

Dell/EMC CX3 Series

Oracle RAC 10g

Reference Architecture Guide

Abstract

This document provides an overview of the architecture of the EMC solution for Oracle RAC 10g on Dell/EMC CX3 Series arrays over FPC. This solution was developed by the EMC Commercial Solutions Practice.

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Oracle RAC 10g Dell/EMC CX3 Series FCP Reference Architecture Guide

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Preface

As part of an effort to improve and enhance the performance and capabilities of its product line, EMC from time to time releases revisions of its hardware and software. Therefore, some functions described in this guide may not be supported by all revisions of the software or hardware currently in use. For the most up-to-date information on product features, refer to your product release notes.

This document provides an overview of the architecture of the EMC solution for Oracle RAC 10g on Dell/EMC CX3 Series arrays over FPC. This solution was developed by the EMC Commercial Solutions Practice.

Purpose

Information in this document can be used as the basis for a solution build, white paper, best practices document, or training.

Information in this document can also be used by other EMC organizations (for example, the technical services or sales organization) as the basis for producing documentation for a technical services or sales kit.

Audience

This document is intended for Dell and EMC customers, partners, and personnel.

Scope

This document describes the architecture of an EMC solution built and tested by the EMC Commercial Solutions Practice, located in Research Triangle Park, N.C.

Implementation instructions and best practices are beyond the scope of this document. See the related documents, below.

Related documents

The following documents, available from the EMC Powerlink website (<http://powerlink.emc.com/>) provide additional, relevant information:

- ◆ Oracle Database 10g/Oracle RAC 10g CLARiiON CX3 Series FCP Best Practices Planning
- ◆ Oracle Database 10g/Oracle RAC 10g CLARiiON CX3 Series FCP Applied Technology
- ◆ Oracle RAC 10g presentations and white papers on EMC Powerlink

Documentation for Dell/EMC CX3 series storage is available from ww.dell.com/storage,

Chapter 1 Solution Overview

This chapter presents these topics:

The business challenge	1-2
The technology solution	1-2

The business challenge

Mid-size enterprises face the same challenges as their larger counterparts when it comes to managing database environments. Typical challenges include cost, control, resource utilization, and scaling.

Oracle RAC 10g supports numerous functions ranging from manufacturing to online web applications. These deployments may be in smaller data centers that often support applications ranging from custom database applications to standard packages such as SAS, Siebel, PeopleSoft, and SAP, or they may be in large, centralized data centers.

Mid-size enterprises need scalable and RAID-protected storage but must be extremely cost-conscious. They may lack the IT resources to deploy, manage, and maintain complex environments at the departmental level.

The technology solution

The Oracle RAC 10g Dell/EMC CX3 Series FCP solution enables a mid-size enterprise to deploy a Dell/EMC storage area network (SAN) architecture with FCP connectivity for its Oracle RAC 10g database applications.

Solution advantages

The solution offers the following advantages:

Benefit	Details
Lower total cost of ownership (TCO)	Lower acquisition, administration, and maintenance costs
Manageability	Easier implementation, provisioning, and LUN management
Simplified Real Application Clusters (RAC) implementation	Leverages ASM for simple administration of storage
Higher availability	Implements a clustering architecture that provides very high levels of data availability
Increased flexibility	Easily make databases, or copies of database, available (via clones) to other servers using storage based cloning
Improved data protection	Integrate both availability and backup as well as disaster protection

Table 1-1 Solution advantages

Chapter 2 Solution Architecture

This chapter presents these topics:

Overall architecture	2-2
Storage network architecture	2-4
Storage architecture	2-4
Database server architecture.....	2-9
Application architecture	2-10

Overall architecture

The following figures show the overall architecture of the Oracle RAC 10g Dell/EMC CX3 Series FCP solution:

Figure	Configuration
Figure 2-1	All solutions other than test/dev
Figure 2-2	Test/dev solution

Table 2-1 Oracle RAC 10g FCP Solution configurations

Each of the configurations includes the following components:

- ◆ Client, RAC interconnect, and storage networks consisting of dedicated network switches and VLANs
- ◆ Oracle RAC 10g servers connected to the client, RAC interconnect, and storage networks
- ◆ Clients connected to the Oracle RAC 10g servers via the public network
- ◆ A Dell/EMC CX3 Series (CX3-20C) storage array connected to the Oracle RAC 10g servers via the storage network

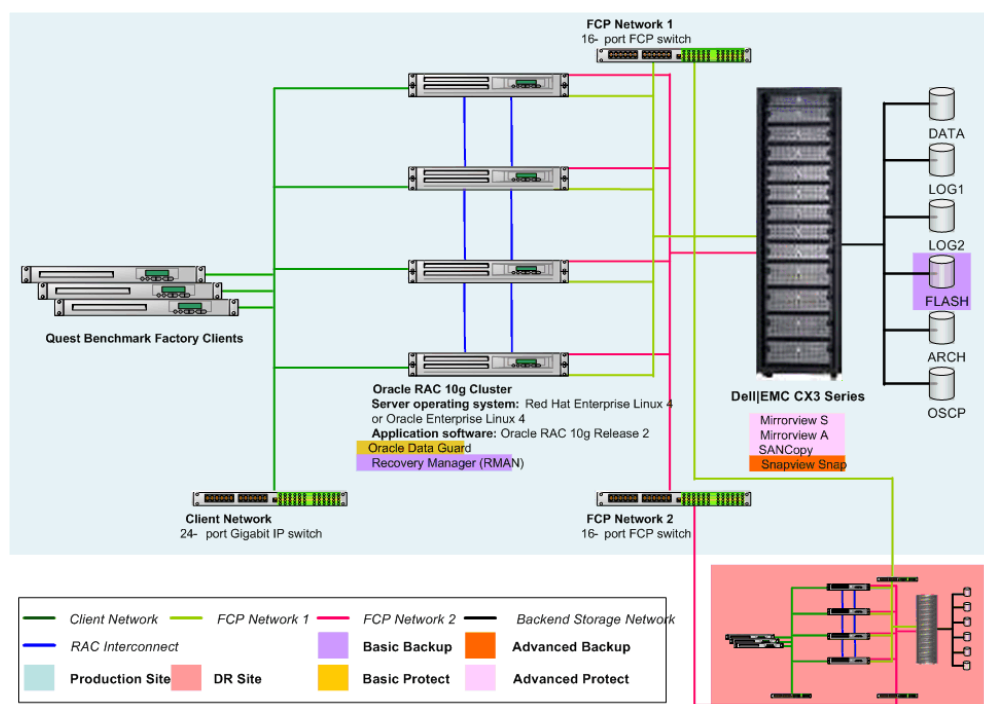


Figure 2-1 Overall architecture of all Oracle RAC 10g Dell/EMC CX3 Series FCP solutions other than test/dev

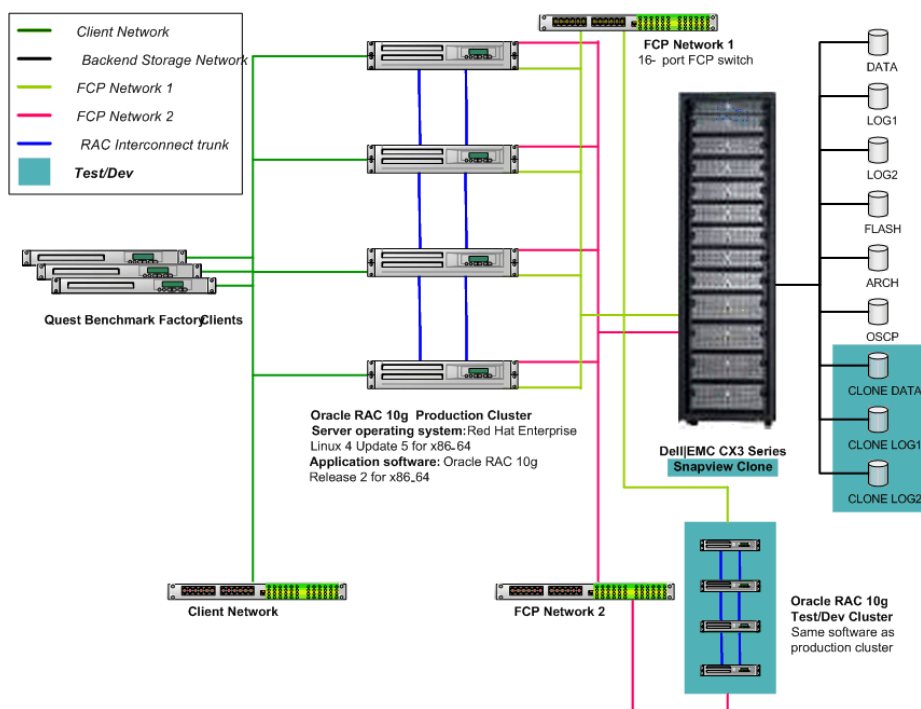


Figure 2-2 Overall architecture of the Oracle RAC 10g Dell/EMC CX3 Series FCP test/dev solution

General characteristics

Each solution configuration has the following general characteristics:

- ◆ Each configuration consists of a four-node active/active Oracle RAC 10g cluster.
- ◆ Oracle database files, online redo log files, archived log files and the flashback recovery area each reside on their own ASM disk group, stored on one or more storage LUNs. Online redo log files are mirrored across two different ASM disk groups using Oracle software multiplexing. All ASM disk groups are set to external redundancy.
- ◆ The control files are mirrored across the online redo log disk groups.
- ◆ The voting disk and ocr files are stored on an OCFS2 file system mounted on all RAC hosts.
- ◆ Storage LUNs are designed to satisfy the I/O demands of individual database objects, using RAID 5, RAID 3, RAID 1-0 or RAID 1, as appropriate.
- ◆ Trunked RAC interconnect network connections use jumbo frames.
- ◆ All database files are stored on the Dell/EMC CX3 storage array, making database server replacement relatively simple.
- ◆ Oracle RAC 10g for x86 or x86-64 runs under Red Hat Enterprise Linux.
- ◆ FCP provides storage connectivity via a fully-switched environment.

Storage network architecture

The following are the characteristics of the FCP network employed in testing this solution.

FCP

- ◆ Fully redundant FCP switches are used.
- ◆ Two target ports on each of the Dell/EMC CX3 storage processors are utilized. Each target port is connected to a separate FCP switch.
- ◆ Two redundant single-ported HBAs are used on each Oracle RAC 10g server. Each HBA is connected to a separate FCP switch.
- ◆ Zoning is employed on the FCP switches to ensure that all RAC hosts have redundant paths to access all LUNs on the Dell/EMC CX3 series array.
- ◆ EMC PowerPath software is employed on the RAC hosts to ensure path failover in the event of HBA failure, switch or switch port failure, or SP or SP port failure

Resiliency testing is employed to ensure seamless, consistent failover of all elements of the FCP network, including the RAC servers, the FCP switches, and the Dell/EMC array itself. All elements of this solution are found to be robust and reliable, being able to survive the failure of any other element in the solution.

Storage architecture

Setting up storage involves:

- ◆ Creating RAID groups
- ◆ Binding LUNs
- ◆ Allocating hot spares
- ◆ Creating a storage group
- ◆ Assigning hosts to the storage group
- ◆ Assigning LUNs to the storage group

High availability and failover

The Dell/EMC CX3 Series has built-in high-availability features. These HA features allow the Dell/EMC CX3 Series to survive various failures without a loss of access to the Oracle RAC 10g database. These features protect against the following:

- ◆ Storage processor failure
- ◆ FCP target port failure

- ◆ Power loss affecting a single circuit connected to the storage array
- ◆ Disk failure

RAID type and RAID group configuration

Four sets of RAID and disk configurations are tested, as shown in the following table.

Figure	Configuration	Description
Figure 2-5	Configuration 1	3 FC shelf RAID 1-0 / RAID 1
Figure 2-6	Configuration 2	3 FC shelf RAID 5 / RAID 1
Figure 2-7	Configuration 3	2 FC shelf RAID 1-0 / RAID 1
Figure 2-8	Configuration 4	2 FC shelf RAID 5 / RAID 1

Table 2-2 Oracle RAC 10g FCP Solution RAID Configurations

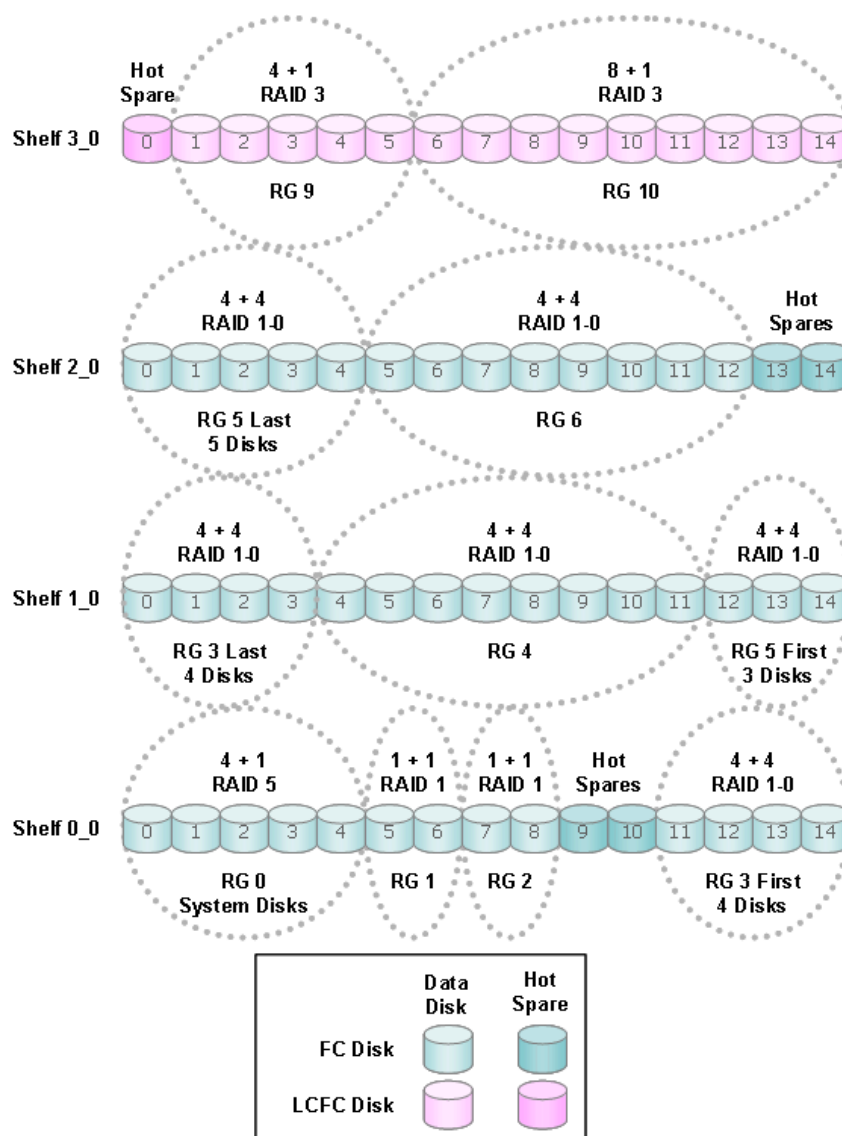


Figure 2-5 Configuration 1: 3 FC shelf RAID 1-0 / RAID 1

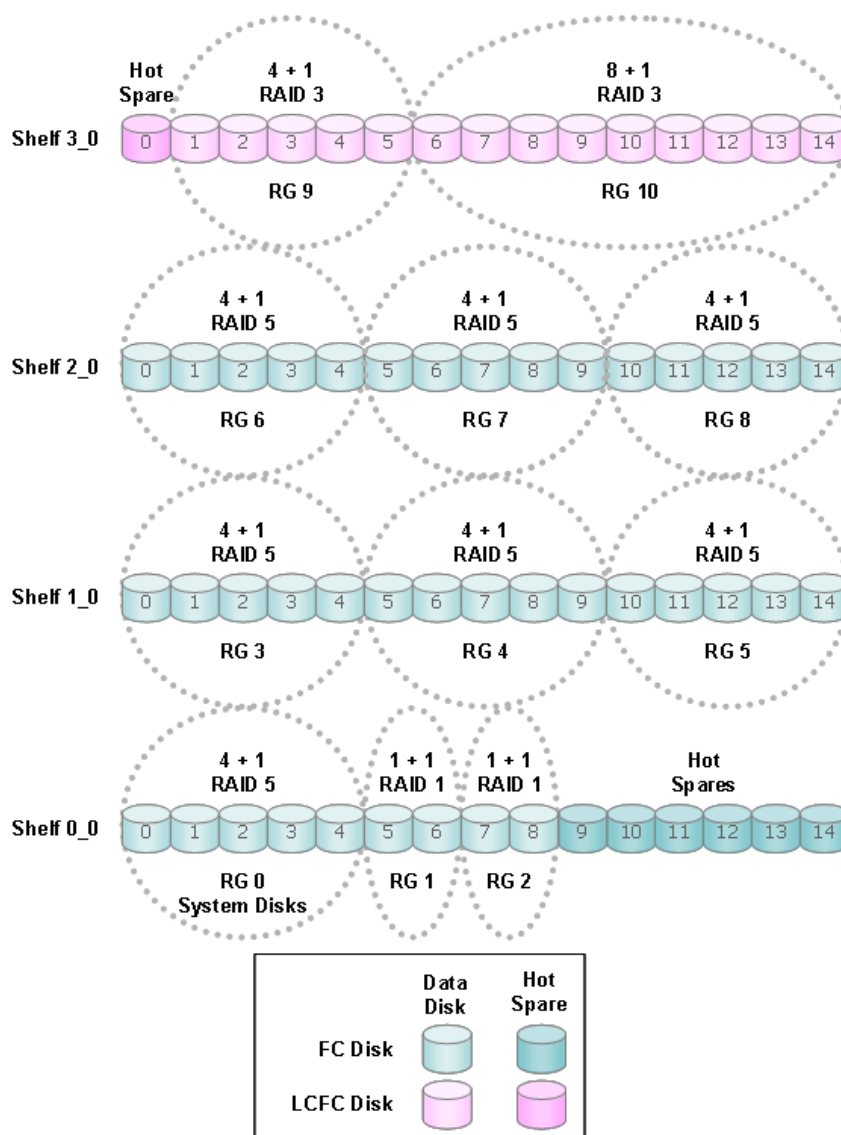


Figure 2-6 Configuration 2: 3 FC shelf RAID 5 / RAID 1

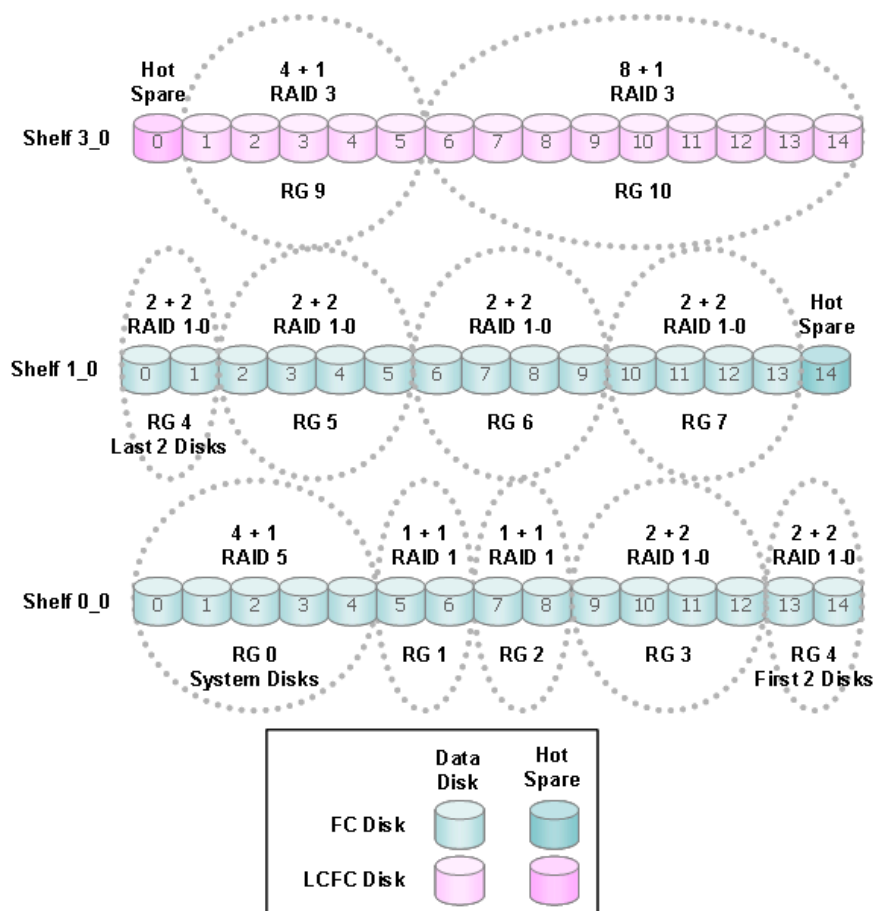


Figure 2-7 Configuration 3: 2 FC shelf RAID 1-0 / RAID 1

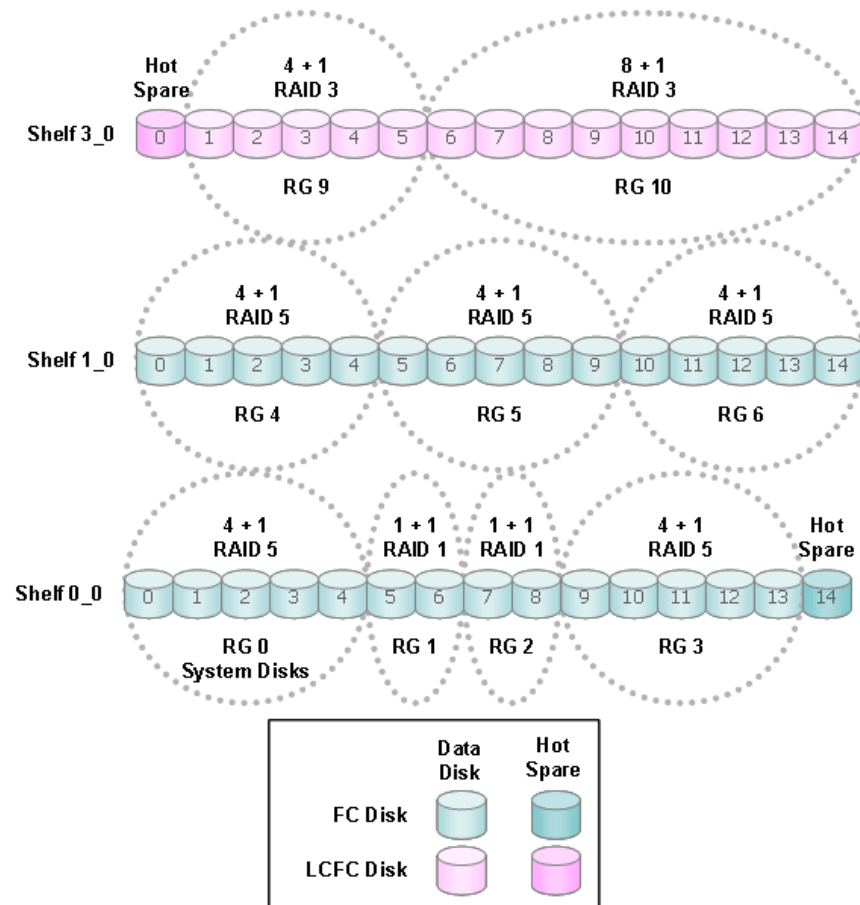


Figure 2-8 Configuration 4: 2 FC shelf RAID 5 / RAID 1

LUN setup

Once the RAID groups are created, EMC Navisphere software is used to create the LUNs which are used to store the database. These LUNs are added to a storage group which is accessible to the RAC hosts.

ASM and OCFS2

In general, Automatic Storage Management (ASM) is used to store all of the database objects. The exception is the Oracle cluster registry file and the voting disk. Both of these files must be stored on shared storage that is not on an ASM file system. Oracle Cluster File System (OCFS2) is used to store these files. The following table contains a detailed description of all of the database objects and where they are stored.

File system / mount point	File system type	LUNs stored on	Contents
/u02	OCFS2	LUN 0	Oracle cluster registry file and voting disk
+DATA	ASM	LUNs 3 through 8	Oracle datafiles
+LOG1	ASM	LUN 1	Online redo logs and control file (one of the mirrored copies)
+LOG2	ASM	LUN 2	Online redo logs and control file (the other of the mirrored copies)
+FLASH	ASM	LUN 9	Flashback recovery area (all backups stored here)
+ARCH	ASM	LUN 10	Archived log dump destination
+CLONEDATA	ASM	LUNs 53 through 58	Cloned Oracle datafiles
+CLONELOG1	ASM	LUN 51	Cloned online redo logs and control file (one of the mirrored copies)
+CLONELOG2	ASM	LUN 52	Cloned online redo logs and control file (the other of the mirrored copies)

Table 2-3 File system layout

Database server architecture

This section describes the database server architecture.

Oracle Database 10g server FCP network architecture

Each Oracle RAC 10g server has two single-ported HBAs. Each HBA on each server is connected to a separate, redundant FCP switch. Zoning on each switch is used to ensure redundant pathways to the Dell/EMC storage. PowerPath software is used on the hosts to ensure path failover in the event of an HBA or switch port failure.

Oracle Database 10g server IP network architecture

Each Oracle RAC 10g server has three network interfaces. Two interfaces connect the server to the RAC interconnect network, enabling the heartbeat and other network I/O required by Oracle cluster ready services.

One interface connects to the client network. [Table 2-4](#) lists each interface and describes its use

Interface port ID	Description
eth0	Client network
eth1	RAC interconnect (trunked)
eth2	RAC interconnect (trunked)

Table 2-4 Database server network interface configuration

Oracle cluster ready services (CRS)

Oracle cluster ready services (CRS) are enabled on each of the Oracle RAC 10g servers. The servers operate in active/active mode to provide local protection against a server failure and to provide load balancing.

High availability and failover

TCP/IP provides the ability to establish redundant paths for sending I/O from a networked computer to another networked computer. This approach uses the link aggregation protocol, commonly referred to as “trunking”. Redundant paths facilitate high availability and load balancing for the networked connection. Two trunked NICs on each Oracle RAC 10g server are used for the RAC interconnect. Although the network diagrams shown [above](#) exclude the switches for simplicity, and fully switched environment is used for the RAC interconnect.

Application architecture

The Oracle RAC 10g binary files, including the Oracle Cluster Ready Services software, are installed on the database servers’ local disks. Datafiles, online redo log files, archive log files, tempfiles, and CRS files reside on the Dell/EMC CX3 Series. These file systems are designed (in terms of the RAID level and number of disks used) to be appropriate for each type of file. See [Table 2-3](#) for more information on the location where each of these objects is stored.

Chapter 3 Hardware and Software Resources

This chapter presents these topics:

Hardware resources	3-2
Software resources.....	3-2

Hardware resources

The Oracle RAC 10g - Dell/EMC CX3 Series FCP solution uses the following hardware resources.

Equipment	Quality	Configuration
Dell™ PowerEdge™ 2950 server	Four	Two 3.0-GHz Intel Xeon dual-core processors 12 GB of RAM Two 73 GB 10K internal SAS disks Two onboard GbE Ethernet NICs One additional dual-port GbE Ethernet NIC Two QLogic QLE2460 FCP HBAs
Brocade M4400	Two	16 ports per switch
Dell/EMC CX3-20	One	Two Storage Processors Two target FCP ports per Storage Processor Two or three FC shelves One LCFC shelf 30 or 45 146 GB FC disks (depending on configuration) Fifteen 320 GB LCFC disks

Table 3-1 Hardware specifications

Software resources

The Oracle RAC 10g – Dell/EMC CX3 Series FCP solution uses the software resources in [Table 3-2](#).

Software title	Number of licenses.
Red Hat Enterprise Linux	One per database server
Oracle RAC 10g Enterprise Edition	One per database server
EMC Navisphere Agent	One per database server
EMC PowerPath	One per database server
EMC FLARE	One per CX3 Storage Processor
EMC Navisphere Management	One per CX3 Storage Processor

Table 3-2 Software specifications