec				
Summary func Field Name	tions: 1-Total Summary Functions	summary I, 2-Aver Column	age, 3-Minimum, 4-M Column Headings	aximum, 5-	Dec	Null	Len	Dec	Numeric			
Summary func Field Name	tions: 1-Total Summary Functions	summary I, 2-Aver Column Spacing	age, 3-Minimum, 4-M	aximum, 5- Len	Dec Pos	Null	Len	Dec	Numeric			
Summary func Field Name _SSEQE	tions: 1-Total Summary Functions	summary I, 2-Aver Column Spacing	age, 3-Minimum, 4-M Column Headings Sequence	aximum, 5- Len	Dec Pos	Null	Len	Dec	Numeric			
Summary func Field Name _SSEQE	tions: 1-Total Summary Functions	summary I, 2-Aver Column Spacing 2	age, 3-Minimum, 4-M Column Headings Sequence	aximum, 5- Len 11	Dec Pos O	Null	Len	Dec	Numeric			
Summary func Field Name _SSEQE	tions: 1-Total Summary Functions	summary I, 2-Aver Column Spacing 2	age, 3-Minimum, 4-M Column Headings Sequence Errors	aximum, 5- Len 11	Dec Pos O	Null	Len	Dec	Numeric			
Summary func Field Name _SSEQE _SFTRN	tions: 1-Total Summary Functions	summary I, 2-Aver Column Spacing 2	age, 3-Minimum, 4-M Column Headings Sequence Errors Frames Transmitted	aximum, 5- Len 11	Dec Pos O	Null	Len	Dec	Numeric			
Summary func Field Name _SSEQE _SFTRN	tions: 1-Total Summary Functions	summary I, 2-Aver Column Spacing 2 2	age, 3-Minimum, 4-M Column Headings Sequence Errors Frames Transmitted Frames	aximum, 5- Len 11 11	Dec Pos O	Null	Len	Dec	Numeric			
Summary func Field Lame LSSEQE LSFTRN LSFRCV	tions: 1-Total Summary Functions	summary I, 2-Aver Column Spacing 2 2	age, 3-Minimum, 4-M Column Headings Sequence Errors Frames Transmitted	aximum, 5- Len 11 11 11	Dec Pos O O	Null	Len	Dec	Numeric			
Summary func Field Lame LSSEQE LSFTRN LSFRCV	tions: 1-Total Summary Functions	summary I, 2-Aver Column Spacing 2 2	age, 3-Minimum, 4-M Column Headings Sequence Errors Frames Transmitted Frames Received	aximum, 5- Len 11 11	Dec Pos O	Null	Len	Dec	Numeric			
Summary func Field Lame LSSEQE LSFTRN LSFRCV	tions: 1-Total Summary Functions	summary I, 2-Aver Column Spacing 2 2	age, 3-Minimum, 4-M Column Headings Sequence Errors Frames Transmitted Frames Received Bytes	aximum, 5- Len 11 11 11	Dec Pos O O	Null	Len	Dec	Numeric			
Summary func Field Name _SSEQE _SFTRN _SFRCV _SBTRN	tions: 1-Total Summary Functions	summary J, 2-Aver Column Spacing 2 2 2 2	age, 3-Minimum, 4-M Column Headings Sequence Errors Frames Transmitted Frames Received	aximum, 5- Len 11 11 11 11	Dec Pos 0 0 0	Null	Len	Dec	Numeric			
Summary func Field Name _SSEQE _SFTRN _SFRCV _SBTRN	tions: 1-Total Summary Functions	summary I, 2-Aver Column Spacing 2 2	age, 3-Minimum, 4-M Column Headings Sequence Errors Frames Transmitted Frames Received Bytes Transmitted	aximum, 5- Len 11 11 11	Dec Pos O O	Null	Len	Dec	Numeric			
Summary func Field Name _SSEQE _SFTRN _SFRCV _SBTRN	tions: 1-Total Summary Functions	summary J, 2-Aver Column Spacing 2 2 2 2	age, 3-Minimum, 4-M Column Headings Sequence Errors Frames Transmitted Frames Received Bytes Transmitted Bytes	aximum, 5- Len 11 11 11 11	Dec Pos 0 0 0	Null	Len	Dec	Numeric			
Summary func Field Name LSSEQE LSFTRN LSFRCV LSBTRN LSBRCV	tions: 1-Total Summary Functions	summary , 2-Aver Column Spacing 2 2 2 2 2 2 2	age, 3-Minimum, 4-M Column Headings Sequence Errors Frames Transmitted Frames Received Bytes Transmitted Bytes Received	aximum, 5- Len 11 11 11 11	Dec Pos 0 0 0	Null	Len	Dec	Numeric			
Summary func Field Name LSSEQE LSFTRN LSFRCV LSBTRN LSBRCV	tions: 1-Total Summary Functions	summary J, 2-Aver Column Spacing 2 2 2 2	age, 3-Minimum, 4-M Column Headings Sequence Errors Frames Transmitted Frames Received Bytes Transmitted Bytes Received Total	aximum, 5- Len 11 11 11 11 11	Dec Pos 0 0 0 0 0	Null	Len	Dec	Numeric			
Summary func Field Name LSSEQE LSFTRN LSFRCV LSBTRN LSBRCV	tions: 1-Total Summary Functions	summary , 2-Aver Column Spacing 2 2 2 2 2 2 2	age, 3-Minimum, 4-M Column Headings Sequence Errors Frames Transmitted Frames Received Bytes Transmitted Bytes Received	aximum, 5- Len 11 11 11 11 11	Dec Pos 0 0 0 0 0	Null	Len	Dec	Numeric			
Summary func Field Name LSSEQE LSFTRN LSFRCV LSBTRN LSBRCV LQTOC	tions: 1-Total Summary Functions	summary , 2-Aver Column Spacing 2 2 2 2 2 2 2	age, 3-Minimum, 4-M Column Headings Sequence Errors Frames Transmitted Frames Received Bytes Transmitted Bytes Received Total Outgoing	aximum, 5- Len 11 11 11 11 11	Dec Pos 0 0 0 0 0	Null	Len	Dec	Numeric			
Summary func Field Name LSSEQE LSFTRN LSFRCV LSBTRN LSBRCV LQTOC	tions: 1-Total Summary Functions	summary , 2-Aver Column Spacing 2 2 2 2 2 2 2 2 2 2 2 2	age, 3-Minimum, 4-M Column Headings Sequence Errors Frames Transmitted Frames Received Bytes Transmitted Bytes Received Total Outgoing Calls Retry for Outgoing	aximum, 5- Len 11 11 11 11 11 11	Dec Pos 0 0 0 0 0	Null	Len	Dec	Numeric			
Summary func Field Name LSSEQE LSFTRN LSFRCV LSBRCV LSBRCV LQTOC LQROC	tions: 1-Total Summary Functions	summary, 2-Aver Column Spacing 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2	age, 3-Minimum, 4-M Column Headings Sequence Errors Frames Transmitted Frames Received Bytes Received Total Outgoing Calls	aximum, 5- Len 11 11 11 11 11 11 11	Dec Pos 0 0 0 0 0 0 0 0	Null	Len	Dec	Numeric			
Summary func Field Name LSSEQE LSFTRN LSFRCV LSBTRN LSBRCV LSBRCV	tions: 1-Total Summary Functions	summary , 2-Aver Column Spacing 2 2 2 2 2 2 2 2 2 2 2 2	age, 3-Minimum, 4-M Column Headings Sequence Errors Frames Received Bytes Received Bytes Received Total Outgoing Calls Retry for Outgoing Calls Total	aximum, 5- Len 11 11 11 11 11 11	Dec Pos 0 0 0 0 0	Null	Len	Dec	Numeric			
Summary func Field SSEQE LSSEQE LSFRCV LSBRCV LSBRCV LQTOC LQROC	tions: 1-Total Summary Functions	summary, 2-Aver Column Spacing 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2	age, 3-Minimum, 4-M Column Headings Sequence Errors Frames Transmitted Frames Received Bytes Transmitted Bytes Received Total Outgoing Calls Retry for Outgoing Calls Incoming	aximum, 5- Len 11 11 11 11 11 11 11	Dec Pos 0 0 0 0 0 0 0 0	Null	Len	Dec	Numeric			
Summary func Field SSEQE SSEQE SSERCV SBRCV QTOC QROC QTIC	tions: 1-Total Summary Functions	summary, 2-Aver Column Spacing 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2	age, 3-Minimum, 4-M Column Headings Sequence Errors Frames Transmitted Frames Received Bytes Received Total Outgoing Calls Total Incoming Calls	aximum, 5- Len 11 11 11 11 11 11 11 11	Dec Pos 0 0 0 0 0 0 0 0 0 0	Null	Len	Dec	Numeric			
Summary func Field SSEQE SSEQE SSERCV SBRCV QTOC QROC QTIC	tions: 1-Total Summary Functions	summary, 2-Aver Column Spacing 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2	age, 3-Minimum, 4-M Column Headings Sequence Errors Frames Transmitted Frames Received Bytes Transmitted Bytes Received Total Outgoing Calls Retry for Outgoing Calls Total Incoming Calls Retry for	aximum, 5- Len 11 11 11 11 11 11 11	Dec Pos 0 0 0 0 0 0 0 0	Null	Len	Dec	Numeric			
Summary func Field SSEQE SSEQE SSERCV SBRCV QTOC QROC QTIC	tions: 1-Total Summary Functions	summary, 2-Aver Column Spacing 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2	age, 3-Minimum, 4-M Column Headings Sequence Errors Frames Transmitted Frames Received Bytes Transmitted Bytes Received Total Outgoing Calls Retry for Outgoing Calls Retry for Incoming Calls	aximum, 5- Len 11 11 11 11 11 11 11 11	Dec Pos 0 0 0 0 0 0 0 0 0 0	Null	Len	Dec	Numeric			
Summary func Field Name LSSEQE LSFTRN LSFRCV LSBRCV LSBRCV LQTOC LQROC LQRIC	tions: 1-Total Summary Functions	summary, 2-Aver Column Spacing 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2	age, 3-Minimum, 4-M Column Headings Sequence Errors Frames Transmitted Frames Received Bytes Received Total Outgoing Calls Retry for Outgoing Calls Retry for Incoming Calls Retry for Incoming Calls	aximum, 5- Len 11 11 11 11 11 11 11 11 11	Dec Pos 0 0 0 0 0 0 0 0 0 0 0	Null	Len	Dec	Numeric			
Summary func Field Name LSSEQE LSFTRN LSFRCV LSBRCV LSBRCV LQTOC LQROC LQTIC	tions: 1-Total Summary Functions	summary, 2-Aver Column Spacing 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2	age, 3-Minimum, 4-M Column Headings Sequence Errors Frames Transmitted Frames Received Bytes Transmitted Bytes Received Total Outgoing Calls Retry for Outgoing Calls Retry for Incoming Calls	aximum, 5- Len 11 11 11 11 11 11 11 11	Dec Pos 0 0 0 0 0 0 0 0 0 0	Null	Len	Dec	Numeric			

Figure 214. NWI\_ALL Query Definition, Part 2

			IBM Query,	/400	1	1/17/96	20:10:03	Page	5	
Report bre	aks									
Break N	lew Suppress	Break								
Level P	age Summarie	s Text								
0 N	lo Yes									
1 N	lo No									
Selected o	utput attrib	tes								
Output t	уре		Pr	inter						
Form of	output		Det	tail						
Line wra	pping		Yes	S						
Wrappi	ng width .		378	3						
Record	on one page		No							
Printer Ou	tput									
Printer	device		*PI	RINT						
Report s	ize									
Length			66	5 (default)						
Width			378	В						
Report s	tart line			6 (default)						
Report e	nd line		60	) (default)						
Report 1	ine spacing .		Siı	ngle space						
Print de	finition .		No							
Printer Sp	ooled Output									
Spool th	e output .		(D	efaults to va	lue in print 1	file, QPQU	JPRFIL)			
Form typ	e		(D	efaults to va	lue in print 1	file, QPQU	JPRFIL)			
Copies				1						
Hold .			(D	efaults to va	lue in print 1	file, QPQU	JPRFIL)			
Cover Page										
Print co	ver page .		No							
Cover	page title									
Page headi	ngs and foot	ngs								
Print st	andard page H	eading	Yes	5						
Page h	eading									
Page f	ooting									
	* * * *	* END	0 F Q	UERY PI						

Figure 215. NWI\_ALL Query Definition, Part 3

### H.2 NWI\_CALLS

```
IBM Query/400
                                                                 SYSTEM01 11/17/96 20:16:02
5716QU1 V3R6M0 950929
                                                                                                                1
                                                                                                         Page
  Query . . . . . . . . . . . . . . . . NWI_CALLS

        Query CCSID
        37

        Query language id
        ENU

        Query country id
        US

        ***. is the decimal separator character for this query ***

  Collating sequence . . . . . . . . . Hexadecimal
  Processing options
   Use rounding . . . . . . . . . . . . Yes (default)

Ignore decimal data errors . . . . No (default)

Ignore substitution warnings . . . . Yes

Use collating for all compares . . . Yes
  Special conditions
*** All records selected by default ***
Selected files
 ID File
                         Librarv
                                        Member
                                                       Record Format
         QAPMLAPD
                         QPFRDATA
                                       Q963121422 QAPMLPDR
Result fields
              Expression
                                                    Column Heading
  Name
                                                                              Len Dec
  PCTRETRYI (LQRIC * 100) / LQTIC
                                                    Pct Incoming
                                                                                     1
                                                    Calls
                                                    Retried
  PCTRETRYO (LQROC * 100) / LQTOC
                                                    Pct Outgoing
                                                                                 4 1
                                                    Calls
                                                    Retried
 DATE
              substr(DTETIM,3,2) || '/' ||
                                                    Date
              substr(DTETIM,5,2)
  TIME
              substr(DTETIM,7,2) || ':' ||
                                                    Time
              substr(DTETIM,9,2)
                                     IBM Query/400
                                                                           11/17/96 20:16:02
                                                                                                         Page 2
Ordering of selected fields
Field Sort Ascending/ Break Field
                   Priority Descending Level Text
  Name
  I DNWT
                   10
                              A
A
                                          1
                                                  Network interface description
  DATE
                   20
  TIME
                   30
                              А
                                                  Total outgoing calls
  LOTOC
  LQROC
                                                  Retry for outgoing calls
  PCTRETRYO
  LQTIC
                                                  Total incoming calls
  LQRIC
                                                  Retry for incoming calls
  PCTRETRYI
Report column formatting and summary functions
  Summary functions: 1-Total, 2-Average, 3-Minimum, 4-Maximum, 5-Count
                                                                                       Overrides
                                                                       Dec Null
  Field
                   Summary Column
                                                                                         Dec Numeric
                   Functions Spacing Column Headings
                                                                  Len Pos Cap Len Pos Editing
  Name
  LDNWI
                               0
                                        Network
                                                                   10
                                        Interface
                                        Description
  DATE
                               2
                                                                    5
                                        Date
  TIME
                               2
                                         Time
                                                                     5
 LOTOC
                   24
                               2
                                        Total
                                                                   11
                                                                         0
                                        Outgoing
                                        Calls
                                        Retry for
 LOROC
                                                                   11 0
                   24
                              2
                                        Outgoing
                                        Calls
 PCTRETRYO
                                        Pct Outgoing
                                                                    4 1
                   24
                              2
                                        Calls
                                        Retried
 LQTIC
                   24
                               2
                                                                   11
                                                                         0
                                         Total
                                        Incoming
                                        Calls
  LQRIC
                   24
                               2
                                         Retry for
                                                                   11
                                                                          0
                                        Incoming
                                        Calls
  PCTRETRYI
                   24
                               2
                                        Pct Incoming
                                                                    4
                                                                        1
                                        Calls
                                        Retried
```

Figure 216. NWI\_CALLS Query Definition, Part 1

	IBM Qu	ery/400	11/17/96	20:16:02	Page	3	
Report breaks							
Break New Suppress	Break						
Level Page Summarie	s Text						
0 No Yes							
1 No No	Summary for net	vork interface &ldnwi					
Selected output attribu	tes						
Output type		Printer					
Form of output		Detail					
Line wrapping		No					
Printer Output							
Printer device		*PRINT					
Report size							
Length		66 (default)					
Width		132					
Report start line		6 (default)					
Report end line		60 (default)					
Report line spacing .		Single space					
Print definition		No					
Printer Spooled Output							
Spool the output		(Defaults to value in	n print file, QPQU	JPRFIL)			
Form type		(Defaults to value in	n print file, QPQU	JPRFIL)			
Copies		1					
Hold		(Defaults to value i	n print file, QPQU	JPRFIL)			
Cover Page							
Print cover page		No					
Cover page title							
Page headings and footi	ngs						
Print standard page h	eading	Yes					
Page heading							
Page footing							
	IBM Qu	ery/400	11/17/96	20:16:02	Page	4	
* * * *	* END OF	OUERY PRIN	T * * * * *				

Figure 217. NWI\_CALLS Query Definition, Part 2

## H.3 NWI\_ERRORS

-											
5716QU1 V3R Query	5M0 950929		M Query/40		SYSTE	MO1 11/17/96	5 20:16:	27	Page	1	
•				NWI error re	ated p	erformance 1	fields				
	)										
	age id										
	try id the decimal sep			r this query	***						
	sequence										
Processing											
	ding ecimal data erro										
	ubstitution warr			craure)							
	ating for all co	ompares .	Yes								
Special con	nditions records selected	hv defau	1+ ***								
Selected file		, by acraa									
ID File			Member	Record							
TO1 QAPM Result field:	1LAPD MYLI s	LB	Q963121422	2 QAPMLPD	R						
Name	Expression			Column Hea	ding	Len	Dec				
LINEUTILT	(LSBTRN * 800)	) / INTSEC	/LDLSP	Trn		4	1				
				Line Util							
LINEUTILR	(LSBRCV * 800)	) / INTSEC	/LDLSP	Rcv		4	1				
				line							
PCERRTR	(LLFRIE * 100)	/ (LSFRC	V +	Util Pct Frames		4	1				
	LLFRIE)			Transmitte	d						
PCERRRCV	(LLFRIE * 100)			in Error Pct Frames		4	1				
FCERRCY	(LEIKIE 100)	/ LJIKU		Received		4	1				
				in Error							
DATE	substr(DTETIM, substr(DTETIM,		(* 11	Date							
			M Query/400	0		11/17/96	5 20:16:	27	Page	2	
Result field											
Name TIME	Expression substr(DTETIM,	7.2)    '	: 11	Column Hea Time	ding	Len	Dec				
	substr(DTETIM,										
	selected fields	A	( Bussie								
Field Name			/ Break I g Level <sup>-</sup>								
LDNWI	10	A		Network inte	rface d	escription					
DATE TIME	20 30	A									
LINEUTILT	50										
LINEUTILR											
PCERRTR PCERRRCV											
LPLOFA			I	oss of fram	e align	nent					
LPLECV				ocal end co							
LPDTSI LPDTSO				Detected acc Detected acc							
LPFECV				ar end code							
LPES				Errored seco							
LPSES LPCOL				Severely err Collision de		conds					
Report column	n formatting and		functions								
Summary fu Field	nctions: 1-Tota Summary	al, 2-Aver Column	age, 3-Min	imum, 4-Maxi	mum, 5-	Count Dec Null	0verr	ides Numeric			
Name	-		Column Hea	adings	Len		Len Pos				
LDNWI		0	Network	<b>.</b>	10						
			Interface Descr								
DATE		2	Descr Date		5						
TIME		2	Time		5						
LINEUTILT	2 4	2	Trn Line		4	1					
			Util								
LINEUTILR	2 4	2	Rcv		4	1					
			line Util								
PCERRTR	2 4	2	Pct Frm		4	1					
			Trnd								
PCERRRCV	2 4	2	in Err Pct Frm		4	1					
ICENNUT	L 4	-	Rcv		4	1					
			in Err								

Figure 218. NWI\_ERRORS Query Definition, Part 1

Report Column	formatting		M Query/400	od)	1	1/17/9	0	20:16:	27	Page	3	
			functions (continu age, 3-Minimum, 4-		Count			Overr	idee			
			age, 3-Minimum, 4-	Maximum, 5								
Field	Summary	Column				Null			Numeric			
Name	Functions		Column Headings		Pos	Cap	Len	Pos	Editing			
LPLOFA		2	Loss of	11	0							
			Frame									
			Alignment									
LPLECV		2	Local	11	0							
			End code									
			Violation									
LPDTSI		2	Detect Acc	11	0							
			Transm									
			Error In									
LPDTSO		2	Detect Acc	11	0							
			Transm									
			Error Out									
LPFECV		2	Far	11	0							
			End code									
			Violation									
LPES		2	Errd	5	0							
			Secs	5	0							
LPSES		2	Svr	5	0							
21 323		2	Errd	5	0							
			Secs									
LPCOL		2	Collision	11	0							
LFCUL		2	Detect	11	0							
1 No	No Su											
Form of outp	t attributes  ut	· · · · · ·	Detail									
Output type Form of outp	t attributes	· · · · · ·	Printer Detail No									
Output type Form of outp Line wrapping	t attributes  ut g	· · · · · ·	Printer Detail		1	1/17/9	6	20:16:	27	Page	4	
Output type Form of outp Line wrapping Printer Output	t attributes  ut J	   IB	Printer Detail No M Query/400		1	1/17/9	6	20:16:	27	Page	4	
Output type Form of outp Line wrapping Printer Output Printer devi	t attributes  ut g	   IB	Printer Detail No M Query/400		1	1/17/9	6	20:16:	27	Page	4	
Output type Form of outp Line wrapping Printer Output Printer devi Report size	t attributes		Printer Detail No M Query/400 *PRINT		]	1/17/9	6	20:16:	27	Page	4	
Output type Form of outp Line wrapping Printer Output Printer devi Report size Length	t attributes		Printer Detail No M Query/400 *PRINT 66 (default)		1	11/17/9	6	20:16:	27	Page	4	
Output type Form of outp Line wrapping Printer Output Printer devi Report size Length Width.	t attributes		Printer Detail No M Query/400 *PRINT 66 (default) 178		1	1/17/9	6	20:16:	27	Page	4	
Output type Form of outp Line wrapping Printer Output Printer devi Report size Length Width.	t attributes		Printer Detail No M Query/400 *PRINT 66 (default) 178 6 (default)		]	11/17/9	6	20:16:	27	Page	4	
Output type Form of outp Line wrapping Printer Output Printer devi Report size Length Width Report start Report end 1	t attributes		Printer Detail No M Query/400 *PRINT 66 (default) 178 6 (default) 60 (default)		]	11/17/9	6	20:16:	27	Page	4	
Output type Form of outp Line wrapping Printer Output Printer devi Report size Length Width Report start Report end 1 Report line	t attributes		Printer Detail No M Query/400 *PRINT 66 (default) 60 (default) 60 (default) Single space		]	11/17/9	6	20:16:	27	Page	4	
Output type Form of outp Line wrapping Printer Output Printer devi Report size Length Width Report start Report end 1 Report line Print defini	t attributes		Printer Detail No M Query/400 *PRINT 66 (default) 60 (default) 60 (default) Single space		]	11/17/9	6	20:16:	27	Page	4	
Output type Form of outp Line wrapping Printer Output Printer devin Report size Length . Width . Report start Report line Print defini Printer Spoole	t attributes		Printer Detail No M Query/400 *PRINT 66 (default) 178 6 (default) 60 (default) Single space No						27	Page	4	
Output type Form of outp Line wrapping Printer Output Printer devi Report size Length Width. Report start Report end 1 Report line Print defini Printer Spoole	t attributes		Printer Detail No M Query/400 *PRINT 66 (default) 178 6 (default) 60 (default) 5ingle space No (Defaults to	value in p	rint	file, Q	PQUP	RFIL)	27	Page	4	
Output type Form of outp Line wrapping Printer Output Printer devi Report size Length . Width . Report tart Report line Print defini Print defini Print spool the ou Form type .	t attributes		Printer Detail No M Query/400 *PRINT 66 (default) 178 60 (default) Single space No (Defaults to (Defaults to	value in p	rint	file, Q	PQUP	RFIL)	27	Page	4	
Output type Form of outp Line wrapping Printer Output Printer devi Report size Length . Width . Report start Report line : Print defini Printer Spoole Spool the ou Form type . Copies .	t attributes		Printer Detail No M Query/400 *PRINT 66 (default) 178 6 (default) Single space No (Defaults to 0Efaults to 1	value in p value in p	rint f	file, Q	PQUP	RFIL) RFIL)	27	Page	4	
Output type Form of outp Line wrapping Printer Output Printer devin Report size Length . Width . Report start Report line Printer Spoole Spool the ou Form type . Copies . Hold	t attributes		Printer Detail No M Query/400 *PRINT 66 (default) 178 60 (default) Single space No (Defaults to (Defaults to	value in p value in p	rint f	file, Q	PQUP	RFIL) RFIL)	27	Page	4	
Output type Form of outp Line wrapping Printer Output Printer devi Report size Length . Width . Report start Report line : Print defini Printer Spoole Spool the ou Form type . Copies .	t attributes		Printer Detail No M Query/400 *PRINT 66 (default) 178 6 (default) Single space No (Defaults to 0Efaults to 1	value in p value in p	rint f	file, Q	PQUP	RFIL) RFIL)	27	Page	4	
Output type Form of outp Line wrapping Printer Output Printer devi Report size Length . Width Report start Report line Print defini Print defini Print offini Print offini Print offini Copies Hold Cover Page	t attributes		Printer Detail No M Query/400 *PRINT 66 (default) 178 60 (default) Single space No (Defaults to 1 (Defaults to	value in p value in p	rint f	file, Q	PQUP	RFIL) RFIL)	27	Page	4	
Output type Form of outp Line wrapping Printer Output Printer devi Report size Length . Width Report start Report line Print defini Print defini Print offini Print offini Print offini Copies Hold Cover Page	t attributes		Printer Detail No M Query/400 *PRINT 66 (default) 178 60 (default) Single space No (Defaults to 1 (Defaults to	value in p value in p	rint f	file, Q	PQUP	RFIL) RFIL)	27	Page	4	
Output type Form of outp Line wrapping Printer Output Report size Length . Report start Report end 1 Report line ? Print defini Printer Spoole Spool the ou Form type . Copies . Hold . Cover Page Print cover	t attributes		Printer Detail No M Query/400 *PRINT 66 (default) 178 60 (default) Single space No (Defaults to 1 (Defaults to	value in p value in p	rint f	file, Q	PQUP	RFIL) RFIL)	27	Page	4	
Output type Form of outp Line wrapping Printer Output Printer devi Report size Length . Width Report start Report line Print defini Print offini Print oppe . Copies . Hold Cover Page Print cover Cover page Page headings	t attributes		Printer Detail No M Query/400 *PRINT 66 (default) 178 60 (default) Single space No (Defaults to 1 (Defaults to No	value in p value in p	rint f	file, Q	PQUP	RFIL) RFIL)	27	Page	4	
Output type Form of outp Line wrapping Printer Output Printer devi Report size Length . Width Report start Report line Print defini Print offini Print oppe . Copies . Hold Cover Page Print cover Cover page Page headings	t attributes		Printer Detail No M Query/400 *PRINT 66 (default) 178 60 (default) Single space No (Defaults to 1 (Defaults to No	value in p value in p	rint f	file, Q	PQUP	RFIL) RFIL)	27	Page	4	
Output type Form of outp Line wrapping Printer Output Report size Length . Report start Report end 1 Report line : Print defini Printer Spoole Spool the ou Form type . Copies . Hold . Cover Page Print cover Cover page Page headings Print standa	t attributes		Printer Detail No M Query/400 *PRINT 66 (default) 178 60 (default) Single space No (Defaults to 1 (Defaults to No	value in p value in p	rint f	file, Q	PQUP	RFIL) RFIL)	27	Page	4	

Figure 219. NWI\_ERRORS Query Definition, Part 2

## H.4 NWI\_IOP

5716QU1 V3R6	MO 950929	IB	M Query/400	SYSTE	EMO1 11/17/9	6 20:1	6:55	Page	1
Query			NWI_IOP						
				IOP related per	formance fie	lds			
			aracter for th						
Processing			Hexadecim	ld I					
			Yes (defa	ult)					
			No (defau						
		arnings		,					
		compares .							
Special con									
		ted by defau	lt ***						
Selected file									
ID File		ibrary	Member	Record Format					
TO1 QAPM		PFRDATA	Q963121422	QAPMLPDR					
TO2 QAPM	CION (	PFRDATA	Q963121422	QAPMCIOR					
Join tests	n		Matched r	ecords					
Type of Join Field	n		Field	ccorus					
T01.INTNUM	EQ		T02.INTNUM						
T01.IOPRN	EQ		T02.IOPRN						
Result fields	`								
Name	Expression			lumn Heading	Len	Dec			
DATE		DTETIM,3,2)	'/'   Da	te					
	substr(TO1.								
TIME		DTETIM,7,2)	':'      Ti	me					
	substr(TO1.		M Query/400		11/17/9	c	6:55	Page	2
Result fields	(continued)		M Query/400		11/1//9	0 20:1	10:55	Page	2
Name	Expression		Co	lumn Heading	Len	Dec			
IOPUTIL		DLC * CIIDLT		t IOP	4	1			
		T02.INTSEC))		i1					
IOPNAME	T01.IOPRN		10	P Name					
NWINAME	T01.LDNWI		Ne	twork					
			In	terface					
Ordering of s			/ Break Er 3	d					
Field Name	Sort		/ Break Fiel g Level Text						
Name IOPNAME	10 Priorit	y Descendin A	g Level lext						
T02.CITYPE	10	n	-	Туре					
NWINAME	20	A	2						
DATE									
TIME									
IOPUTIL									
Report column									
			age, 3-Minimum	ı, 4-Maximum, 5-			errides		
Field	Summary		Column 11		Dec Null Dec Cor		c Numeric		
Name IOPNAME	Functio	ns Spacing 0	Column Headin IOP Name	gs Len 10	Pos Cap	Len Po	os Editing		
TOPNAME TO2.CITYPE		2	IOP Name	10					
L		-	Туре	4					
NWINAME		2	Network	10					
			Interface						
DATE		2	Date	5					
TIME		2	Time	5					
IOPUTIL	24	2	Pct IOP	4	1	4	1		
			Util						
Report breaks	Supp	Bweak							
Break New Level Page	Suppress Summaries	Break							
0 No	Yes	ICAL							
1 No	No	Summary for	IOP &iopname						
2 No	No	-	NWI &nwiname						

Figure 220. NWI\_IOP Query Definition, Part 1

	IBM Query/400	11/17/96	20:16:55	Page	3
Selected output attributes					
Output type	Printer				
Form of output	Detail				
Line wrapping	No				
Printer Output					
Printer device	*PRINT				
Report size					
Length	66 (default)				
Width	132				
Report start line	6 (default)				
Report end line	60 (default)				
Report line spacing	Single space				
Print definition	No				
Printer Spooled Output					
Spool the output	(Defaults to value i	n print file, QPQ	UPRFIL)		
Form type	(Defaults to value i	n print file, QPQ	UPRFIL)		
Copies	1				
Hold	(Defaults to value i	n print file, QPQ	UPRFIL)		
Cover Page					
Print cover page	No				
Cover page title					
Page headings and footings					
Print standard page heading	Yes				
Page heading					
Page footing					
* * * * *	END OF QUERY PRIN	T * * * * *			

Figure 221. NWI\_IOP Query Definition, Part 2

## H.5 NWI\_LAPD

5716QU1 V3R6 Query	MO 950929		M Query/400 NWI_LA		SYSTEMO	01 11/17/9	6 2	1:16:45	Page	1	
Library .			MYLIB								
	· · · · · · · ·			WI related p	performan	ice tields					
Query langua	age id		ENU								
	ryid				***						
	the decimal sep equence				***						
Processing			nexuue	e man							
	ing										
	cimal data erro			fault)							
	bstitution warr ting for all co										
Special con	ditions										
	ecords selected	d by defau	lt ***								
Selected file ID File	s Libr	rarv	Member	Record F	ormat						
T01 QAPM		RDATA	Q963121422								
Result fields							_				
Name LINEUTILT	Expression (LSBTRN * 800)	) / INTSEC		Column Head Transmit	iing	Len 4	Dec 1				
LINCOTICI	(ESBIRN 000)	/ / 101310	/ LDL3F	Line		4	1				
				Util							
LINEUTILR	(LSBRCV * 800)	) / INTSEC	/LDLSP	Receive		4	1				
				line Util							
PCERRTR	(L1FRIE * 100)	/ (LSFRC	V +	Pct Frames		4	1				
	LLFRIE)			Trnsmitd							
PCERRRCV	(LLFRIE * 100)	/   9 50 74		in Error Pct Frames		4	1				
FULKKKUV	(ELINIC ~ 100)	/ LOFKUV		Recd		4	Ţ				
				in Error							
DATE	substr(DTETIM,		(* 11	Date							
	substr(DTETIM,		M Query/400			11/17/9	6 2	1:16:45	Page	2	
Result fields	(continued)	10	(1 que: j) 100			11, 1, , , ,	0 2		. uge	-	
Name	Expression			Column Head	ling	Len	Dec				
TIME	substr(DTETIM, substr(DTETIM,		:11	Time							
Ordering of s	substr(DIEIIM, elected fields	,,,,,,									
Field	Sort		/ Break F								
Name			g Level T		face 1	eninti					
LDNWI DATE		A	1 N	etwork inter	∙⊺ace des	cription					
TIME		A									
LINEUTILT											
LSBTRN LSFTRN				ytes transmi rames transm							
PCERRTR			F	rumes transm	nuceu						
LINEUTILR											
LSBRCV				ytes receive							
LSFRCV PCERRRCV			F	rames receiv	red						
	formatting and	d summary	functions								
Summary fun	ctions: 1-Tota	al, 2-Aver		mum, 4-Maxim	num, 5-Co	ount		Overrides			
Field	Summary	Column	C. 1	44		ec Null		Dec Numeric			
Name LDNWI	Functions	Spacing O	Column Hea Network	aings	Len P 10	os Cap	Len	Pos Editing			
*		-	Interface								
			Descr								
DATE		2	Date		5						
TIME LINEUTILT	2 4	2	Time Trn		5 4	1					
		-	Line			-					
			Util								
LSBTRN		2	Pytos		11	0					
			Bytes Transmtd								
LSFTRN		2			11	0					
			Frames								
PCERRTR	24	2	Transmtd Pct Frm		4	1					
LOENNIN	L 4	-	Trnd		4	±					
		_	in Err								
LINEUTILR	2 4	2	Rcv		4	1					
			line Util								
			-								
-											_

Figure 222. NWI\_LAPD Query Definition, Part 1

		IB	M Query/400		1	1/17/9	62	1:16:	45	Page	3	
Report column	formatting an		functions (continued	)								
		-	age, 3-Minimum, 4-Ma		Count			0verr	ides			
Field	Summary	Column	,	, .		Nu11			Numeric			
Name			Column Headings	Len			len		Editing			
LSBRCV	- uncertoine	2	ooraani neaariigs	11	0	oup	2011	105	curring			
			Bytes									
			Rcvd									
LSFRCV		2		11	0							
		-	Frames									
			Rcvd									
PCERRRCV	2 4	2	Pct Frm	4	1							
1 OEMANOT		-	Rcvd		-							
			in Frr									
Report breaks												
Break New	Suppress E	Break										
	Summaries 1											
0 No	Yes	exe										
1 No		Summary for	NWI &ldnwi									
Selected outpu		anniary ror	INI GIGINI									
			Printer									
	iq											
Printer Output	-											
			*DDINT									
Report size												
			66 (default)									
			6 (default)									
			60 (default)									
			Single space									
	ition		÷ .									
Printer Spoole			NO									
			(Defaults to va	luo in nu		110 0	חחווחח					
			(Defaults to va									
				inde in pi	THE I	iie, ų	ryurk	(11)				
			(Defaults to va	lus in n		1.1.0.0	חחווחח					
HOIG			M Query/400	liue in pr		1/17/9			45	Page	4	
C		18	M Query/400		1	1/1//9	0 2	1:10:	45	Page	4	
Cover Page			No									
	page		NO									
Cover page												
Page headings			N									
	ırd page headi	ny	tes									
Page headi Page footi	-											
	na											
ruge root.	* * * * *	END	OF QUERY P	RINT	* *	* * *						

Figure 223. NWI\_LAPD Query Definition, Part 2

# H.6 IDLC\_ALL

~ <u> </u>														
5716001	/3R6M0 950929	TOM	1 Query/40	10	C V C T I	M01 1	1/17/0		20:17:43		Page	1		
					31311	101 1	1/1//9	0 4	20:17:43	<b>)</b>	raye	1		
	 y													
	y				rmance fiel	de								
	SID				initalice ilei	us								
	inguage id													
	ountry id													
	ng sequence			locimal										
	ing options		nexa	lec mia i										
	ounding		Ves	(default)										
	e decimal data erro													
	substitution war			ici dui c)										
	ollating for all c													
	conditions	ompares .												
	Il records selecter	d hv defaul	+ ***											
Selected 1		a by actual												
		rary	Member	Rec	ord Format									
		RDATA	096298104		MIDLR									
Ordering o	of selected fields													
Field	Sort	Ascending/	Break	Field										
Name	Priority	Descending	Leve1	Text										
INTNUM	20	Α		Interval	number									
DTETIM				Interval	date and t	ime:	y ymmd d	lhhmms	S S					
INTSEC					interval se	econds	6							
IOPRN					urce Name									
ISTYPE				ІОР Туре										
ISLND	10	Α			cription									
ISNWI					interface o									
ISLSP					ed: in bits		second							
ISPRCL					: always I-	IDLC								
ILCRCE					CRC errors									
ILSFE					ame errors									
I LORUN				Receive										
ILURUN					underrun									
ILABRT				Aborts r										
ILFRIE ISFRT					eceived in itted frame									
ISSEQE				Sequence		:5								
155202		TBM	Query/40		cirors	1	11/17/9	6	20:17:43	2	Page	2		
Ordering (	of selected fields													
Field	Sort	Ascending/		Field										
Name	Priority	Descending												
ISFTRN				Frames t	ransmitted									
ISFRCV				Frames r	eceived									
ISBTRN				Bytes tr	ansmitted									
ISBRCV				Bytes re										
ISB1				B1 chann										
ISB2				B2 chann	el									
	lumn formatting an													
Summary Field	functions: 1-Tota Summary	al, 2-Avera Column	ige, 3-Mir	inmum, 4-	Maximum, 5-		Null		Overrid	1es ≬umeric				
Name		Spacing	Column He	adinac	Lon			Lon	Pos E					
INTNUM	Functions	0	COTUNIT RE	aunys	5	0	Cap	Len	PUS	urting				
11111011		0	Itv		5	0								
			Nbr											
DTETIM		2	Interval		12									
			Date											
			and time											
INTSEC		2	Elapsed		7	0								
			Itv											
			Seconds											
IOPRN		2	IOP		10									
			Resource											
			Name											
ISTYPE		2			4									
			IOP											
		_	Туре											
ISLND		2			10									
			Line											
TONUT		2	Descr		10									
ISNWI		2	Network		10									
			Interf Descr											
ISLSP		2	Descr		11	0								
13235		-	Line		11	J								
			Speed											
ISPRCL		2			1									
TOLKOL		-	Prot		1									
ILCRCE		2	Receive		11	0								
			CRC			5								
			Errors											
ILSFE		2	Short		11	0								
			Frame											
			Errors											
														_
_														_

Figure 224. IDLC\_ALL Query Definition, Part 1

	umatting		M Query/400	<b>`</b>	1	1/17/96		20:17:	43	Page	3	
Summary functi			functions (continued age, 3-Minimum, 4-Ma		Count			0verr	ides			
Field	Summary	Column				Null			Numeric			
Name			Column Headings	len			len		Editing			
ILORUN	- uncerons	2	oordaan neddrings	11	0	oup	2011		Lurenng			
120100		-	Receive									
			Overrun									
ILURUN		2	overrun	11	0							
120100		-	Transmit									
			Underrun									
TLABRT		2	onderrun	11	0							
TENDINI		L	Aborts		0							
			Received									
TIFRIF		2	Frames	11	0							
ILIKIL		2	Received	11	0							
			In error									
ISFRT		2	in error	11	0							
ISERI		2	Retransmtd	11	0							
			Frames									
ISSEQE		2		11	0							
			Sequence									
			Errors									
ISFTRN		2		11	0							
			Frames									
			Transmtd									
ISFRCV		2		11	0							
			Frames									
			Received									
ISBTRN		2		11	0							
			Bytes									
			Transmtd									
ISBRCV		2		11	0							
			Bytes									
			Received									
ISB1		2		1	0							
			B1									
			Ch									
ISB2		2		1	0							
1302		2	B2	-	0							
			Ch									
Report breaks												
	uppress Br	reak										
Level Page S												
					1				12		4	
	es	тр	M Ouony/400			1/17/06		20.17.		Dago		
O No Y		IB	M Query/400		-	1/17/96		20:17:	40	Page	4	
0 No Y Selected output	attributes					1/17/96		20:17:	45	Page	4	
0 No Y Selected output Output type .	attributes		Printer		-	1/17/96		20:17:	45	Page	4	
0 No Y Selected output Output type . Form of output	attributes		Printer Detail		-	1/17/96	; ;	20:17:	40	Page	4	
0 No Y Selected output Output type . Form of output Line wrapping	attributes		Printer Detail		-	1/17/96		20:17:	+0	Page	4	
0 No Y Selected output Output type . Form of output Line wrapping Printer Output	attributes	 	. Printer . Detail . No		-	1/17/96	; ;	20:17:	+J	Page	4	
O No Y Selected output Output type . Form of output Line wrapping Printer Output Printer device	attributes	 	. Printer . Detail . No			1/17/96	; ;	20:17:	+J	Page	4	
0 No Y Selected output Output type . Form of output Line wrapping Printer Output Printer device Report size	attributes	 	. Printer . Detail . No . *PRINT			1/17/96	i :	20:17:	+0	Page	4	
0 No Y Selected output Output type . Form of output Line wrapping Printer Output Printer device Report size Length .	attributes	· · · · · · · · · · · · · · · · · · ·	Printer Detail No *PRINT 66 (default)			1/17/96	i :	20:17:	40	Page	4	
0 No Y Selected output Output type Form of output Line wrapping Printer Output Printer device Report size Length Width	attributes	· · · · · · · · · · · · · · · · · · ·	Printer Detail No *PRINT 			1/17/96	;	20:17:		Page	4	
0 No Y Selected output Output type . Form of output Line wrapping Printer Output Printer device Report size Length . Width .	attributes	· · · · · · · · · · · · · · · · · · ·	<ul> <li>Printer</li> <li>Detail</li> <li>No</li> <li>*PRINT</li> <li>66 (default)</li> <li>312</li> <li>6 (default)</li> </ul>			1/17/96	;	20:17:		Page	4	
O No Y Selected output Output type . Form of output Line wrapping Printer Output Printer device Report size Length . Width . Report start 1 Report end lin	attributes	· · · · · · · · · · · · · · · · · · ·	Printer . Detail . No . *PRINT . 66 (default) . 312 . 6 (default) . 60 (default)		-	1/17/96	;	20:17:	+5	Page	4	
0 No Y Selected output Output type . Form of output Line wrapping Printer Output Printer device Report size Width Report start 1 Report end 1im sp	attributes	· · · · · · · · · · · · · · · · · · ·	. Printer . Detail . No . *PRINT . 66 (default) . 312 . 6 (default) . 60 (default) . Single space		-	1/17/96	i :	20:17:		Page	4	
0 No Y Selected output Output type . Form of output Line wrapping Printer Output Printer device Report size Length Report start 1 Report end lin Report line sp Print definiti	attributes	· · · · · · · · · · · · · · · · · · ·	. Printer . Detail . No . *PRINT . 66 (default) . 312 . 6 (default) . 60 (default) . Single space		-	1/17/96	; : ;	20:17:	+J	Page	4	
0 No Y Selected output Output type . Form of output Line wrapping Printer Output Printer device Report size Length Report start 1 Report end lin Report line sp Print definiti	attributes	· · · · · · · · · · · · · · · · · · ·	. Printer . Detail . No . *PRINT . 66 (default) . 312 . 6 (default) . 60 (default) . Single space		-	1/17/96	;	20:17:	+J	Page	4	
0 No Y Selected output Output type . Form of output Line wrapping Printer Output Printer device Report size Length . Width . Report start 1 Report start 1 Report line sp Printer Spooled	attributes	· · · · · · · · · · · · · · · · · · ·	. Printer . Detail . No . *PRINT . 66 (default) . 312 . 6 (default) . 60 (default) . Single space	lue in pr					-U	Page	4	
0 No Y Selected output Output type . Form of output Line wrapping Printer Output Printer device Report size Width Report start 1 Report start 1 Report line sp Print definiti Printe Spool the outp	attributes	· · · · · · · · · · · · · · · · · · ·	<ul> <li>Printer</li> <li>Detail</li> <li>No</li> <li>*PRINT</li> <li>66 (default)</li> <li>312</li> <li>6 (default)</li> <li>60 (default)</li> <li>Single space</li> <li>No</li> <li>(Defaults to va</li> </ul>		int 1	file, QF	ŶQUP	RFIL)		Page	4	
0 No Y Selected output Output type . Form of output Line wrapping Printer Output Printer device Report size Length Width Report start 1 Report end lin Report line sp Print definiti Printer Spooled Spool the outpu	attributes	· · · · · · · · · · · · · · · · · · ·	<ul> <li>Printer</li> <li>Detail</li> <li>No</li> <li>*PRINT</li> <li>66 (default)</li> <li>312</li> <li>6 (default)</li> <li>60 (default)</li> <li>Single space</li> <li>No</li> <li>(Defaults to va</li> <li>(Defaults to va</li> </ul>		int 1	file, QF	ŶQUP	RFIL)		Page	4	
0 No Y Selected output Output type . Form of output Line wrapping Printer Output Printer device Report size Length . Width . Report start 1 Report start 1 Report line sp Print definiti Printer Spooled Spool the outp Form type	attributes		<ul> <li>Printer</li> <li>Detail</li> <li>No</li> <li>*PRINT</li> <li>66 (default)</li> <li>312</li> <li>6 (default)</li> <li>60 (default)</li> <li>Single space</li> <li>No</li> <li>(Defaults to va</li> <li>(Defaults to va</li> <li>1</li> </ul>	lue in pr	int 1	file, QF	9QUP	RFIL) RFIL)		Page	4	
0 No Y Selected output Output type Form of output Line wrapping Printer Output Printer device Report size Length . Width . Report start 1 Report start 1 Report end 1in Report line sp Print definiti Printer Spooled Spool the outp Form type . Copies	attributes		<ul> <li>Printer</li> <li>Detail</li> <li>No</li> <li>*PRINT</li> <li>66 (default)</li> <li>312</li> <li>6 (default)</li> <li>60 (default)</li> <li>Single space</li> <li>No</li> <li>(Defaults to va</li> <li>(Defaults to va</li> </ul>	lue in pr	int 1	file, QF	9QUP	RFIL) RFIL)	<b>*</b> J	Page	4	
O No Y Selected output Output type . Form of output Line wrapping Printer Output Printer device Report size Length . Width . Report start 1 Report start 1 Copies . Copies . Hold . Cover Page	attributes		<ul> <li>Printer</li> <li>Detail</li> <li>No</li> <li>*PRINT</li> <li>66 (default)</li> <li>312</li> <li>6 (default)</li> <li>60 (default)</li> <li>Single space</li> <li>No</li> <li>(Defaults to va</li> <li>1</li> <li>(Defaults to va</li> </ul>	lue in pr	int 1	file, QF	9QUP	RFIL) RFIL)	4J	Page	4	
O No Y Selected output Output type . Form of output Line wrapping Printer Output Printer device Report size Length . Width . Report start 1 Report start 1 Report start 1 Report start 1 Print definiti Printer Spooled Spool the outp Form type . Copies . Hold . Cover Page Print cover pa	attributes		<ul> <li>Printer</li> <li>Detail</li> <li>No</li> <li>*PRINT</li> <li>66 (default)</li> <li>312</li> <li>6 (default)</li> <li>60 (default)</li> <li>Single space</li> <li>No</li> <li>(Defaults to va</li> <li>1</li> <li>(Defaults to va</li> </ul>	lue in pr	int 1	file, QF	9QUP	RFIL) RFIL)	<b>*</b> J	Page	4	
O No Y Selected output Output type Form of output Line wrapping Printer Output Printer device Report size Length . Width . Report start 1 Report end lin Report end lin Report line spo Print definit Form type . Copies . Hold Cover Page Print cover page	attributes		<ul> <li>Printer</li> <li>Detail</li> <li>No</li> <li>*PRINT</li> <li>66 (default)</li> <li>312</li> <li>6 (default)</li> <li>60 (default)</li> <li>Single space</li> <li>No</li> <li>(Defaults to va</li> <li>1</li> <li>(Defaults to va</li> </ul>	lue in pr	int 1	file, QF	9QUP	RFIL) RFIL)	*J	Page	4	
O No Y Selected output Output type. Form of output Line wrapping Printer Output Printer device Report size Length . Width . Report start 1 Report start 1 Copies . Hold . Cover Page Print cover page Cover page t Page headings an	attributes 		<ul> <li>Printer</li> <li>Detail</li> <li>No</li> <li>*PRINT</li> <li>66 (default)</li> <li>312</li> <li>6 (default)</li> <li>60 (default)</li> <li>Single space</li> <li>No</li> <li>(Defaults to va</li> <li>1</li> <li>(Defaults to va</li> <li>No</li> </ul>	lue in pr	int 1	file, QF	9QUP	RFIL) RFIL)	<b>*</b> J	Page	4	
O No Y Selected output Output type . Form of output Line wrapping Printer Output Printer device Report size Length . Width . Report start 1 Report end lin Report start 1 Report start 1 Print definiti Printer Spooled Spool the outp Form type . Copies . Hold . Cover Page Print cover page Cover page tandard	attributes 		<ul> <li>Printer</li> <li>Detail</li> <li>No</li> <li>*PRINT</li> <li>66 (default)</li> <li>312</li> <li>6 (default)</li> <li>60 (default)</li> <li>Single space</li> <li>No</li> <li>(Defaults to va</li> <li>1</li> <li>(Defaults to va</li> <li>No</li> </ul>	lue in pr	int 1	file, QF	9QUP	RFIL) RFIL)	*J	Page	4	
O No Y Selected output Output type . Form of output Line wrapping Printer Output Printer device Report size Length Width Report start 1 Report end lin Report line spo Print definiti Printer Spooled Spool the outp Print definit Prom type Copies Hold Cover Page Print cover page Prage headings an	attributes 		<ul> <li>Printer</li> <li>Detail</li> <li>No</li> <li>*PRINT</li> <li>66 (default)</li> <li>312</li> <li>6 (default)</li> <li>60 (default)</li> <li>Single space</li> <li>No</li> <li>(Defaults to va</li> <li>1</li> <li>(Defaults to va</li> <li>No</li> </ul>	lue in pr	int 1	file, QF	9QUP	RFIL) RFIL)	*J	Page	4	

Figure 225. IDLC\_ALL Query Definition, Part 2

## H.7 IDLC\_IOP

57160U1 V3	R6M0 950929	TF	M Query/400	1	SYSTEMO	1 11/17/06	20:18:06	Page	1	
					51512110	,1 11,1,,,,0	20.10.00	ruge	1	
				. OF						
Ouenu ter	t		NUT a	ad TOD molator	Inonfor	manco fiel	da			
				iu ior related	i perior	mance field	us			
	ID									
	guage id									
	ntry id									
	s the decimal s				**					
	sequence		Hexade	ecimal						
Processin										
	nding									
Ignore	decimal data er	rors	No (de	efault)						
Ignore	substitution wa	rnings	Yes							
Use col	lating for all	compares .	Yes							
Special c	onditions									
*** A11	records selected	ed by defau	lt ***							
Selected fi										
TD Fi		brary	Member	Record Fo	rmat					
T01 QA		FRDATA	0963121422							
		FRDATA	0963121422							
Join tests	uncior QP	INVALA	4303121422	QAFFICIUR						
	. i .		M !							
	oin			u records						
Field	Test		Field	м						
T01.INTNU			T02.INTNU							
TO1.IOPRN			T02.IOPRM	I						
Result fiel							_			
Name	Expression		11.42	Column Headi	ng	Len	Dec			
DATE	substr(TO1.D		'/'	Date						
	substr(TO1.D									
TIME	substr(TO1.D		':'	Time						
	substr(TO1.D									
		IE	M Query/400	)		11/17/96	20:18:06	Page	2	
	ds (continued)									
Name	Expression			Column Headi	ng	Len	Dec			
IOPUTIL	100 - ((CIID			Pct IOP		4	1			
	(1000000 * T			Util						
IOPNAME	T01.IOPRN			IOP Name						
NWINAME	T01.ISNWI			Network						
				Interface						
Ordering of	selected field	s								
Field	Sort		/ Break F	ield						
Name	Priority		g Level 1							
IOPNAME	10	A	1							
T02.CITYP		•	-	OP Type						
NWINAME	20	А	2							
DATE	20	**	-							
TIME										
IOPUTIL										
	mn formatting a	nd summann	functions							
				mum / Max			Overrides			
Summary f Field	unctions: 1-To	tal, 2-Aver Column	aye, 3-Mini	mulli, 4-Maximu		ount Dec Null	Dec Numeric			
	Summary		0-1	44						
Name	Function		Column Hea	aings		os Cap	Len Pos Editing			
IOPNAME	-	0	IOP Name		10					
T02.CITYP	Ł	2	IOP		4					
			Туре							
NWINAME		2	Network		10					
			Interface							
DATE		2	Date		5					
TIME		2	Time		5					
IOPUTIL	2 4	2	Pct IOP		4	1	4 1			
			Util							
Report brea	ks									
Break Ne		Break								
Level Pa	ge Summaries	Text								
0 No	Yes									
1 No	No	Summary for	IOP &iopna	ıme						
2 No			NWI &nwina							
			M Query/400			11/17/96	20:18:06	Page	3	
								-		

Figure 226. IDLC\_IOP Query Definition, Part 1

Output type	Printon
Form of output	
Line wrapping	. NO
rinter Output	
Printer device	. *PRINI
Report size	
Length	
Width	
Report start line	
Report end line	
Report line spacing	
Print definition	. No
rinter Spooled Output	
Spool the output	. (Defaults to value in print file, QPQUPRFIL)
Form type	. (Defaults to value in print file, QPQUPRFIL)
Copies	. 1
Hold	. (Defaults to value in print file, QPQUPRFIL)
Cover Page	
Print cover page	. No
Cover page title	
age headings and footings	
Print standard page heading	. Yes
Page heading	
Page footing	

Figure 227. IDLC\_IOP Query Definition, Part 2

# H.8 IDLC\_UTIL

-									
5716QU1 V3R6 Ouerv	MO 950929		M Query/400 IDLC UTIL		MO1 11/17/9	6 20:18:29	Page	1	
Library .			MYLIB						
				related perform	ance fields				
	age id								
Query count	ryid		US						
	the decimal se								
Collating s Processing	equence		Hexadecima	1					
	ling		Yes (defa	ult)					
	cimal data erro								
	bstitution war								
Use colla Special cor	ting for all co	ompares .	Yes						
	ecords selected	d bv defau	lt ***						
Selected file									
ID File		rary	Member	Record Format					
TO1 QAPM Result fields		RDATA	Q963121422	QAPMIDLR					
Name	Expression		Col	lumn Heading	Len	Dec			
LINEUTILT	(ISBTRN * 800)	) / INTSEC		ansmit	4	1			
			Lii						
	(10000) * 000	\ / THITOGO	Ut:		4	,			
LINEUTILR	(ISBRCV * 800)	/ INISEC	/ISLSP Rec lin	ceive ne	4	1			
			Ut						
PCERRTR	(ILFRIE * 100)	/ (ISFRC		Frames	4	1			
	ILFRIE)			nsmitd Error					
PCERRRCV	(ILFRIE * 100)	/ ISFRCV		Error E Frames	4	1			
		, _51101	Red		•	-			
				Error					
DATE	substr(DTETIM, substr(DTETIM,		/'   Dat	te					
	SUDSTr(DIEIIM		M Query/400		11/17/9	6 20:18:29	Page	2	
Result fields	(continued)						-		
Name	Expression	7 0) 11 (		lumn Heading	Len	Dec			
TIME	substr(DTETIM, substr(DTETIM,		:'   Tir	ne					
Ordering of s	elected fields	, , , , , ,							
Field	Sort	Ascending	/ Break Field	ł					
Name	Priority 20		g Level Text						
DATE TIME	30	A A							
LINEUTILT	50								
LINEUTILR									
ISFTRN PCERRTR			Frame	es transmitted					
ISFRCV			Frame	es received					
PCERRRCV									
	formatting and								
Summary fur Field	ictions: 1-Tota Summary	al, 2-Aver Column	age, 3-Minimum	, 4-Maximum, 5-	Count Dec Null	Overrides Dec Numeric			
Name			Column Heading	ıs Len		Len Pos Editing			
DATE		0	Date	5					
TIME		2	Time	5					
LINEUTILT	2 4	2	Transmit Line	4	1				
			Line Util						
LINEUTILR	2 4	2	Receive	4	1				
			line						
ICCTO.			Util						
ISFTRN		2	Frames	11	0				
			Transmitted						
PCERRTR	2 4	2	Pct Frames	4	1				
			Trnsmitd in Error						
ISFRCV		2	IN Error	11	0				
131 664		-	Frames	11	0				
			Received						
PCERRRCV	2 4	2	Pct Frames	4	1				
			Recd in Error						

Figure 228. IDLC\_UTIL Query Definition, Part 1

			IBM Q	uery/400		11/17/96	20:18:29	Page	3	
Report breaks										
Break New	Suppress	Break								
Level Page	Summaries	Text								
0 No	Yes									
1 No	No	Summary	for NW	I &ldnwi						
Selected outpu	it attribute	s								
Output type				. Printer						
Form of outp	out			. Detail						
Line wrappin	g			. No						
Printer Output										
Printer devi	ce			. *PRINT						
Report size										
Length .				. 66 (default	)					
Width				. 132						
Report start	line			. 6 (default	)					
Report end 1	ine			. 60 (default	)					
Report line	spacing			. Single space						
Print defini	tion			. No						
Printer Spoole	d Output									
Spool the ou	tput			. (Defaults to	value in prim	nt file, QPQ	UPRFIL)			
Form type .				. (Defaults to	value in prim	nt file, QPQ	UPRFIL)			
Copies				. 1						
Hold				. (Defaults to	value in prim	nt file, QPQ	UPRFIL)			
Cover Page										
Print cover	page			. No						
Cover page	e title									
Page headings	and footing	s								
Print standa		ding		. Yes						
Page headi										
Page footi	ng									
			IBM Q	uery/400		11/17/96	20:18:29	Page	4	
	* * * * *	EN	) 0 F	OUERY	PRINT *	* * * *				

Figure 229. IDLC\_UTIL Query Definition, Part 2

# Appendix I. Guidelines for Interpreting Performance Data

Table 16. Resource Utilization Guidelines			
Resource Description	Good	Acceptable	Poor
CPU 1 Processor (1)	<0.70	0.70-0.80	0.80<
CPU 2 Processors (1)	<0.76	0.76-0.83 (2)	0.83< (2)
CPU 3 Processors (1)	<0.79	0.79-0.85 (2)	0.85< (2)
CPU 4 Processors (1)	<0.81	0.81-0.86 (2)	0.86< (2)
DISK ARM	<0.40	0.40-0.50	0.50<
DISK IOP	<0.60	0.70	0.80<
IOP Local	<0.25	0.35	0.40<
IOP Multifunction	<0.35	0.45	0.50<
IOP Communications	<0.35	0.45	0.50<
IOP Lan (Interactive)	<0.35	0.40	0.50<
LINE Remote (Interactive)	<0.30	0.35	0.40<
FSIOP Read/Write Cache Hit (3)	>0.90	0.90	0.90<
FSIOP OS/2 CPU Utilization (3)	<0.80	0.80	0.80<

Note:

1. This refers to CPU utilization of jobs whose priorities are equal to or higher than the interactive job priorities.

2. In a multiple processor environment, the guidelines are more sensitive to exceeding the values specified in the "good" column.

3. You need to query the file QAPMIOPD to obtain these values. See the index entry for *Integrated PC Server* for sample queries.

Table 17. Machine Pool, Non-Database Page Faults				
Main Storage Size	Good	Acceptable	Poor	
All Systems	< 1 0	10-15	15<	

Table 18. Sum of Database and Non-Database Page Faults for Each Pool			
Model	Good	Acceptable	Poor
9402 mod400 2130 2131 2132 2133	< 5 0	50-100	100<
9406 mod500 2140 2141	< 5 0	50-100	100<
9406 mod510 2144, 9406 mod530 2150, 50S 2121	<150	150-300	300<
9406 mod530 2151 2152 2153, 53S 2154 2155 2156	<200	200-325	325<

Table 19. Sum of Database and	Table 19. Sum of Database and Non-Database Page Faults in All Pools			
Model	Good	Acceptable	Poor	
9402 mod400 2130 2131 2132 2133	<75	75-125	125<	
9406 mod500 2140 2141	<75	75-125	125<	
9406 mod500 2142 2143, 40S 2110, 50S 2120	<150	150-350	350<	
9406 mod510 2144, 9406 mod530 2150, 50S 2121	<300	300-600	600<	
9406 mod530 2151 2152 2153, 53S 2154 2155 2156	<400	400-650	650<	

Table 20. Ratio of Wait-to-Ineligible/Active-to-Wait				
Good	Acceptable	Poor		
<.1	.125	.25<		

/ain Storage Size (MB)	*Base Pool size (KB)/ Activity Level	*Interact Pool Size (KB)/Activity Level
< 96	18340/9	42800/21
128	25930/9	60503/20
256	61690/21	14394/48
288	68170/13	159063/32
480	121810/24	284223/57
512	127990/17	298643/62
768	199510/26	465523/62
800	205450/18	479383/43
1024<	268030/24	625403/57

Table 22. QINTER Activity Level Factor				
Main Storage Size (MB)	Activity Level Factor (KB)			
< 96	2000			
128 - 256	3000			
288 - 480	5000			
512 - 768	7500			
800 - 1024	11000			
1024 <	15000			

Number of Writers	Initial Size (KB)	Activity Levels
1	1500	1
2	1700	2
3	1900	3
4	2100	4
4 <	2300	5

Table 24. QSPL Pool Sizes and Activity Levels for Non-Advanced Function Printers				
Number of Writers	Initial Size (KB)	Activity Level		
1	256	1		
2	256	2		
3	256	3		
4	292	4		
4 <	352	5		

Table 25. Batch Job Storage Guidelines				
Batch Job Type	Initial Storage (KB)	Comments		
Short-Running Production	1250	May run in 800KB; may require as much as 1750KB		
Long-Running Production	2500	May run in 1250KB; may require as much as 3500KB		
Compiles	16000	May run in 12000KB; runs better in 32000KB		
Reformat (Sort)	2000	Smaller sorts may run in 1500KB; larger sorts may use 3000KB		
Queries	2000	Small queries run in 1500KB; larger queries may use up to 4000KB		
Save/Restore	2000	Some SAVE operations run in 1000KB; others may need 6000KB for maximum throughput.		

Table 26. Authority Lookup Exceptions versus CPU % Cost - ILE DFTAG(*NO) or OPM													
Exceptions per second	2130	2131	2132	2133	2140	2141	2142	2143	2144	2150	2151	2152	2153
25	13	9	6	5	9	6	4	2	2	1	1	1	0
50	26	17	12	9	17	12	9	5	4	3	2	1	1
100	52	34	24	18	34	24	17	10	7	6	5	3	2
300			71	56		71	52	30	22	18	14	9	6
500				92			86	50	37	30	23	15	10
700								70	52	42	32	21	14
1000								99	74	59	45	29	19
2000											90	59	39
3000												88	58
4000													77
5000													97
6000													

Exceptions per second	2130	2131	2132	2133	2140	2141	2142	2143	2144	2150	2151	2152	2153
5	87	58	40	31	58	40	29	17	12	10	8	5	3
10			80	62		80	58	34	25	20	15	10	7
15				94			87	50	37	30	23	15	10
20								67	50	40	31	20	13
25								84	62	50	38	25	16
30									75	60	46	30	20
35									87	70	53	35	23
40									99	80	61	40	26
45										90	69	45	29
50											76	50	33
100												99	65
150													98

Table 28. Siz	Table 28. Size Exceptions versus CPU % Cost - OPM												
Exceptions per second	2130	2131	2132	2133	2140	2141	2142	2143	2144	2150	2151	2152	2153
10	26	17	12	9	17	12	9	5	4	3	2	1	1
20	52	34	24	18	34	24	17	10	7	6	5	3	2
30	77	52	35	28	52	35	26	15	11	9	7	4	3
40		69	47	37	69	47	34	20	15	12	9	6	4
50		86	59	46	86	59	43	25	18	15	11	7	5
100				92			86	50	37	30	23	15	10
200								99	74	60	45	29	19
300										89	68	44	29
400											90	59	39
500												74	48
600												88	58
700													68
800													77
900													87
1000													97

Table 29. Siz	Table 29. Size Exceptions versus CPU % Cost - ILE DFTAG(*YES)												
Exceptions per second	2130	2131	2132	2133	2140	2141	2142	2143	2144	2150	2151	2152	2153
1000	15	9	7	5	10	7	5	3	2	2	1	1	1
2000	30	20	14	11	20	14	10	6	4	3	3	2	1
3000	44	30	20	16	30	20	15	9	6	5	4	3	2
4000	59	39	27	21	39	27	20	11	8	7	5	3	2
5000	74	49	34	27	49	34	25	14	11	9	6	4	3
10000		99	68	53	99	68	49	29	21	17	13	8	6
15000				80			74	43	32	26	19	13	8
20000							99	57	42	34	26	17	11
25000								71	53	43	32	21	14
30000								86	63	51	39	25	17
35000								100	74	60	45	30	19
40000									85	68	52	34	22
45000									95	77	58	38	25
50000										85	65	42	28
55000										94	71	46	31

Table 30. Siz	Table 30. Size Exceptions versus CPU % Cost - ILE DFTAG(*NO)												
Exceptions per second	2130	2131	2132	2133	2140	2141	2142	2143	2144	2150	2151	2152	2153
1000	11	7	5	4	7	5	4	2	2	1	1	1	0
2000	22	15	10	8	15	10	7	4	3	3	2	1	1
3000	34	22	15	12	22	15	11	6	5	4	3	2	1
4000	45	30	21	16	30	21	15	9	6	5	4	3	2
5000	56	37	26	20	37	26	19	11	8	6	5	3	2
10000		75	51	40	75	51	37	22	16	13	10	6	4
15000			77	60		77	56	32	24	19	15	10	6
20000				80			75	43	32	26	20	13	8
25000							93	54	40	32	25	16	10
30000								65	48	39	29	19	13
35000								76	56	45	34	22	15
40000								86	64	52	39	26	17
45000								97	72	58	44	29	19
50000									80	65	49	32	21
55000									88	71	54	35	23

Table 31. Ve	erify Exc	eptions	versus (	CPU %	Cost - O	PM							
Exceptions per second	2130	2131	2132	2133	2140	2141	2142	2143	2144	2150	2151	2152	2153
25	13	9	6	5	9	6	4	3	2	2	1	1	0
50	26	17	12	9	17	12	9	5	4	3	2	1	1
100	52	35	24	19	35	24	17	10	7	6	5	3	2
300			72	56		72	52	30	22	18	14	9	6
500				93			87	50	37	30	23	15	10
700								70	52	42	32	21	14
900								90	67	54	41	27	18
1000									74	60	46	30	20
2000											91	59	39
3000												89	59
4000													78
5000													98

Table 32. Ve	erify Exc	eptions	versus (	CPU %	Cost - IL	E DFTA	G(*YES	)					
Exceptions per second	2130	2131	2132	2133	2140	2141	2142	2143	2144	2150	2151	2152	2153
25	13	8	6	5	8	6	4	2	2	1	1	1	0
50	25	17	12	9	17	12	8	5	4	3	2	1	1
100	50	34	23	18	34	23	17	10	7	6	4	3	2
300			70	54		69	50	29	22	17	13	9	6
500				90			84	49	36	29	22	14	9
700								68	50	41	31	20	13
900								88	65	52	40	26	17
1000								97	72	58	44	29	19
2000											88	58	38
3000												86	57
4000													76
5000													94

Table 33. Ve	erify Exc	eptions	versus (	CPU %	Cost - IL	E DFTA	G(*NO)						
Exceptions per second	2130	2131	2132	2133	2140	2141	2142	2143	2144	2150	2151	2152	2153
25	13	9	6	5	9	6	4	2	2	2	1	1	0
50	26	17	12	9	17	12	9	5	4	3	2	1	1
100	52	34	24	18	34	24	17	10	7	6	5	3	2
300			71	55		71	52	30	22	18	14	9	6
500				92			86	50	37	30	23	15	10
700								70	52	42	32	21	14
900								89	66	54	41	26	17
1000								99	74	59	45	29	19
2000											90	59	39
3000												88	58
4000													77
5000													97

Table 34. Queuing Multiplier Based on CPU Utilization									
u %	QM (1 Processor)	QM (2 Processors)	QM (3 Processors)	QM (4 Processors)					
70	3.33	1.96	1.52	1.32					
75	4.00	2.29	1.73	1.46					
80	5.00	2.78	2.05	1.69					
85	6.66	3.60	2.59	2.09					
90	10.00	5.26	3.69	2.91					
95	20.00	10.25	7.01	5.39					

**Note:** As the Queuing Multiplier increases above 4, performance problems with the resource (CPU) should be expected. This is a conservative guideline as multi-processors can deliver acceptable performance with higher Queuing Multiplier values. PRTTNSRPT - Job Summary report shows CPU Queuing Multiplier.

The contents of Table 35 should be viewed as "indicators" that the associated job must be analyzed for the reasonability of the work being done. For example, a job may be updating two sets of similar database data. This can cause the count of physical I/Os to be high. If this double updating is actually required, exceeding the database I/O guidelines must be accepted.

Type of Synchronous I/O Number of I/Os - Internal Disk(*) Number of I/Os - 9337(*)							
DB Reads	20 or less	25 or less					
DB Writes	10 or less	13 or less					
Total I/O 50 or less 65 or less							

and 6502 disk controller write cache support may support higher disk I/O rates satisfactorily.

Job Activity	Physical I/O Type	Logical I/O Type	Fault Type	I/O Counted In:
Read a record randomly	S-DBR	Read	DB	Job
Read a record sequentially	A-DBR	Read		Job
Search access path	S-DBR	Other	DB	Job
Re-page a record	S-DBR		DB	Job
Update a record	A-DBW	Other		Job
Add a record	A-DBW	Write		Job
Delete a record	A-DBW	Other		Job
Update a record (Force Write Rat > 0)	S-DBW	Other		Job
Add a record (FWR > 0)	S-DBW	Write		Job
Delete a record (FWR > 0)	S-DBW	Other		Job
Open a file	S-NDBR		NDB	Job
Close a file	S-DBW			Job
Journaling	S-NDBW			Job
Get a user program	S-NDBR		NDB	Job
Re-page a user program	S-NDBR		NDB	Job
Get a system (LIC) program	S-NDBR			Job
Read the PAG	S-NDBR		NDB if purge is *NO	Job
Re-page the PAG	S-NDBR		NDB	Job
Write the PAG	S-NDBW			Job (PURGE(*YES only)
Read a data area/data queue	S-NDBR		NDB	Job
Read a subfile	S-NDBR		NDB	Job
Modify a source member using SEU	S-NDBR		NDB	Job
Display messages	S-NDBR		NDB	Job
PCS File Transfer to AS/400	S-NDBR/ S-DBW		NDB	PCS
PCS File Transfer from AS/400	S-NDBR		NDB	PCS
PCS Shared Folders	S-NDBW/ A-NDBW			System

The contents of Table 37 includes average disk service time, internal lab batch benchmark run time, and Ops/Sec/GB guideline values that can be used as a reference when considering upgrading to newer disk configurations and manually modeling batch job run time based on disk I/O operations.

Using BEST/1 is still recommended for capacity planning, although you have to do additional calculations for estimating batch job run time. The table is an excerpt from the *Performance Capabilities Reference* manual.

Disk Model and IOP	GB of Storage per Arm	Typical Service Time	Batch Runtime (Hrs)	Batch Non-RAID Ops/Sec per GB	Batch RAID Ops/Sec pe GB
9337-010 with 6500	.542	19.0	5.6	39	NA
9337-015 with 6500	.542	15.0	5.2	49	NA
9337-020 with 6500	.970	19.0	5.6	22	NA
9337-025 with 6500	.970	16.6	5.2	25	NA
9337-040 with 6500	1.967	17.1	5.2	12	NA
9337-110 with 6500	.407	19.0	7.8	NA	23
9337-115 with 6500	.407	15.0	7.2	NA	30
9337-120 with 6500	.728	19.0	7.8	NA	13
9337-125 with 6500	.728	16.6	7.2	NA	15
9337-140 with 6500	1.475	17.1	7.2	NA	07
9337-210 with 6501	.542	12.1	4.3	51	38
9337-215 with 6501	.542	09.5	4.0	66	49
9337-220 with 6501	.970	12.1	4.3	29	21
9337-225 with 6501	.970	10.7	4.0	33	24
9337-240 with 6501	1.967	11.0	4.0	16	12
9337-420 with 6501	.970	10.0	3.8	38	34
9337-440 with 6501	1.967	08.6	3.5	22	20
9337-480 with 6501	4.194	08.9	3.6	10	09
320MB with 6530	.320	17.7	5.8	71	NA
400MB with 6530	.400	16.6	5.7	60	NA
988MB with 6530	.988	15.6	5.4	26	NA
6602 with 6530	1.031	13.5	4.4	29	NA
6603 with 6530	1.967	14.0	4.4	15	NA
6606 with 6530	1.967	11.5	4.0	18	NA
6607 with 6530	4.194	11.9	4.0	08	NA
320MB with 6502	.320	17.7	5.8	71	NA
400MB with 6502	.400	16.6	5.7	60	NA
988MB with 6502	.988	15.6	5.4	26	NA
6602 with 6502	1.031	10.1	3.9	34	28
6603 with 6502	1.967	10.5	3.9	17	14
6606 with 6502	1.967	08.7	3.6	21	17
6607 with 6502	4.194	09.0	3.6	09	08
2800	.320	19.5	5.9	64	NA
2801	.988	16.8	5.3	24	NA
2802	1.031	13.5	5.0	29	NA

• The preceding figures are averages with the disks at approximately 40% busy. The preceding values were derived from a Rochester lab unique batch application and do not include all test results. The Performance Capabilities Reference manual contains the complete test results.

- Note that the 6502 (internal) and 6501 (external IOP) have 2MB and 4MB write caches which enable a significant number of application output operations to be performed per physical I/O operation.
- For both the 9337-4xx and the 6606 and 6607 disk, the non-RAID-5 and RAID-5 physical disk I/O guidelines are close to each other.
- The service times shown are in milliseconds for non-RAID-5 configurations. When RAID-5 is used, add 2 milliseconds to service time for a reasonable approximation.

### Appendix J. Special Notices

This publication provides an explanation to enable a better understanding of AS/400 communications and networking performance. It is also intended to help customers, IBM system engineers, and IBM business partners who want to tune the IBM AS/400 system to improve communications performance. The information in this publication is not intended as the specification of any programming interfaces that are provided by the AS/400 Performance Tools, 5716-PT1, or the AS/400 Query/400, 5716-QU1. See the PUBLICATIONS section of the IBM Programming Announcement for the AS/400 Performance Tools, 5716-PT1, and AS/400 Query/400, 5716-QU1 for more information about which publications are considered to be product documentation.

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## Appendix K. Related Publications

The publications listed in this section are considered particularly suitable for a more detailed discussion of the topics covered in this redbook.

#### K.1 International Technical Support Organization Publications

For information on ordering these ITSO publications see "How to Get ITSO Redbooks" on page 393.

- AS/400 Client/Server Performance using the Windows Client, SG24-4526-01
- AS/400 Performance Management V3R6/V3R7, SG24-4735

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#### K.3 Other Publications

These publications are also relevant as further information sources.

- AS/400 Work Management Guide, SC41-4306
- AS/400 Performance Tools/400, SC41-3340
- Query/400 User's Guide, SC41-9614-02
- AS/400 BEST/1 Capacity Planning Tool, SC41-3341
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 AS/400 Programming: Version 3 Release 1 Performance Capabilities Reference, ZC41-8166 This document contains internal laboratory performance test results that are helpful in setting reasonable expectations and understanding the relationship between system resources and certain system parameter values.

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### Index

### **Special Characters**

\*BASE 19, 42

### **Numerics**

5494 response time 39

## Α

ACCONM 186 ACNTID 186 active jobs working with 21 activity and disk I/O cross reference chart, job 387 activity level 19, 42 activity report printing 30 actuator 24 advisor 27 advisor, use 28 AFP 381 analysis cycle 27 analysis, application performance 44 ANTDUP 186 AnyNet 197 ANZACCGRP command 33, 51 ANZPFRDTA command 27 application level 43 application performance analysis 44 APPN 181 appn information displaying 187 APPNALL 190 assigning jobs 54 asynchronous 25 authority lookup 37 Authority Lookups, CPU Cost 381 auto-delete 184 automatic data collection 5

# В

babble errors 109 BATCH, Job Storage Guidelines 381 beacon frames 106 bibliography 391 bottleneck 89 brackets 165 bridge 117, 125 broadcast search 193 burst error 108

### С

capacity planning 53 BEST/1 53 Change Network Attributes (CHGNETA) command 188 changing network attributes 188 charging resource utilization 44 chart, job activity and disk I/O cross reference 387 checksum errors detected 141 CHGNETA (Change Network Attributes) command 188 CHGRTGE 17 CL Program 242, 261 class-of-service (COS) 164 class-of-service (COS) update 189 class, error 79 CNNPOLLTMR 156 CNOS 166 code, secondary 79 collecting data 2 collision 104 command, CL Change Network Attributes (CHGNETA) 188 CHGNETA (Change Network Attributes) 188 collecting 2 Copy Spooled File (CPYSPLF) 87 CPYSPLF (Copy Spooled File) 87 Display APPN Information (DSPAPPNINF) 187 Display Historical Graph (DSPHSTGPH) 29 Display Performance Graph (DSPPFRGPH) 29 Display Program Temporary Fix (DSPPTF) 15 DSPAPPNINF (Display APPN Information) 187 DSPHSTGPH (Display Historical Graph) 29 DSPPFRGPH (Display Performance Graph) 29 DSPPTF (Display Program Temporary Fix) 15 End Communications Trace (ENDCMNTRC) 80 ENDCMNTRC (End Communications Trace) 80 Print Activity Report (PRTACTRPT) 30 Print Component Report (PRTCPTRPT) 31 Print Error Log (PRTERRLOG) 14 Print Job Report (PRTJOBRPT) 31 Print Lock Report (PRTLCKRPT) 31 Print Pool Report (PRTPOLRPT) 31 Print Resource Report (PRTRSCRPT) 31 Print System Report (PRTSYSRPT) 31 Print Trace Report (PRTTRCRPT) 31 Print Transaction Report (PRTTNSRPT) 31 PRTACTRPT (Print Activity Report) 30 PRTCPTRPT (Print Component Report) 31 PRTERRLOG (Print Error Log) 14 PRTJOBRPT (Print Job Interval Report) 31 PRTLCKRPT (Print Lock Report) 31 PRTPOLRPT (Print Pool Report) 31

command, CL (continued) PRTRSCRPT (Print Resource Report) 31 PRTSYSRPT (Print System Report) 31 PRTTNSRPT (Print Transaction Report) 31 PRTTRCRPT (Print Trace Report) 31 Send Program Temporary Fix Order (SNDPTFORD) 15 SNDPTFORD (Send Program Temporary Fix Order) 15 Start Communications Trace (STRCMNTRC) 80 Start Database Monitor (STRDBMON) 4 Start Performance Monitor (STRPFRMON) 1, 3 STRCMNTRC (Start Communications Trace) 80 STRDBMON (Start Database Monitor) 4 STRPFRMON (Start Performance Monitor) 1.3 Work with Active Jobs (WRKACTJOB) 21 Work with Disk Status (WRKDSKSTS) 23 Work with System Activity (WRKSYSACT) 24 Work with System Status (WRKSYSSTS) 16 Work with System Values (WRKSYSVAL) 11 WRKACTJOB (Work with Active Jobs) 21 WRKDSKSTS (Work with Disk Status) 23 WRKSYSACT (Work with System Activity) 24 WRKSYSSTS (Work with System Status) 16 WRKSYSVAL (Work with System Values) 11 communications IOP 40, 89 communications performance 39 communications trace 173, 179 ending 80 starting 80 component interval 32 component report 32 printing 31 conclusions 29 conclusions and interval conclusions, recommendations, 28 congestion 100, 137, 153 connect poll retries 155 connections 164 considerations BEST/1 69 communications IOP 64 contention loser 190 contention winner 190 control point (CP) capabilities 191 control point session activation 190 controllers 61 convert performance data 51 Copy Spooled File (CPYSPLF) command 87 copying spooled file 87 Counters 248 CPI communications trace 173 CPMGR 182 CPPS 182 CPPS recommendations 192 CPU % cost, size exception 382

CPU % cost, verify exception 384, 386 CPU performance 34 CPU utilization 36 CPYSPLF (Copy Spooled File) command 87 CSMA/CD 104 cycle, problem analysis 27

### D

data compression 172 data conversion 51 data format 175 data link reset 155 data units received in error 138 data units retransmitted 138 datagram 176 DATATYPE parameter 28 deactivation 190 deletions 188 description, resource 379 detailed report 30 DFTPKTSIZE 133, 225 DFTWDWSIZE 133, 225 diagnostic code 136, 138 directory services registrations 188 disconnect frame 113 disconnect mode 113 disk I/O cross reference chart, job activity and 387 disk performance report 37 disk physical I/O per transaction guidelines 386 disk status working with 23 disk utilization 38 Display APPN Information (DSPAPPNINF) command 187 Display Historical Graph (DSPHSTGPH) command 29 Display Performance Graph (DSPPFRGPH) command 29 Display Program Temporary Fix (DSPPTF) command 15 displaying appn information 187 historical graph 29 performance graph 29 program temporary fix 15 DS 182 DSPACCGRP command 33, 51 DSPAPPNINF (Display APPN Information) command 187 DSPHSTGPH (Display Historical Graph) command 29 DSPPFRDTA command 43 DSPPFRGPH (Display Performance Graph) command 29 DSPPTF (Display Program Temporary Fix) command 15 DTACPR 171 DUPLEX 161

# Ε

ELLC 225 End Communications Trace (ENDCMNTRC) command 80 ENDCMNTRC (End Communications Trace) command 80 ending communications trace 80 ENDJOBTRC command 48 ENDSRVJOB command 46 EORn, End of Response time 45 EOTn,End of Resource usage 45 Error class 79 error log 178 printing 14 error log, communications 40 Ethernet frame size 124 Ethernet Queries 258 ETM1R 258 ETMBBE 109 ETMDCN 258 ETMM1R 258 ETMSQE 109 exception CPU % cost, size 382 exception CPU % cost, verify 384, 386 exceptions 37 exceptions, with BEST/1 60

# F

FAIRPLLTMR 157 file server IOP 41 flow control 176 format trace data 84 frame copied error 108 frame reject 113 FRAMERTY 157 frequency error 108 FTP 176

# G

guidelines for interpreting performance data 379 guidelines, disk physical I/O per transaction 386 guidelines, resource utilization 379

# Н

hard errors 106 high level data link control (HDLC) 127 histogram,using 27 historical graph displaying 29

### I

I/O Task 304

ICF communications trace 173 IDLTMR 157 Indicators Ethernet 262 Token-ring 243 information frame 131, 150, 215 INPACING 167, 168 Integrated PC Server 122 Integrated PC Server performance data queries 345 Integrated PC Server performance data query 345 internal session level pacing 167 interpreting performance data, guidelines for 379 interval conclusions, recommendations, and conclusions 28 IOP 89 changing type 64 creating IOP feature 65 LAN 61, 63 performance considerations 64 T2 Station Task 308 IOP utilization 40, 89, 143, 158 IP header 175 IPL 12 **ISDN 207** ISDN (X.25) 223 isolating 106

# J

jabber errors 109 job activity and disk I/O cross reference chart 387 job classification 54 job report printing 31 job trace 46 journal writes 37

# L

LAN IOP 61, 63 LAN lines 41 LAN Overheads 254 LAN, definition of 63 LANACCPTY 122 LANACKFRQ 118, 120 LANACKTMR 118 LANCNNRTY 116 LANCNNTMR 116 LANFRMRTY 111, 117 LANINACTMR 121 LANMAXOUT 105, 120 LANRSPTMR 111, 117, 118 LANWDWSTP 121 LIC task 38 limitations BEST/1 69 line creating line resource 67 distribution of characters 67 line error 131, 150 line error (IDLC) 221 line error (ISDN) 213 line IOM task 172 line transmission time 169 line utilization 97, 128, 147 line utilization (IDLC) 218 line utilization (LAP-D) 209 lines utilization 40 LLC congestion 142 LLC protocol data units discarded 140 LLC reject 139 local area network (LAN) 97 local location list 189 local not ready 134 local WS IOP 40 lock report printing 31 LOCMGR 182 logical link control (LLC) 127, 137

## Μ

MAC error 106 MAC Errors 248 machine pool 33 machine pool, size 18 MAXFRAME 124, 139, 152, 170, 224 maximum transmission unit (MTU) 176 MAXLENRU 170, 195, 225 MAXOUT 152 MAXPKTSIZE 133, 225 memory performance 33 memory usage 33 memory utilization 33 mode update 189 model 54, 57 MODULUS 133, 152, 225 MSCP 182 MTU (maximum transmission unit) 176 multi-function IOP 89 multifunction IOP 40

# Ν

NDB page fault 33 NDMPOLLTMR 156 network attributes changing 188 network status 179 node congestion 185 NODETYPE 183 non-isolating 106 not ready 100

# 0

objectives, performance 32

options, performance review 27 OUTLMT 157 OUTPACING 167, 168, 196 overhead 113 Overheads 254

# Ρ

packet 136 packet level control (PLC) 127, 136 PAG 51 page fault, NDB 33 performance communications IOP 64 Ethernet 262 Token-ring 243 performance analysis, application 44 performance data, guidelines for interpreting 379 performance graph displaying 29 performance graphics 29 performance management/400 5 performance objectives 32 performance problem 33 performance review options 27 performance tools, reports 31, 43 performance utilities, programmer 46 physical I/O per transaction guidelines, disk 386 PM/400 5 polling activity 95 polling, effect on utilization 95 POLLLMT 157 POLLPAUSE 157 POLLPRTY 158 POLLRSPDLY 158 pool report printing 31 Print Activity Report (PRTACTRPT) command 30 Print Component Report (PRTCPTRPT) command 31 Print Error Log (PRTERRLOG) command 14 Print Job Report (PRTJOBRPT) command 31 Print Lock Report (PRTLCKRPT) command 31 Print Pool Report (PRTPOLRPT) command 31 Print Resource Report (PRTRSCRPT) command 31 Print System Report (PRTSYSRPT) command 31 Print Trace Report (PRTTRCRPT) command 31 Print Transaction Report (PRTTNSRPT) command 31 printer file for DSPPFRGPH and DSPHSTGPH 29 printer file, QPPGGPH 29 printing activity report 30 component report 31 error log 14 job report 31 lock report 31 pool report 31 resource report 31 system report 31 trace report 31

printing (continued) transaction report 31 priority 122 problem analysis cycle 27 problem analysis, application level 43 problem analysis, system-wide 33 problem analysis, user level 42 problems, performance 33 Process Access Group 51 Processor Usage 302 Program 242, 261 program temporary fix displaying 15 program temporary fix order sending 15 programmer performance utilities 46 PRTACTRPT (Print Activity Report) command 30 PRTCPTRPT (Print Component Report) command 31 PRTERRLOG (Print Error Log) command 14 PRTJOBRPT (Print Job Report) command 31 PRTLCKRPT (Print Lock Report) command 31 PRTPOLRPT (Print Pool Report) command 31 PRTRSCRPT (Print Resource Report) command 31 PRTSYSRPT (Print System Report) command 31 PRTTNSRPT (Print Transaction Report) command 31 PRTTRCRPT (Print Trace Report) command 31 PTF commands 14

# Q

QACTJOB 12 QADLACTJ 12 QAPMAPPN 181 QAPMCIOP 89, 143, 159, 239 QAPMECL 102, 239 QAPMETH 102, 239 QAPMHDLC 147 QAPMIDLC 209 QAPMJOBS 144, 160, 181 QAPMLAPD 208 QAPMMIOP 89 QAPMSAP 177 QAPMSNA 163, 181 QAPMSTNE 103, 239 QAPMSTNL 103, 239 QAPMX25 127, 209 QCMN 69 QCMNRCYLMT system value 13 QHST, messages 40 QINTER 19, 42 QINTER, Activity Level Factor 380 QLLC 225 QLUS 166, 182 QLUS function 165 QLUS task 183 QMAXACTLVL 12 QMCHPOOL system value 12 QPFRADJ system value 13

QPPGGPH printer file 29 QPPTTRC1, printer file 49 QPPTTRC2, printer file 49 QSPL, Activity Level for AFP 381 QSPL, Activity Levels 381 QSPL, Pool Sizes 381 QSPL, Pool Sizes for AFP 381 QSYSOPR, messages 40 QTOTJOB 11 queuing multiplier 386

### R

ratio of wait-to-ineligible/active-to-wait 380 receive congestion 104, 108 recommendations 28 BEST/1 59 recommendations, conclusions and interval conclusions 28 recommendations, with BEST/1 60 reference code 79 remote job 144, 160 remote lines 41 remote location list 189 remote not ready 134 report detailed 30 summary 30 report, component 32, 37 report, job summary 43 report, pool 38 report, resource 38, 40 report, system 37 report, transaction 38 report, transaction detail 44 report, transaction summary 43, 44 report, transition detail 45 reset indication 142 resource description 379 resource report 98 printing 31 Resource Usage resource utilization guidelines 379 resource utilization, highest 43 resources utilization communications line 61 LAN and WAN 61 multifunction IOP 61 response time - remote workstations 39 response time buckets 39 response time, remote workstation 39 ring error monitor (REM) 106 routing entries 17 RRSPTIME 39 run priority 17

### S

SABME 113 SDLC 147 search request 193 secondary code 79 segmentation 170 Send Program Temporary Fix Order (SNDPTFORD) command 15 sending program temporary fix order 15 sequence errors 100 session level pacing 166 session priority 163 session setup 192 session type 163 sessions 165 signal quality error 109 size 37 size exception CPU % cost 382 SNA 163 SNA trace 173 SNDPTFORD (Send Program Temporary Fix Order) command 15 soft errors 106 SOR, Start of Resource Utilization 45 SOTn, Start of Transaction 45 spooled file copying 87 Start Communications Trace (STRCMNTRC) command 80 Start Database Monitor (STRDBMON) command 4 Start Performance Monitor (STRPFRMON) command 1, 3 starting communications trace 80 Station IOM 298 status of trace 83 stop/wrap 82 storage pool routing 17 STRCMNTRC (Start Communications Trace) command 80 STRDBMON (Start Database Monitor) command 4 STRJOBTRC command 48 STRPFRMON (Start Performance Monitor) command 1, 3 STRPFRMON command 39 STRSRVJOB command 46 Subsystem description 17 summary report 30 supervisory frame 131, 150, 215 synchronous 25 system activity working with 24 System Name 295 system performance 33 System Processor 302 system report 31, 98 printing 31

system status working with 16 system values working with 11 system-wide problem analysis 27

#### Т

T2 Station 298, 308 T2 station I/O manager 182 T2 station IOM task 172 Table ID 79 TCP header 175 TCP/IP 175 tcp/ip-assist function 177 tdus 184 timeout 141 timeouts 111 token error 108 Token-ring CL Program 242 token-ring frame size 124 Token-ring IOM 300 token-ring queries 239 top 10 30 topology database update 191 topology database updates (TDUs) 186 topology entry removal 187 topology exchange 186 topology maintenance 184 trace direction 82 trace points 45 trace report printing 31 trace, communication 80 trace, job 46 trace, starting 80 transaction detail 44 transaction report printing 31 transition guideline 19 transmission group update 185 transmission priority 195 transmission queue 168 TRCFULL(\*STOPTRC) 80 TRCJOB command 46 TRNLOGLVL 110 TRNUSAGE 240 TRS 182

# U

UDP header 175 UNBIND 166 unnumbered frame 131, 151 unnumbered information frame 216 usage, memory 33 user level 42 using performance tools/400 27 utilization, CPU 36 utilization, CPU 36 utilization, disk 38 utilization, lines and IOPs 40 utilization, local workstation IOP 39 utilization, memory 33 utilization, twinaxial 39

## V

values, system 11 verify exception CPU % cost 384, 386

### W

wait-to-ineligible/active-to-wait, ratio of 380 WAN, definition of 63 WCB table 11 window 176 Work with Active Jobs (WRKACTJOB) command 21 Work with Disk Status (WRKDSKSTS) command 23 Work with System Activity (WRKSYSACT) command 24 Work with System Status (WRKSYSSTS) command 16 Work with System Values (WRKSYSVAL) command 11 working with active jobs 21 disk status 23 system activity 24 system status 16 system values 11 workload 54, 69 WRKACTJOB (Work with Active Jobs) command 21 WRKACTJOB command 43 WRKACTJOB performance 11 WRKDSKSTS (Work with Disk Status) command 23 WRKSHRPOOL command 13 WRKSYSACT (Work with System Activity) command 24 WRKSYSACT command 43 WRKSYSSTS (Work with System Status) command 16 WRKSYSVAL (Work with System Values) command 11

# Х

X.25 127 X.25 (ISDN) 223 X.31 223 X25CNNTMR 141 X25RSPTMR 141

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