Abstract

This deployment guide describes the design and deployment of the mixed Oracle database environments that are tested in the Dell EMC Ready Solutions for Oracle using Dell EMC XtremIO X2 and Data Domain for data protection.

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Data Domain client and database setup  
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XtremIO storage configuration

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Dell EMC Ready Bundle for Oracle with XtremIO and Data Domain
Enterprise-Class Storage Provisioning and Data Protection
Deployment Guide
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Document purpose

This guide describes how to deploy Dell EMC Ready Solutions for Oracle including the Dell EMC Data Domain backup appliance and Dell EMC XtremIO purpose-built all-flash storage. It provides a brief overview of the solution architecture and design, which includes the network, compute, and storage design, as well as the virtualization and database consolidation. It also provides implementation and deployment steps for the major components of this Ready Solution.

Before reading this deployment guide, read the Ready Solutions for Oracle with Data Protection Validation Guide, paying particular attention to

- **Chapter 3, Architecture Overview:** Chapter 3 describes the logical and physical architecture of Ready Solutions for Oracle, its hardware and software stacks, details of the three Oracle database environments—production database in a physical environment, XtremIO Virtual Copy (XVC) databases in a physical environment, and virtual databases—and creating the Data Domain architecture.

- **Chapter 4, Design Considerations:** Chapter 4 discusses the design principles of each layer of the Ready Solution and each of the components that you must implement and deploy. It also discusses the design principles of the Data Domain backup appliance and its integration with the Ready Solution system.

This guide assumes that personnel who deploy the solution hardware have general knowledge of Dell EMC PowerEdge servers, Dell EMC XtremIO X2, and the Dell EMC Data Domain backup appliance. It also assumes knowledge of Fibre Channel network host bus adapters (HBAs), cables, and switches, and Ethernet network cards, cables, and switches. This guide also assumes that personnel who deploy the software stack have a working knowledge of VMware software, Red Hat Enterprise Linux (RHEL), and Oracle database systems. Chapter 9 References provides links to the related documentation.

This document addresses the deployment steps that are specific to this Ready Solutions for Oracle with XtremIO X2, instead of a general-purpose deployment of the hardware and software stacks.

Deployment workflow

Ready Solutions for Oracle with XtremIO X2 and Data Domain deployment consists of three phases:

- **Phase I—Hardware stack setup and configuration.** This phase involves setting up all the components of the Ready Solution hardware including PowerEdge servers; Ethernet network switches and cable connections; and XtremIO X2 storage array, Fibre Channel network switches, and cable connections. It also includes steps on how to integrate the Data Domain hardware with the Ready Solution hardware infrastructure.
The following table outlines the specific tasks for deployment phase I.

### Table 1. Phase I: Hardware stack setup and configuration

<table>
<thead>
<tr>
<th>Task #</th>
<th>Task</th>
<th>Task description</th>
<th>Reference</th>
</tr>
</thead>
</table>
| 1      | Server setup                          | Configure compute servers’ local disks, BIOS, and network adapters | • Hardware requirements: Compute
        |                                                      | • Hardware requirements: Management server                 |                                                                                           |
|        |                                                      | • Preparing PowerEdge servers                              |                                                                                           |
|        |                                                      | • Recommended slots for NICs and HBAs                      |                                                                                           |
| 2      | Network setup                          | Set up top-of-rack (ToR) network switches, management switch, and network cable connections | • Datacenter requirements
        |                                                      | • Hardware requirements: Network                           |                                                                                           |
|        |                                                      | • Physical LAN design and connectivity                     |                                                                                           |
|        |                                                      | • Configuring Dell EMC Networking S4048-ON ToR switches    |                                                                                           |
|        |                                                      | • Configuring the management switch                        |                                                                                           |
| 3      | XtremIO X2 setup                       | Configure XtremIO X2 connectivity                          | • Hardware requirements: Storage
        |                                                      | • Physical SAN design and connectivity                     |                                                                                           |
| 4      | Data Domain setup                      | Physical connectivity and initial appliance setup          | • Hardware requirements: Data Domain backup solution
        |                                                      | • Physical LAN design and connectivity                     |                                                                                           |
|        |                                                      | • Data Domain backup appliance initial system setup        |                                                                                           |
| 5      | Fibre Channel (FC) network setup       | Set up FC switches, HBAs, cable connections, and zoning   | • Hardware requirements: Network
        |                                                      | • Recommended slots for NICs and HBAs                      |                                                                                           |
|        |                                                      | • Physical SAN design and connectivity                     |                                                                                           |
|        |                                                      | • Configuring zoning on FC switches                        |                                                                                           |

- **Phase II—Physical and virtual infrastructure installation and configuration.**
  This phase establishes the physical and virtual environments for running Oracle Databases on top of the hardware stack that was established in phase I. For physical environments, the tasks include creating and setting up XtremIO X2 storage volumes, installing RHEL OS, configuring network, and storage volumes within OS. For the virtual environment, the tasks include setting up VMware ESXi on management and database servers, installing VMware vCenter Server Appliance (VCSA), creating and setting up XtremIO X2 storage volumes, creating VMs, and setting up the storage and network for the VMs. It also provides steps for setting up the Data Domain backup appliance.

The following two tables outline the specific tasks for deployment of phase II.
### Table 2. Phase II: Physical infrastructure installation and configuration

<table>
<thead>
<tr>
<th>Task #</th>
<th>Task</th>
<th>Task description</th>
<th>Reference</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>XtremIO X2 configuration</td>
<td>Create Initiator Groups. Create and map storage volumes on XtremIO X2 storage.</td>
<td>• Production RAC Database Environment Setup: XtremIO storage configuration&lt;br&gt;• XtremIO Virtual Copy (XVC) Database Environment Setup: XtremIO storage configuration</td>
</tr>
<tr>
<td>2</td>
<td>OS installation and configuration, including prerequisites for grid and database</td>
<td>Install RHEL on the physical database servers. Configure OS, network, and storage volumes. Configure additional best practices specific to XtremIO environments.</td>
<td>• Production RAC Database Environment Setup: Configuring OS, network, and storage&lt;br&gt;  ▪ Wiki article: How to deploy Oracle 12c Release 2 Grid and RAC Database on RHEL 7.x&lt;br&gt;• XtremIO Virtual Copy (XVC) Database Environment Setup: Configuring OS, network, and storage&lt;br&gt;  ▪ Wiki article: How to deploy Oracle 12c Release 2 standalone Database on RHEL 7.x&lt;br&gt;• Production RAC Database Environment Setup: Additional best practices in an XtremIO environment (applies to both production and XVC databases environment)&lt;br&gt;  ▪ Dell EMC XtremIO Storage Array Host Configuration Guide</td>
</tr>
</tbody>
</table>

### Table 3. Phase II: Virtual infrastructure installation and configuration

<table>
<thead>
<tr>
<th>Task #</th>
<th>Task</th>
<th>Task description</th>
<th>Reference</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>ESXi and VCSA installation</td>
<td>Install ESXi and VCSA on the management server. Install ESXi on the virtual database server. Configure additional best practices specific to the XtremIO environment.</td>
<td>• Installing ESXi and vCenter Server Appliance on the management server&lt;br&gt;• Installing and configuring ESXi on the database server&lt;br&gt;• ESXi database server setup: Additional best practices in XtremIO environment&lt;br&gt;  ▪ Dell EMC XtremIO Storage Array Host Configuration Guide</td>
</tr>
<tr>
<td>2</td>
<td>vSphere datacenter and host configuration</td>
<td>Configure the vSphere datacenter and add the ESXi database host.</td>
<td>• Creating a vSphere datacenter&lt;br&gt;• Adding hosts to vCenter</td>
</tr>
<tr>
<td>3</td>
<td>XtremIO X2 configuration</td>
<td>Create Initiator Groups. Create and map storage volumes on XtremIO X2 storage.</td>
<td>Virtual Databases Environment Setup: XtremIO storage configuration</td>
</tr>
<tr>
<td>4</td>
<td>Virtual switch on ESXi host configuration</td>
<td>Configure virtual distributed switches (VDS) for Oracle public traffic.</td>
<td>Configuring a vSphere Distributed Switch</td>
</tr>
<tr>
<td>Task #</td>
<td>Task</td>
<td>Task description</td>
<td>Reference</td>
</tr>
<tr>
<td>--------</td>
<td>-----------------------------------------------</td>
<td>----------------------------------------------------------------------------------</td>
<td>---------------------------------------------------------------------------</td>
</tr>
<tr>
<td>5</td>
<td>Storage on ESXi host configuration</td>
<td>Configure datastores.</td>
<td>Configuring datastores</td>
</tr>
<tr>
<td>6</td>
<td>VM creation</td>
<td>Create VMs for virtual databases.</td>
<td>Creating VMs for Oracle Databases</td>
</tr>
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<td>7</td>
<td>Virtual network on VM OS configuration</td>
<td>Configure public network on VDS and VM OS.</td>
<td>Setting up networking for ESXi hosts and VMs</td>
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<tr>
<td>8</td>
<td>Storage on VM OS configuration</td>
<td>Configure storage disks on database VMs for Oracle Clusterware and Oracle RAC installation.</td>
<td>Preparing storage disks for Oracle stand-alone databases</td>
</tr>
</tbody>
</table>
| 9      | Guest OS installation and configuration, including prerequisites for grid and database | Install and configure prerequisites in RHEL 7 VM for 12cR2 virtual database, install and configure prerequisites in RHEL 6 VM for 11gR2 virtual database. | • Guest OS configuration  
  ▪ Wiki article: How to deploy Oracle 12c Release 2 standalone Database on RHEL 7.x  
  ▪ Wiki article: How to deploy Oracle 11g Release 2 standalone Database on RHEL 6.x  
  ▪ Guest OS best practices in the XtremIO environment  
  ▪ Dell EMC XtremIO Storage Array Host Configuration Guide |

- **Phase III—Oracle Grid and Database configurations.** This phase establishes the Oracle 12c Release 2 RAC production database and Oracle 12c R2 XVC databases on top of the physical infrastructure that was established in phase II. It also establishes the Oracle 11gR2 and Oracle 12cR2 virtual databases on top of the virtual infrastructure that was established in phase II. Tasks in this phase include:
  - Preparing for the installation of Oracle Grid and Database software
  - Installing Oracle Grid Infrastructure and Oracle Database software in each environment
  - Creating and configuring the Oracle databases in each environment
  - For XVC databases, taking XtremIO X2 level snapshots (XVC) of the Oracle production database volumes, and integrating and reconfiguring the existing Oracle grid and database configuration in the XVC database server to bring up the snapshot database.
  - Configuring the Oracle databases to integrate and work with the Data Domain backup appliance.

The following table outlines the specific tasks for deployment phase III.
### Table 4. Phase III: Oracle Grid and databases, XVC snapshots, and Data Domain client software installation and configuration

<table>
<thead>
<tr>
<th>Task #</th>
<th>Task</th>
<th>Task description</th>
<th>Reference</th>
</tr>
</thead>
</table>
| 1      | Oracle Grid and Database installation  | Install Oracle Clusterware and database software. Create seed database.           | 1. Production RAC Database Environment Setup: Oracle 12c Grid and Database setup  
|        |                                        |                                                                                 |   - Wiki article: [How to deploy Oracle 12c Release 2 Grid and RAC Database on RHEL 7.x](#)  
|        |                                        |                                                                                 |   - Wiki article: [How to deploy Oracle 12c Release 2 standalone Database on RHEL 7.x](#)  
|        |                                        |                                                                                 | 2. XtremIO Virtual Copy (XVC) Database Environment Setup: Oracle Grid and Database setup  
|        |                                        |                                                                                 |   - Wiki article: [How to deploy Oracle 12c Release 2 standalone Database on RHEL 7.x](#)  
|        |                                        |                                                                                 |   - Wiki article: [How to deploy Oracle 11g Release 2 standalone Database on RHEL 6.x](#)  
|        |                                        |                                                                                 | - Virtual Databases Environment Setup: Installing Oracle 12c Grid and Database  
|        |                                        |                                                                                 |   - Wiki article: [How to deploy Oracle 12c Release 2 Grid and RAC Database on RHEL 7.x](#)  
|        |                                        |                                                                                 |   - Wiki article: [How to deploy Oracle 11g Release 2 standalone Database on RHEL 6.x](#)  |
| 2      | Snapshot creation on XtremIO for XVC databases | Create snapshots of production database for XVC databases.                      | Taking XVC snapshots of the PROD database                                |
|        | Reconfigure ASM and mount snapshot volumes to create snapshot databases on XVC database server. |                                                                                 | Creating a snapshot database on the XVC server                            |
| 3      | Data Domain (DD) client and database setup | Install and configure the DD agent and configure Oracle RMAN.                   | Data Domain client and database setup                                    |
We value your feedback

Dell EMC and the authors of this document welcome your feedback on the solution and the solution documentation. Contact EMC.Solution.Feedback@emc.com with your comments.

Authors: Oracle Ready Solutions Engineering team, Reed Tucker

The following page of the Oracle space on the Dell EMC Communities website provides links to additional documentation for this solution: Oracle Info Hub for Ready Solutions
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- **Hardware requirements** ........................................................................... 19
- **Software requirements** ............................................................................. 23
- **Datacenter requirements** .......................................................................... 24
Architecture and design overview

For details about the architecture and design of Ready Solutions for Oracle with XtremIO X2 and Data Protection with Data Domain, see the Ready Solutions for Oracle with Data Protection Validation Guide.

The XtremIO X2-based Ready Solutions for Oracle is designed to consolidate multiple types of mixed-workload Oracle database environments in a single system. The following types of Oracle database environments have been tested and validated in this Ready Solutions for Oracle:

- A production database in a physical environment (two nodes)
  - Two-nodes running Oracle Real Application Clusters (RAC) OLTP production database
- XtremIO Virtual Copy (XVC) databases in a physical environment (single node)
  - One XVC database repurposed from the production database for an OLAP workload
  - One OLTP XVC database repurposed from the production database for development
- Oracle databases in a virtual environment (single node)
  - One Virtual Machine (VM) running Oracle Database 11g Release 2
  - A second VM running Oracle Database 12c Release 2

The following figure shows the logical architecture overview of the consolidated mixed databases environment. It includes the multiple layers of infrastructure components in this Ready Solutions for Oracle with XtremIO X2 along with Data Protection using Data Domain DD6300 as the backup appliance.
The server layer consists of:

- **R940 PROD database servers**—The production 12cR2 RAC database is deployed on two R940 PowerEdge servers running RHEL 7.4 as the bare-metal OS.
- **R740 XVC databases server**—The two stand-alone 12cR2 XVC databases that are repurposed from the production 12cR2 database are deployed on a single R740 PowerEdge server running RHEL7.4 as the bare-metal OS.
- **R940 Virtual databases server**—The two virtual OLTP databases – 11gR2 and 12cR2 – are deployed as separate VMs running RHEL 7.4 and 6.9 respectively as the guest OS. Both VMs are running on a single R940 PowerEdge server that is installed with ESXi 6.5 U2 hypervisor.
- **R640 management server**—The VMware vCenter Server Appliance (VCSA) is deployed as a VM on a single R640 PowerEdge server running VMware ESXi 6.5 as the hypervisor.

Each database server has:

- **Two 10 GbE NICs**—Two dual-port 10 GbE network adapters for Oracle public and private (PROD servers only) network traffic
- **Two 16 Gbps HBAs**—Two dual-port 16 Gbps Host Bus Adapters (HBAs) for SAN traffic
- **1 GbE management rNDC**—At least one 1 GbE rNDC or LOM port for in-band server management from within the OS
• **1 GbE iDRAC**—Dedicated iDRAC Ethernet port for out-of-band management of the server

• The switch layer consists of:
  - **Two 10 GbE ToR switches**—Redundant S4048-ON switches are top-of-rack (ToR) 10 GbE LAN switches to support the public, private, and backup traffic.
  - **Two 16 Gbps FC switches**—Redundant DS6510-B switches for Fibre Channel (FC) SAN traffic and connectivity between the database servers and the storage array.
  - **One 1 GbE Management switch**—Single 1U S3048-ON as the 1 GbE switch for the management traffic.

• The storage layer consists of:
  - **Two X-Bricks XtremIO X2 array**—XtremIO X2 is the FC SAN storage that consolidates all the databases. XtremIO X2 arrays consist of a two X-Bricks cluster, each with two storage controllers. Each storage controller has two front-end 16 Gbps FC ports.
  - **Data Domain DD6300 appliance**—For database backup and recovery, the solution was tested with the DD6300 backup appliance. Two 10 GbE ports from the DD6300 appliance were connected to the ToR switches for the backup and recovery traffic.

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**Physical design overview**

This section provides an overview of the physical LAN and SAN design and connectivity that is deployed in this solution.

**Physical LAN design and connectivity**

The following figure shows the physical LAN design and redundant connectivity between the database servers, ToR 10 GbE switches, 1 GbE management switch, and the DD6300 backup appliance. It also shows the recommended PCIe slots to populate the NICs in their respective servers.

---

**Note:** The ports on the switches that are shown in the following figure to which the database servers and the DD6300 network ports are connected are for illustration purposes only. Network administrators can choose any available ports on the switches, as appropriate.
Figure 2. Physical LAN design and connectivity
Virtual network design

The following figure provides a high-level overview of the virtual network design that is implemented in the VMware ESXi databases host in the virtual environment. It also shows the mapping between the virtual switches and the physical switches.

Figure 3. Virtual network design in the ESXi virtual databases host

The main components of the design are:

- **Public virtual distributed switch (VDS)**—We created one VDS, which contains two Distributed Ports Groups. The public port group provides the virtual interfaces for Oracle public traffic for the two Oracle database VMs. The physical uplinks port group is used to add the two 10 GbE physical network ports that are connected to the external 10 GbE ToR switches.

- **Standard switch**—This switch contains two default ports groups. The Management Network port group provides the VMKernel port vmk0 to manage the ESXi host from VCSA. The VM Network port group provides the 1 GbE virtual interfaces for in-band management of the database VMs. All this management traffic is routed through the 1 GbE physical rNDC or LOM port on the server that is connected to the external management switch.

Physical SAN design and connectivity

The following figure shows the physical SAN design and redundant connectivity between the database servers, redundant 16 Gbps FC switches, and the two X-Bricks XtremIO X2 cluster. It also shows the recommended PCIe slots to populate the HBAs in their respective servers.
Note: The ports on the FC switches shown in the figure below to which the database server HBA ports and the XtremIO FC front-end ports are connected are for illustration purposes only. SAN administrators can choose any available ports on the switches, as appropriate.

Figure 4. Physical SAN design and connectivity

The SAN design features redundant components and connectivity at every level to ensure that there is no single point of failure. Because of this design, the database server is able to reach the storage array even if one or more HBA ports, one HBA, one FC switch, one XtremIO front-end port or storage controller, or one XtremIO X-Brick fails.
Hardware requirements

This section provides the hardware and software details about the components with which this Ready Solutions for Oracle with XtremIO X2 was tested.

The following table lists the major hardware components.

Table 5. Ready Solutions for Oracle with XtremIO X2: Components overview

<table>
<thead>
<tr>
<th>Component</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Database servers</td>
<td>2 x Dell EMC 4S PowerEdge R940 servers for physical production databases</td>
</tr>
<tr>
<td></td>
<td>1 x Dell EMC 4S PowerEdge R940 server for virtual databases</td>
</tr>
<tr>
<td></td>
<td>1 x Dell EMC 2S PowerEdge R740 for physical XVC databases</td>
</tr>
<tr>
<td>LAN switches</td>
<td>2 x Dell EMC Networking S4048-ON 10 Gb Ethernet switches</td>
</tr>
<tr>
<td>SAN switches</td>
<td>2 x Dell EMC Connectrix DS6510-B 16 Gb/s FC switches</td>
</tr>
<tr>
<td>Management</td>
<td>1 x S3048-ON 1 Gb Ethernet switch</td>
</tr>
<tr>
<td></td>
<td>1 x Dell EMC 2S PowerEdge R640 server</td>
</tr>
<tr>
<td>Storage array</td>
<td>Dual X-Bricks XtremIO X2 cluster</td>
</tr>
</tbody>
</table>

The following tables list the hardware, firmware, and driver details of the various components in the database servers that we tested in this Ready Solutions for Oracle.

**Note**: Newer and updated BIOS and firmware versions are supported, if they are available. For the latest versions, go to Dell EMC Online Support.

Table 6. Ready Solution for Oracle with XtremIO X2: Physical production database server components

<table>
<thead>
<tr>
<th>Component</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Servers</td>
<td>2 x PowerEdge R940</td>
</tr>
<tr>
<td>Chassis</td>
<td>2.5&quot; chassis with up to 8 hard drives</td>
</tr>
<tr>
<td>Processor per server</td>
<td>4 x Intel Xeon Gold 6150 18c 2.7 GHz</td>
</tr>
<tr>
<td>Memory per server</td>
<td>1,536 GB (24 x 64 GB QR DDR4 2666MT/s LRDIMMs)</td>
</tr>
<tr>
<td>Local disks per server</td>
<td>3 x 1.2 TB 10 K SAS 12 Gb/s 2.5 in. HDDs (includes 1 hot spare)</td>
</tr>
<tr>
<td>RAID controller</td>
<td>PERC H740P/H730P</td>
</tr>
<tr>
<td>iDRAC</td>
<td>iDRAC9 Enterprise</td>
</tr>
<tr>
<td>rNDC</td>
<td>Broadcom 5720 QP 1 Gb Base-T rNDC</td>
</tr>
<tr>
<td>Add-on NICs per server</td>
<td>2 x Broadcom 57412 DP 10 Gb SFP+ PCIe adapter</td>
</tr>
</tbody>
</table>
Chapter 2: Architecture, Design, and Solution Components Overview

Table 7. Production database servers: PowerEdge R940 firmware and RHEL 7 drivers

<table>
<thead>
<tr>
<th>Component</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>BIOS</td>
<td>1.4.5</td>
</tr>
<tr>
<td>Lifecycle Controller and iDRAC9 Enterprise</td>
<td>Firmware (FW): 3.21.21.21</td>
</tr>
<tr>
<td>Emulex LPe31002-M6-D DP 16 Gb/s FC HBAs</td>
<td>FW: 02.03.02; Driver: 11.4.258.2-1 (lpfc)</td>
</tr>
<tr>
<td>Broadcom 57412 DP 10 GbE SFP+ NICs</td>
<td>FW: 20.08.04.04; Driver: 1.8.54 (bnxt_en)</td>
</tr>
<tr>
<td>Broadcom 5720 QP 1 GbE rNDC</td>
<td>FW: 20.8.4; Driver: 3.137w (tg3)</td>
</tr>
<tr>
<td>Dell EMC PERC H730P adapter</td>
<td>FW: 25.5.5.0005; Driver: 07.703.06.00 (megalraid_sas)</td>
</tr>
<tr>
<td>Delta 1600W power supplies</td>
<td>FW: 00.3D.67</td>
</tr>
</tbody>
</table>

Table 8. Ready Solution for Oracle with XtremIO X2: Physical XVC databases server components

<table>
<thead>
<tr>
<th>Component</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Server</td>
<td>1 x PowerEdge R740</td>
</tr>
<tr>
<td>Chassis</td>
<td>8 x 2.5 in. SAS/SATA hard disk drives (HDDs) for 2-CPU configuration</td>
</tr>
<tr>
<td>Processor</td>
<td>2 x Intel Xeon Gold 6136 12c 3.0 GHz</td>
</tr>
<tr>
<td>Memory</td>
<td>768 GB (24 x 32 GB DR DDR4 2667 MT/s RDIMMs)</td>
</tr>
<tr>
<td>Local disks</td>
<td>3 x 1.2 TB 10 K SAS 12 Gb/s 2.5 in. HDDs (includes 1 hot spare)</td>
</tr>
<tr>
<td>RAID controller</td>
<td>PERC H740P Adapter</td>
</tr>
<tr>
<td>iDRAC</td>
<td>iDRAC9 Enterprise</td>
</tr>
<tr>
<td>rNDC</td>
<td>Broadcom 5720 DP 1Gb + 57412 DP 10 Gb NetXtreme- E rNDC</td>
</tr>
<tr>
<td>Add-on NICs</td>
<td>None</td>
</tr>
<tr>
<td>HBAs</td>
<td>2 x Emulex LPe16002B-M6-D DP 16 Gb/s FC HBAs</td>
</tr>
<tr>
<td>Power supply</td>
<td>2 x 1,100 W</td>
</tr>
</tbody>
</table>

Table 9. XVC databases server: PowerEdge R740 firmware and RHEL 7 drivers

<table>
<thead>
<tr>
<th>Component</th>
<th>Version</th>
</tr>
</thead>
<tbody>
<tr>
<td>BIOS</td>
<td>1.4.5</td>
</tr>
<tr>
<td>Lifecycle Controller and iDRAC9 Enterprise</td>
<td>FW: 3.21.21.21</td>
</tr>
<tr>
<td>Emulex LPe16002B-M6-D DP 16 Gb/s FC HBAs</td>
<td>FW: 02.03.02; Driver: 11.4.258.2 (lpfc)</td>
</tr>
</tbody>
</table>
Chapter 2: Architecture, Design, and Solution Components Overview

## Component Version

<table>
<thead>
<tr>
<th>Component</th>
<th>Version</th>
</tr>
</thead>
<tbody>
<tr>
<td>Broadcom 5720 DP 1Gb + 57412 DP 10Gb NetXtreme- E rNDC</td>
<td>FW: 20.8.4 (5720) + 20.08.04.04 (57412) Driver: 3.137W (tg3 – 5720) + 1.8.54 (bnxt_en - 57412)</td>
</tr>
<tr>
<td>Dell EMC PERC H730P adapter</td>
<td>FW: 25.5.5.0005; Driver: 7.703.06.00 (megaraid_sas)</td>
</tr>
<tr>
<td>Delta 1100W power supplies</td>
<td>FW: 00.1D.7D</td>
</tr>
</tbody>
</table>

### Table 10. Ready Solution for Oracle with XtremIO X2: Virtualized databases server components

<table>
<thead>
<tr>
<th>Component</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Servers</td>
<td>1 x PowerEdge R940</td>
</tr>
<tr>
<td>Chassis</td>
<td>2.5” chassis with up to 8 hard drives</td>
</tr>
<tr>
<td>Processor</td>
<td>4 x Intel Xeon Gold 6150 18c 2.7 GHz</td>
</tr>
<tr>
<td>Memory</td>
<td>1,536 GB (48 x 32 GB DR DDR4 2667 MT/s RDIMMs)</td>
</tr>
<tr>
<td>Local disks</td>
<td>8 x 1.6 TB SAS 12 Gb/s 2.5 in. SSDs</td>
</tr>
<tr>
<td>RAID controller</td>
<td>PERC H740P</td>
</tr>
<tr>
<td>iDRAC</td>
<td>iDRAC9 Enterprise</td>
</tr>
<tr>
<td>rNDC</td>
<td>Broadcom 5720 QP 1 Gb Base-T rNDC</td>
</tr>
<tr>
<td>Add-on NICs</td>
<td>2 x Intel X710 DP 10 Gb SFP+ NICs</td>
</tr>
<tr>
<td>HBAs</td>
<td>2 x QLogic QLE2692 DP 16 Gb/s FC HBAs</td>
</tr>
<tr>
<td>Power supply</td>
<td>2 x 2,000 W</td>
</tr>
</tbody>
</table>

### Table 11. Virtual databases server: PowerEdge R940 firmware and ESXi drivers

<table>
<thead>
<tr>
<th>Component</th>
<th>Version</th>
</tr>
</thead>
<tbody>
<tr>
<td>BIOS</td>
<td>1.4.5</td>
</tr>
<tr>
<td>Lifecycle Controller and iDRAC9 Enterprise</td>
<td>FW: 3.21.21.21</td>
</tr>
<tr>
<td>QLogic QLE2692 DP 16 Gb/s FC HBAs</td>
<td>FW: 01.42.23; Driver: 2.1.63.0 (qlnativefc)</td>
</tr>
<tr>
<td>Intel X710 DP 10 Gb SFP+ NICs</td>
<td>FW: 18.5.17; Driver: 1.5.8 (i40en)</td>
</tr>
<tr>
<td>Broadcom 5720 QP 1 GbE rNDC</td>
<td>FW: 20.8.4; Driver: 4.1.3.0 (ntg3)</td>
</tr>
<tr>
<td>Dell EMC PERC H740P adapter</td>
<td>FW: 50.3.0-1022; Driver: 7.703.18.00 (lsi_mr3)</td>
</tr>
</tbody>
</table>

### Storage

The following table lists the hardware details of the storage array that is used in this Ready Solutions for Oracle.

### Table 12. Ready Solutions for Oracle: XtremIO X2 storage components

<table>
<thead>
<tr>
<th>Storage array</th>
<th>Dell EMC XtremIO X2</th>
</tr>
</thead>
<tbody>
<tr>
<td>System specification</td>
<td>2 X2-S X-Bricks cluster</td>
</tr>
</tbody>
</table>
Chapter 2: Architecture, Design, and Solution Components Overview

## Storage array
<table>
<thead>
<tr>
<th>Dell EMC XtremIO X2</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>OS version</td>
<td>6.1.0-99_X2</td>
</tr>
<tr>
<td>Active-Active Controllers</td>
<td>4</td>
</tr>
<tr>
<td>Front-end FC ports</td>
<td>8</td>
</tr>
<tr>
<td>SSD enclosures</td>
<td>2</td>
</tr>
<tr>
<td>Number of SSDs</td>
<td>36</td>
</tr>
<tr>
<td>Raw/Usable capacity</td>
<td>13.1 TiB / 10 TiB</td>
</tr>
<tr>
<td>Infiniband switches</td>
<td>2</td>
</tr>
</tbody>
</table>

### Network

The following table lists the network switches used in this Ready Solutions for Oracle.

**Table 13. Ready Solutions for Oracle with XtremIO X2: Network switches**

<table>
<thead>
<tr>
<th>Switch function</th>
<th>Switch model</th>
<th>Firmware/OS</th>
</tr>
</thead>
<tbody>
<tr>
<td>LAN</td>
<td>Dell EMC Networking S4048-ON 10 GbE switches</td>
<td>9.11</td>
</tr>
<tr>
<td>SAN</td>
<td>Dell EMC Connectrix DS-6510B 48-port 16 Gb/s switches</td>
<td>8.1.0a</td>
</tr>
</tbody>
</table>

### Management server

In this Ready Solutions for Oracle, we recommend that you use a dedicated management server to install vCenter Server Appliance, Oracle Enterprise Manager, Dell EMC OpenManage Essentials, or other centralized management software applications.

The following table lists the management server and its components in this Ready Solutions for Oracle.

**Table 14. Management server and components**

<table>
<thead>
<tr>
<th>Category</th>
<th>Components</th>
</tr>
</thead>
<tbody>
<tr>
<td>Server</td>
<td>1 x Dell EMC PowerEdge R640 Server</td>
</tr>
<tr>
<td>Chassis</td>
<td>2.5 in. with up to 8 HDDs and 3 PCIe slots</td>
</tr>
<tr>
<td>Processor</td>
<td>2 x Intel Xeon Gold 6136 12c 3 GHz</td>
</tr>
<tr>
<td>Memory</td>
<td>192 GB (12 x 16 GB DR DDR4 2,667 MT/s RDIMMs)</td>
</tr>
<tr>
<td>Local disks</td>
<td>3 x 1.2 TB 10k rpm SAS 12 Gb/s 2.5-in HDDs (includes 1 hot spare)</td>
</tr>
<tr>
<td>RAID controller</td>
<td>Dell EMC PERC H740P/H730P</td>
</tr>
<tr>
<td>iDRAC</td>
<td>Dell EMC iDRAC9 Enterprise</td>
</tr>
<tr>
<td>rNDC</td>
<td>Broadcom 5720 QP 1 Gb Network Daughter Card (NDC)</td>
</tr>
</tbody>
</table>
The following table lists the hardware components in the Data Domain DD6300 backup appliance.

Table 15. DD6300 backup appliance components

<table>
<thead>
<tr>
<th>Category</th>
<th>Components</th>
</tr>
</thead>
<tbody>
<tr>
<td>Processor</td>
<td>2 x Intel Xeon CPU E5-2680 v3, 2501 MHz</td>
</tr>
<tr>
<td>Memory</td>
<td>96 GB (12 x 8 GB 1866 MHz)</td>
</tr>
<tr>
<td>Number of network ports (in use)</td>
<td>2 x 10 GbE</td>
</tr>
<tr>
<td>Number of enclosures (DS60)</td>
<td>1¹</td>
</tr>
<tr>
<td>Active Tier disks (in use)</td>
<td>11 x 3.64 TiB (40.03 TiB) SAS HDD</td>
</tr>
<tr>
<td>Active Tier disks (spare)</td>
<td>1 x 3.64 TiB SAS HDD</td>
</tr>
<tr>
<td>Cache Tier disks</td>
<td>2 x 0.728 TiB (1.45 TiB) SAS SSDs</td>
</tr>
<tr>
<td>Expandable Storage disks¹</td>
<td>60 x 2.73 TiB (163.8 TiB) SAS HDD</td>
</tr>
<tr>
<td>Expandable Storage disks¹</td>
<td>56 active (152.9 TiB) + 4 spare (10.9 TiB)</td>
</tr>
<tr>
<td>System disks</td>
<td>N/A</td>
</tr>
</tbody>
</table>

¹ – The expandable storage disks in DS60 were available but were not used in the testing.

Software requirements

The following table specifies the software versions of the components that we validated with this Ready Solutions for Oracle and the Data Domain backup solution.

Table 16. Solution software

<table>
<thead>
<tr>
<th>Software</th>
<th>Version</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ready Solutions for Oracle with XtremIO X2 and Data Protection</td>
<td></td>
</tr>
<tr>
<td>VMware ESXi</td>
<td>6.5.0 Build Number 8935087 (update 2)</td>
</tr>
<tr>
<td>VMware vCenter Server Appliance</td>
<td>6.5.0.5500 Build Number 5318154</td>
</tr>
<tr>
<td>Red Hat Enterprise Linux</td>
<td>7.4, kernel version 3.10.0-693.el7.x86_64</td>
</tr>
<tr>
<td>Red Hat Enterprise Linux (Guest OS)</td>
<td>6.9 kernel version 2.6.32-696.el6.x86_64</td>
</tr>
<tr>
<td>Oracle Grid Infrastructure (Clusterware and Automated Storage Management [ASM])</td>
<td>12.2.0.1</td>
</tr>
<tr>
<td>Oracle RAC</td>
<td>12.2.0.1</td>
</tr>
<tr>
<td>Dell EMC XtremIO X2 storage OS</td>
<td>6.1.0-99_X2</td>
</tr>
<tr>
<td>Data Domain backup appliance (DD6300)</td>
<td></td>
</tr>
<tr>
<td>Operating System (OS)</td>
<td>6.0.1.30-570211</td>
</tr>
<tr>
<td>DD Boost for Enterprise Applications</td>
<td>4.5.1.0-1</td>
</tr>
</tbody>
</table>
Chapter 2: Architecture, Design, and Solution Components Overview

Datacenter requirements

To support this Ready Solutions for Oracle, the environment must have the following:

- An existing Ethernet infrastructure with which to integrate. Dell EMC Networking S4810-ON ToR switches support 40 GbE uplinks to the network core switches. Additional components, such as Dell EMC network cables and transceivers, are required. Before you begin deployment, ensure that you have all the necessary components to facilitate connection to the existing network.

- Domain Name System (DNS) and Network Time Protocol (NTP) services. We recommend a Dynamic Host Configuration Protocol (DHCP) server, although it is not required.

- Sufficient power and cooling to support all components. To determine accurate power and cooling needs, see the product documentation for the various components.
This chapter presents the following topics:

- Preparing PowerEdge servers ..............................................................26
- Configuring Dell EMC Networking S4048-ON ToR switches..................28
- Configuring the management switch...................................................31
- Installing ESXi and vCenter Server Appliance on the management server..........................................................32
- Configuring zoning on FC switches ...................................................39
- Data Domain backup appliance initial system setup..............................41
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Preparing PowerEdge servers

To prepare the PowerEdge servers for the production, XVC, virtual, and management environments in this Ready Solutions for Oracle, follow these procedures:

1. Configure the local hard disk drives.
2. Configure the BIOS settings.
3. Review the recommended slots for NICs and HBAs.

Local disk drive configuration

In this Ready Solutions for Oracle, the local hard disk drives (HDDs) in the PowerEdge database servers host software as shown in the table below. The Oracle database data itself resides on the external SAN XtremIO X2 storage array.

<table>
<thead>
<tr>
<th>Server type</th>
<th>Hosted on HDDs</th>
</tr>
</thead>
<tbody>
<tr>
<td>PowerEdge physical database servers</td>
<td>Bare-metal OS</td>
</tr>
<tr>
<td></td>
<td>Oracle grid</td>
</tr>
<tr>
<td></td>
<td>Oracle database software</td>
</tr>
<tr>
<td>ESXi server</td>
<td>Virtual machines</td>
</tr>
<tr>
<td></td>
<td>Oracle grid</td>
</tr>
<tr>
<td></td>
<td>Oracle database software</td>
</tr>
<tr>
<td>Management server</td>
<td>Management software</td>
</tr>
</tbody>
</table>

In each of the PowerEdge servers that are used in this Ready Solutions for Oracle, we recommend the following local disk drive configuration:

- At least two local disks (SSDs or HDDs) per server in a RAID configuration
- Depending on the number of local disks in the server, a single virtual disk (VD) of type RAID 1 or RAID 10
- At least one global hot-spare disk—the same type that you used to create the VD—in each server
- A minimum of 1.2 TB of usable space

Use either of the following Dell EMC Knowledge Base articles to create the RAID 1 or RAID 10 VD, if needed:

- Using System Setup: [Dell PowerEdge: How to create a Virtual Disk through the System Setup on 14G servers?](#)
- Using iDRAC: [Dell PowerEdge: How to create a Virtual Disk using iDRAC 9 on 14G servers?](#)

To create the global hot spare, see the instructions in the following Knowledge Base article: [Dell PowerEdge: How to Assign a Hard Drive in Global Hot Spare?](#)

BIOS configuration

We recommend the following BIOS settings for the PowerEdge servers in Ready Solutions for Oracle:

- **Memory settings**: Default options
- **Processor settings**: Default options
- **System Profile setting**: Performance (nondefault option)

The following table shows the recommended PCIe slots for the NICs and HBAs in the two R940-based production RAC database servers:

**Table 17. Production database servers: Recommended PCIe slots for NICs and HBAs**

<table>
<thead>
<tr>
<th>Adapter</th>
<th>Description</th>
<th>Slot</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td><strong>PowerEdge R940 chassis</strong>: 2.5&quot; chassis with up to 8 hard drives</td>
<td></td>
</tr>
<tr>
<td>NIC 1</td>
<td>Broadcom 57412 DP 10 Gb SFP+ PCIe adapter</td>
<td>3</td>
</tr>
<tr>
<td>NIC 2</td>
<td>Broadcom 57412 DP 10 Gb SFP+ PCIe adapter</td>
<td>6</td>
</tr>
<tr>
<td>HBA 1</td>
<td>Emulex LPe31002-M6-D DP 16 Gb/s FC HBA</td>
<td>2</td>
</tr>
<tr>
<td>HBA 2</td>
<td>Emulex LPe31002-M6-D DP 16 Gb/s FC HBA</td>
<td>5</td>
</tr>
</tbody>
</table>

The following table shows the recommended PCIe slots for the NICs and HBAs in the single R940-based virtual databases server:

**Table 18. Virtual databases server: Recommended PCIe slots for NICs and HBAs**

<table>
<thead>
<tr>
<th>Adapter</th>
<th>Description</th>
<th>Slot</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td><strong>PowerEdge R940 chassis</strong>: 2.5&quot; chassis with up to 8 hard drives</td>
<td></td>
</tr>
<tr>
<td>NIC 1</td>
<td>Intel X710 DP 10 Gb SFP+ PCIe adapter</td>
<td>3</td>
</tr>
<tr>
<td>NIC 2</td>
<td>Intel X710 DP 10 Gb SFP+ PCIe adapter</td>
<td>6</td>
</tr>
<tr>
<td>HBA 1</td>
<td>QLogic QLE2692 DP 16 Gb/s FC HBA</td>
<td>2</td>
</tr>
<tr>
<td>HBA 2</td>
<td>QLogic QLE2692 DP 16 Gb/s FC HBA</td>
<td>5</td>
</tr>
</tbody>
</table>

The following table shows the recommended PCIe slots for the NICs and HBAs in the R740-based XVC databases server:

**Table 19. XVC databases server: Recommended PCIe slots for NICs and HBAs**

<table>
<thead>
<tr>
<th>Adapter</th>
<th>Description</th>
<th>Slot</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td><strong>PowerEdge R740 chassis</strong>: 8 x 2.5&quot; SAS/SATA HDDs for 2 CPU configuration</td>
<td></td>
</tr>
<tr>
<td>NIC 1</td>
<td>Broadcom 5720 DP 1Gb + 57412 DP 10Gb NetXtreme- E rNDC</td>
<td>rNDC or LOM</td>
</tr>
<tr>
<td>HBA 1</td>
<td>Emulex LPe16002B-M6-D DP 16 Gb/s FC HBA</td>
<td>1</td>
</tr>
<tr>
<td>HBA 2</td>
<td>Emulex LPe16002B-M6-D DP 16 Gb/s FC HBA</td>
<td>7</td>
</tr>
</tbody>
</table>

1 - One of the 10 GbE ports on the rNDC was used for Oracle public traffic.

**Note**: The preceding slot recommendations are based on the chassis type that was used in testing Ready Solutions for Oracle. If you choose a different chassis type, the NICs and HBAs shipped from the factory are populated in the correct recommended PCIe slots for that server.
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Configuring Dell EMC Networking S4048-ON ToR switches

The Dell EMC Networking S4048-ON ToR switches support Oracle Database public and private interconnect traffic within this Ready Solutions for Oracle with XtremIO. They are also used to support the database backup and recovery traffic by providing the interconnectivity between this Ready Solutions for Oracle database servers and the Data Domain backup appliance.

This section provides the recommended configuration of the S4048-ON ToR switches to support the solution. Your environment might require additional configuration, including configuring the communication to the core datacenter network. For detailed configuration instructions, see one of the S4048-ON switch configuration guides under Manuals & Documents on the Dell EMC Product Support page.

**Note:** We tested this Ready Solutions for Oracle with S4048-ON version 9.11 and recommend that you refer to the configuration guide for that version.

### Configuration steps

Configure the S4048-ON ToR switches as follows, in accordance with recommended best practices:

   
   a. Configure Virtual Link Trunking (VLT) between the two S4048-ON switches using at least two of the 40 GbE link ports. VLT provides a loop-free environment by presenting two physical switches as one logical switch while not losing bandwidth for the devices connecting to it over two separate links.
   
   b. Configure the management IP address on each switch.

   **Note:** The management IP address on the two switches is also used as the VLT backup link.

   c. Enable Rapid Spanning Tree Protocol (RSTP) on the switches.
      
      A default bridge priority value of 32768 or higher ensures that neither of the ToR switches becomes the root bridge when plugged in to the core datacenter network.

   d. Enable spanning tree edge-port and spanning tree portfast on the ports that are used for Oracle Database private interconnect traffic. Doing so prevents any delays of the Oracle Grid infrastructure’s Cluster Synchronization Services (CSS) misscount that might lead to missed network heartbeats and Oracle node evictions.

2. Create a port channel on both S4048-ON switches by using the port that connects to the S3048-ON management switch. Ensure that the port channel is configured as a VLT peer link aggregation group (LAG) on both switches.

3. Enable jumbo frames \( \text{mtu 9216} \) on the ports to be used for Oracle Database private interconnect traffic.

4. Configure the network traffic for Oracle public, backup and recovery, private interconnect, and private management on separate VLANs.
Chapter 3: Compute, Management, Network, and Data Domain Initial Setup

The following table shows an example of a VLAN configuration for the different traffic types.

**Table 20. Example of VLAN IDs on S4048-ON switches**

<table>
<thead>
<tr>
<th>Traffic type</th>
<th>VLAN ID</th>
</tr>
</thead>
<tbody>
<tr>
<td>Oracle public, backup and recovery</td>
<td>16</td>
</tr>
<tr>
<td>Private management</td>
<td>30</td>
</tr>
<tr>
<td>Oracle private interconnect</td>
<td>100</td>
</tr>
</tbody>
</table>

*Note: VLAN IDs that are shown in the preceding table are examples. Network administrators can use VLAN IDs that conform to their network policies and standards as long as the Oracle public and private networks are on two separate VLANs.*

**Example settings**

This section provides examples and recommended configurations for the S4048-ON switches that are used in this solution.

**Example management settings**

Management VLAN and IP settings on the top S4048-ON switch:

```bash
interface Vlan 30
  ip address 192.168.211.1/26
  tagged Port-channel 1
  no shutdown

Management VLAN and IP settings on the bottom S4048-ON switch:

```bash
interface Vlan 30
  ip address 192.168.211.2/26
  tagged Port-channel 1
  no shutdown

Management port channel setting on the S4048-ON switches:

```bash
interface Port-channel 1
  description "Port-channel to S3048-ON management switch"
  no ip address
  switchport
  vlt-peer-lag port-channel 1
  no shutdown

Management interface port setting on both S4048-ON switches:

```bash
interface TenGigabitEthernet 1/25
  description "Link to S3048-ON management switch"
  no ip address
  !
  port-channel-protocol LACP
  port-channel 1 mode active
  no shutdown
  !
```
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Example VLTi settings

Virtual Link Trunking interconnect (VLTi) setting on the top S4048-ON switch:

```
vlt domain 1
  peer-link port-channel 128
  back-up destination 192.168.211.2
  primary-priority 1
  unit-id 0
!
```

VLTi setting on the bottom S4048-ON switch:

```
vlt domain 1
  peer-link port-channel 128
  back-up destination 192.168.211.1
  primary-priority 8192
  unit-id 1
!
```

VLTi port channel setting on both S4048-ON switches:

```
interface Port-channel 128
  description "VLTi Port Channel"
  no ip address
  channel-member fortyGigE 1/49,1/50
  no shutdown
!
```

Example Oracle public and backup and recovery interfaces and VLAN settings

Oracle public interface port setting on both S4048-ON switches:

```
interface TenGigabitEthernet 1/19
  description "Oracle public interface to database server"
  no ip address
  switchport
  no shutdown
!
```

Oracle backup and recovery interface port setting on both S4048-ON switches:

```
interface TenGigabitEthernet 1/21
  description "Backup and recovery interface to Data Domain backup appliance"
  no ip address
  switchport
  no shutdown
!
```

Oracle public VLAN setting on both S4048-ON switches:

```
interface Vlan 16
  description "Oracle public and backup and recovery VLAN"
  ip address 172.16.160.136/16
  tagged TenGigabitEthernet 1/19,1/37,1/43,1/48 [Public]
  tagged Port-channel 1
  untagged TenGigabitEthernet 1/21 [Backup and recovery]
```
Example Oracle private interconnect interface and VLAN settings

Oracle private interconnect interface port setting on both S4048-ON switches:

```
interface TenGigabitEthernet 1/17
  description "Oracle private interface to Oracle production RAC database servers"
  no ip address
  mtu 9216
  switchport spanning-tree rstp edge-port
  spanning-tree 0 portfast
  no shutdown
```

Oracle private interconnect VLAN setting on both S4048-ON switches:

```
interface Vlan 100
  description "Oracle private interconnect VLAN"
  untagged TenGigabitEthernet 1/17-1/18
  no shutdown
```

Configuring the management switch

A Dell EMC Networking S3048-ON switch serves as the 1 GbE management switch in this Ready Solutions for Oracle. This section provides the recommended configuration of this management switch to work in synchronization with the S4048-ON ToR switches.

Configure the VLANs and port channel on the S3048-ON switches by using the following example configuration:

- **Configure 10 GbE uplink ports connecting to the two S4048-ON ToR switches:**

  ```
  interface TenGigabitEthernet 1/49
    description "Link to S4048-ON ToR switch 1"
    no ip address
  !
  port-channel-protocol LACP
  port-channel 1 mode active
  no shutdown
  !

  interface TenGigabitEthernet 1/50
    description "Link to S4048-ON ToR switch 2"
    no ip address
  !
  port-channel-protocol LACP
  port-channel 1 mode active
  no shutdown
  !
  ```
Configure VLAN 16 for routing public traffic between this switch and the S4048-ON ToR switches. Add the two ports that connect to the management server and the tagged port-channel 1 that routes public traffic to the S4048-ON ToR switches to this VLAN:

```
interface Vlan 16
no ip address
tagged Port-channel 1
untagged GigabitEthernet 1/1-1/2
no shutdown
```

Configure VLAN 30, which is used to route all the private management traffic between all the hardware components, including the management server, physical database servers, virtual ESXi host, switches, storage, and backup appliance. Add all the ports that connect to the designated management ports, including iDRACs, on this Ready Solutions for Oracle hardware components and the Data Domain backup appliance to this VLAN. Also add the tagged port-channel 1 that routes private traffic to the S4048-ON ToR switches:

```
interface Vlan 30
ip address 192.168.211.3/26
tagged Port-channel 1
untagged GigabitEthernet 1/3-1/48
no shutdown
```

### Installing ESXi and vCenter Server Appliance on the management server

Install VMware ESXi and deploy the vCenter Server Appliance on the PowerEdge R640 host that will be the management server.

Although you can install locally or remotely, this section describes how to install remotely through the iDRAC web interface. In this example, we assign static IP addresses to the management interfaces of the ESXi hosts. We do not recommend DHCP for IP allocation of management hosts.

To install ESXi and vCenter Server Appliance on the management server, follow these procedures:

1. Review the prerequisites.
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2. Mount the ESXi image.
3. Install ESXi.
4. Configure the ESXi management network.
5. Deploy vCenter Server Appliance.

Reviewing Prerequisites

You need the following to complete the procedures in this section:

- iDRAC IP addresses or FQDN
- iDRAC credentials
- iDRAC Enterprise license applied on all nodes
- Dell EMC customized ESXi 6.5 image

VMware vSphere ESXi 6.5.x on Dell EMC PowerEdge Systems Image Customization Information on the Dell Support site provides instructions for downloading the image. Note the image location on your system for use when mounting virtual media. This location must be available while you install ESXi on all the servers.

- Host names and VLAN management ID
- Credentials for vSphere
- Static IP addresses for each of the management servers
- (Optional) Records for hostnames to be added to the DNS server

Mounting the ESXi image

Mount the customized ESXi 6.5 image:

1. Using a web browser, go to the iDRAC web interface at https://<iDRAC_Address>.
2. Log in with the appropriate credentials. The default credentials for iDRAC are as follows:
   
   User: root
   
   Password: calvin
3. Next to the Virtual Console Preview, click Launch to open the remote console, then enable pop-up support for each iDRAC in your chosen browser.
4. Under Virtual Media, select Connect Virtual Media.
5. After the virtual media is connected, mount the customized ESXi 6.5 ISO image:
   
   a. Select Virtual Media again, and then select Map CD/DVD.
   
   b. Click Browse and locate the customized ESXi 6.5 ISO image, select the image, and then click Open.
7. From the Virtual Console menu bar, select Next Boot > Virtual CD/DVD/ISO.
Chapter 3: Compute, Management, Network, and Data Domain Initial Setup

8. Click OK to continue, and verify that the location of the ISO image you have mapped is available throughout the full installation process.

9. From the Virtual Console menu bar, select Power > Power on System or, if the system is already on, select Power > Power Cycle System (cold boot).

After the power on self-test, the Boot Menu appears, confirming that the virtual media is mounted, as shown in the following figure.

![Boot Menu](image)

**Figure 5. Boot Menu**

### Installing VMware ESXi

Install VMware ESXi:

1. In the iDRAC Virtual Console, on the **Welcome to VMware ESXi 6.5.0 Installation** screen, press **Enter**.

2. Review the terms of the license agreement, and press **F11** to accept the agreement and continue.

3. When prompted, select a disk to install, use your cursor keys to select the SATADOM device as shown in the following figure, and then press **Enter** to continue.
Chapter 3: Compute, Management, Network, and Data Domain Initial Setup

3. Select a Disk to Install or Upgrade

   ![Select a Disk to Install or Upgrade](image)

   Figure 6. Selecting the installation disk

4. An **ESXi Found** message, shown in the figure below, indicates that the disk has previously been used for ESXi. If this message appears, use the cursor keys to select **Install**, press the spacebar, and then press **Enter** to perform a fresh installation.

   ![ESXi Found](image)

   Figure 7. **ESXi Found** message

5. Choose the keyboard layout for your environment, and then press **Enter** to continue.

6. At **Enter a root password**, type the password that you want to use for the root account, type the password again at the **Confirm** prompt, and then press **Enter**.

7. At **Confirm Install**, press **F11** to install ESXi 6.5.

8. When the installation completes, from the Virtual Console menu bar, select **Virtual Media > Disconnect Virtual Media**.

9. When prompted, click **Yes** to confirm that you want to close the session.

10. At **Installation Complete**, press **Enter** to restart the server.
After the ESXi installation is complete and the server restarts, configure the ESXi management network:

1. In the iDRAC Virtual Console, press F2 to log in to the Direct Console User Interface (DCUI).
2. At **Authentication Required**, type the credentials that you created during setup and press Enter.
3. At **System Customization**, select **Configure Management Network**.
4. Under **Configure Management Network**, select **Network Adapters**.
5. Ensure that vmnic0 and any other NIC ports that are already connected show a status of **Connected**, as shown in the following figure, and then press **Esc** to exit the menu.

![Network Adapters](image)

**Figure 8. Status of network adapters**

*Note:* If a port is not connected, check the cabling and status of the port on the switch and correct any issues. Press **Esc** to return to the previous screen.

6. Select **VLAN (optional)** from the menu, and press Enter.
7. On the **VLAN (optional)** screen, type the VLAN ID for the management network and press Enter.
8. Select **IPv4 Configuration** and press Enter.
9. On the **IPv4 Configuration** screen, select **Set static IPv4 address and network configuration**, and then press the spacebar.
10. Type the information for **IP Address**, **Subnet Mask**, and **Default Gateway**, and press Enter to confirm.

Obtain the information from the Management Host Information section of the site survey.

11. Select **DNS Configuration** and press Enter.
12. On the **DNS Configuration** screen, type the IP address of the DNS servers and the FQDN of the host.
Obtain the information from the Customer Network Services section of the site survey.

13. If the environment has multiple domains, or if it uses subdomains and short names, add the suffixes under **Custom DNS Suffixes**.

14. At **Configure Management Network: Confirm**, press **Esc** to return to the main menu and press **Y** to confirm changes and restart the management network.

15. Select **Test Management Network**.
   
   The **Test Management Network** screen displays the items that will be tested.

16. Press **Enter** to continue.

When iDRAC completes the test, it displays results such as the following.

![Management network test results](image)

This section describes how to deploy vCenter Server Appliance with an embedded Platform Services Controller. If you want to deploy the VM with an external Platform Services Controller, see the appropriate documentation from VMware.

**Prerequisites**

You need the following to deploy vCenter Server Appliance:

- vCenter Server Appliance ISO image, which has been downloaded to a location that is available throughout the installation process
- IP address for vCenter Server Appliance
- Hostname and record created on DNS server, if required

**Deploying the appliance**

Deploy vCenter Server Appliance as follows:

1. Open the vCenter Server Appliance installation ISO image.
   
   In this example, we are using a Windows workstation. Depending on your workstation operating system, you might have to use an external utility to mount the ISO image.

2. From the root of the ISO image, navigate to `\vcsa-ui-installer\win32\`

3. Double-click `installer.exe`

4. On the main menu of the installer, click **Install**.
5. Review the introduction, and then click **Next** to continue.
6. Review the End User License Agreement (EULA), select **I accept the terms of the license agreement**, and then click **Next**.
7. Select **vCenter Server with an Embedded Platform Services Controller** and click **Next**.
8. Type the requested information, as shown below, for the first management host that has a configured vSAN.

   ![Management host details](image)

   **Figure 10. Management host details**

9. Confirm the details and then click **Next**.
10. Verify the certificate thumbprint and click **Yes**.
11. **At Set up appliance VM**, type a name and password for the VM, confirm the password, and then click **Next**.
12. **At Select deployment size**, select sizes and click **Next**.
   
   The deployment sizing screen includes a chart to help you select a deployment size.

13. Select the datastore where vCenter Server Appliance will be located and click **Next**.
14. On the **Configure network settings** page, type the requested information and click **Next**.
15. Review the deployment settings and click **Finish**.
   
   The installer displays a **Deployment complete** message and prompts you to continue to stage 2, appliance setup.

16. Click **Continue**.
17. Review the introduction and click **Next**.
18. Select the time synchronization mode, type the NTP server information, and click **Next**.
19. Type the requested single sign-on (SSO) information, including the SSO domain name and site name, and click **Next**.
20. Review the information about the VMware Customer Experience Improvement Program, choose whether to participate, and then click **Next**.
21. Review the summary information and, if it is correct, click **Finish**.
22. Review the warning about stopping the installation, and click OK.
23. When the installer completes the setup, make note of the URLs that are provided, and then click Close to exit the installer.

### Configuring zoning on FC switches

This section describes the recommended zoning configuration on the Dell EMC Connectrix DS6x10-B FC switches that this Ready Solutions for Oracle supports. The recommended configuration ensures that a path is always available for the Oracle database servers to reach the storage, even if failure occurs with an HBA port, HBA, switch, XtremIO controller, or XtremIO X-Brick.

The following figure shows the logical connectivity view between the initiators on the database servers and the target front-end FC ports on the XtremIO after the recommended zoning configurations are created on the redundant FC switches. It shows the logical view of the two-node Oracle RAC production database environment. The same design and configuration is used for the XVC database and the virtual database servers setup.

Zoning is configured so that each host initiator in the database server is zoned to four target front-end FC ports that are on four separate XtremIO storage controllers.

To implement the recommended zoning on each FC switch:

1. Create an alias for each HBA port or initiator that is connected to the switch from each of the database servers.
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For example:

DS6510B_U36:admin> alicreate "R940-Phy-N1-S2P0",
"10:00:00:90:fa:c7:b7:bb"

where R940 represents the PowerEdge server type, Phy represents the environment (physical) the server is used in, N1 represents the node number (node 1), S2 represents the PCIe slot (slot 2) that the HBA is populated in, and P0 represents the port (port 0) on the HBA that is connected to the FC switch.

Note: As shown in Figure 11, we have four initiators or HBA ports per database server, but only two connect to each FC switch. In this solution, because we have four database servers, we need to create eight HBA port or initiator aliases per FC switch by using the command as shown in the preceding example.

2. Create an alias for each front-end FC port or target on the XtremIO X2 controllers that are connected to the switch.

For example:

DS6510B_U36:admin> alicreate "XIOX2-X2-SC2-P3",
"51:4f:0c:50:37:67:83:11"

where XIOX2 represents XtremIO X2, X2 represents X-Brick number 2, SC2 represents the controller number 2, and P3 represents the port number on the front-end HBA within the controller.

Note: As shown in Figure 11, port 3 from each XtremIO controller connects to one FC switch and port 4 from each XtremIO controller connects to the other FC switch. In this solution, because we have four controllers, we need to create four front-end XtremIO FC port or target aliases on each FC switch by using the command as shown in the preceding example.

3. Create zone sets.

As shown in Figure 11, in each zone set you must include one initiator (alias) from the database server and four target front-end FC ports that belong to four separate controllers on the XtremIO X2 array.

For example:

DS6510B_U36:admin> zonecreate "R940-Phy-N1-XIOX2-P3-Zone1", "R940-Phy-N1-S2P0; XIOX2-X1-SC1-P3; XIOX2-X1-SC2-P3; XIOX2-X2-SC1-P3; XIOX2-X2-SC2-P3"

where R940-Phy-N1-S2P0 represents a single initiator on one of the database servers and XIOX2-X1-SC1-P3; XIOX2-X1-SC2-P3; XIOX2-X2-SC1-P3; XIOX2-X2-SC2-P3 represents the FC port 3 on each of the four XtremIO controllers that are connected to this switch.

Note: In Ready Solutions for Oracle, from each database server we connect two initiator (HBA) ports to one FC switch and two other initiator (HBA) ports to the other FC switch. Therefore, on each FC switch we need to create two zone sets per database server. In this
solution, because we have four database servers, we need to create eight zone sets per FC switch using the command as shown in the preceding example.

4. Run the `cfgsave` command to save the configuration.

5. Create a zone configuration to include all the zone sets that you created in step 3 for this switch.

   For example:
   
   ```
   DS6510B_U36:admin> cfgcreate "DBZONE_RS-Oracle-XIOX2_CONFIG", "
   R940-Phy-N1-XIOX2-P3-Zone1; R940-Phy-N1-XIOX2-P3-Zone2; R940-Phy-
   N2-XIOX2-P3-Zone1; R940-Phy-N2-XIOX2-P3-Zone2; R940-Virt-XIOX2-P3-
   Zone1; R940-Virt-XIOX2-P3-Zone2; R940-XVC-XIOX2-P3-Zone1; R940-XVC-
   XIOX2-P3-Zone1;"
   ```

   **Note:** On each FC switch, we create two zone sets per database server. Because this solution has four database servers, each FC switch’s zone configuration contains eight zone sets, as shown in the example above. Enable the zone configuration as follows:

   ```
   DS6510B_U36:admin> cfgenable DBZONE_RS-Oracle-XIOX2_CONFIG
   ```

6. Run the `cfgsave` command to save the configuration.

---

**Data Domain backup appliance initial system setup**

This section provides the initialization and setup steps for the Data Domain DD6300 and DD9300 backup appliances that are used in the commercial and the enterprise backup solutions, respectively. These steps and examples were performed on the DD9300 appliance, but are identical for the DD6300 appliance.

**Data Domain initialization**

**Accepting the End User License Agreement (EULA)**

Power on the Data Domain appliance and connect to the Serial Comms port. The first time that you log in to a Data Domain system, the End User License Agreement (EULA) is displayed. At the end of the EULA, you are prompted to accept the agreement:

Press any key then hit enter to acknowledge the receipt of EULA information

You can later type the following to redisplay the EULA and accept it:

```
system show eula
```

**Running the Configuration Wizard**

The CLI configuration wizard starts automatically the first time that the system starts. The wizard prompts you through a series of questions that provide enough information for initial system configuration and basic network connectivity.
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Note You can start the CLI configuration wizard manually by typing:
config setup

Configuring the Management Network

1. Type yes to configure the system for network connectivity.

Network Configuration
Configure Network at this time (yes|no) [no]: yes

2. Type yes to configure DHCP (Dynamic Host Configuration Protocol) to obtain network parameters (such as, the hostname, domain name, and IP addresses) dynamically from a DHCP server. Or enter no to configure the parameters manually.

Use DHCP
Use DHCP for hostname, domainname, default gateway and DNS servers? (At least one interface needs to be configured using DHCP) (yes|no|?)

3. Type a FQDN for the hostname or accept the hostname, if the system was able to discover it.

Enter the hostname for this system (fully-qualified domain name) []:

4. Type the DNS (Domain Name System) domain name; for example, yourcompany.com. Or accept the domain name, if the system was able to discover it.

Domainname Enter your DNS domainname []:

5. Enable and configure each Ethernet interface. Accept or decline DHCP for each interface by typing yes or no respectively. If the port does not use DHCP to discover network parameters automatically, enter the information manually. For the Management network setup, disable all other ports except for ethMa. We will set up the other ports in the next section using the Management web UI.

Ethernet port eth0d
Enable Ethernet port eth0a (yes|no|?) [yes]: no

Ethernet port ethMa
Enable Ethernet port eth0b (yes|no|?) [no]: yes

Use DHCP on Ethernet port eth0b (yes|no|?) [no]:
Enter the IP address for eth0b [192.168.10.185]:
Enter the netmask for eth0b [255.255.255.0]:

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6. Type the IP address of the default routing gateway, or accept the default gateway, if the system was able to discover it.
   
   Default Gateway
   
   Enter the default gateway IP address:
   
   **192.168.10.1**

7. Type the IPv6 address of the default routing gateway or accept the IPv6 address of the default gateway, if the system was able to discover it. If IPv6 is not in use, leave the field empty, and press Enter to continue.
   
   IPv6 Default Gateway
   
   Enter the ipv6 default gateway IP address:

8. Type up to three DNS servers to use for resolving host names to IP addresses. Use a comma-separated or space-separated list. Enter a space for no DNS servers or accept the IP addresses of the DNS servers, if the system was able to discover them.
   
   DNS Servers
   
   Enter the DNS Server list (zero, one, two or three IP addresses):
   
   **192.168.10.1**

9. When the summary of the network settings is displayed, accept the settings (Save), reject the settings and exit to the CLI (Cancel), or return to the beginning of the current section and change the settings (Retry). Entering Retry displays your previous responses for each prompt. Press Enter to accept the displayed value or enter a new one. The following is a generic example of the Data Domain hostname and network interfaces.
   
   Pending Network Settings
   
   Hostname: ddbeta1.dallasrdc.com
   
   Domain name: dallasrdc.com
   
   Default Gateway: 192.168.10.1
   
   DNS Server List: 192.168.10.1
   
   Port   Enabled   Cable   DHCP   IP Address      Netmask or Prefix Length
   
   eth0a  no        no      n/a    n/a             n/a
   
   eth0b  no        no      n/a    n/a             n/a
   
   eth0c  no        no      n/a    n/a             n/a
   
   eth0d  no        no      n/a    n/a             n/a
Chapter 3: Compute, Management, Network, and Data Domain Initial Setup

<table>
<thead>
<tr>
<th>Interface</th>
<th>Connect</th>
<th>DHCP</th>
<th>Address</th>
<th>Mask</th>
</tr>
</thead>
<tbody>
<tr>
<td>ethMa</td>
<td>yes</td>
<td>yes</td>
<td>no</td>
<td>192.168.10.181</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>255.255.255.0</td>
<td></td>
</tr>
<tr>
<td>ethMb</td>
<td>no</td>
<td>no</td>
<td>n/a</td>
<td>n/a</td>
</tr>
<tr>
<td>ethMc</td>
<td>no</td>
<td>no</td>
<td>n/a</td>
<td>n/a</td>
</tr>
<tr>
<td>ethMd</td>
<td>no</td>
<td>no</td>
<td>n/a</td>
<td>n/a</td>
</tr>
<tr>
<td>ethMe</td>
<td>no</td>
<td>no</td>
<td>n/a</td>
<td>n/a</td>
</tr>
<tr>
<td>ethMf</td>
<td>no</td>
<td>no</td>
<td>n/a</td>
<td>n/a</td>
</tr>
</tbody>
</table>

Do you want to save these settings (Save|Cancel|Retry):

10. Type **Save** to save the configuration.

11. Open a browser and type the newly configured management IP to continue the setup using the UI.

**Using the management UI to set up licenses and backup the network**

1. Log in to the web UI. When the window opens and prompts you to continue the setup, click **Yes** to set up the licenses or **No** to skip the setup.
2. Next, configure the network, which is used for the RMAN backup.

3. Click **Manually Configure** and type the hostname, domain name, and gateway.
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4. Enable the interface that you are using for your backup network connecting to this Ready Solutions for Oracle and provide a static IP and netmask. In our solution, we used 2 interfaces, eth3a and eth3b. The interfaces must be on the same subnet as your public IP for the Data Domain appliance to communicate with the database servers in the Ready Solution.

5. Select or enter your DNS. Then, click Next.
6. Review the summary and click **Submit** to update the network settings.

7. Do not configure anything else. Click **No** when prompted to configure File System, System Settings, and so on.
Enabling the Filesystem

1. SSH into the management IP of the Data Domain appliance and enter the following command to enable the file system with the default configuration:

```
sysadmin@DD9300# filesystem enable
Please wait...
The filesystem is already enabled.
The filesystem is now enabled.
sysadmin@DD9300#  
```

2. Verify that the file system is enabled:

```
sysadmin@DD9300# filesystem show space
```

Enabling DD Boost

Go back to the UI. On the side panel, navigate to Protocols > DD Boost and click Enable. The following figure shows that DD Boost is enabled:

Add Interface Groups

Navigate to the IP Network Tab after you enable Data Domain Boost for Enterprise Applications (DD Boost), and click the default Interface Groups. Add the IPs of the interfaces to which you assigned IP addresses earlier. The following figure shows the interfaces:
When accessing the Data Domain UI by using the browser, you might encounter this error message:

To fix the problem, follow these steps:

1. Either SSH into the Data Domain system or connect the serial comms and run the following commands:

   Command:  `amindsysadmin@den-dd990# adminaccess disable http`
   Response:  HTTP Access:  disabled

   Command:  `sysadmin@den-dd990# adminaccess disable https`
   Response:  HTTPS Access:  disabled

   Command:  `amindsysadmin@den-dd990# adminaccess certificate generate self-signed-cert`
   Response:  New certificates have been generated.

   Command:  `amindsysadmin@den-dd990# adminaccess enable http`
   Response:  HTTP Access:  enabled

   Command:  `amindsysadmin@den-dd990# adminaccess enable https`
   Response:  HTTPS Access:  enabled

2. Refresh the browser and log in.
Chapter 4  Production RAC Database Environment Setup

This chapter presents the following topics:

Overview......................................................................................................................51
XtremIO storage configuration .......................................................................................51
LAN and SAN switches setup .......................................................................................52
Database server setup .................................................................................................52
Overview

The two-node production Oracle RAC database deployment in a physical environment consists of the following tasks:

1. XtremIO storage configuration
   a. Create Initiator Groups
   b. Create storage volumes
   c. Map the storage volumes to database servers

2. LAN and SAN switches setup
   a. Configure redundant ToR 10 GbE Ethernet switches
   b. Configure redundant 16 Gbps SAN FC switches, including zoning

3. Database servers setup
   a. Prepare PowerEdge servers
   b. Configure OS, network, and storage volumes
   c. Install Oracle 12c R2 Grid and Oracle 12c R2 Database

XtremIO storage configuration

In this environment setup, the Oracle RAC production database runs across two physical R940-based nodes or servers. Each database server has four HBA ports or initiators that are connected to the XtremIO storage array by redundant FC switches.

On the XtremIO storage array, configure the storage that is based on the design for the physical production database environment:

1. Create two Initiator Groups.
   - Initiator Group 1 contains the four initiators from the first database RAC node
   - Initiator Group 2 contains the four initiators from the second database RAC node

   **Note:** Record the four unique World Wide Names (WWN) of the four HBA initiators in each of the physical database servers. You need these initiator WWNs when you create the two Initiator Groups on the XtremIO storage array.

2. Create dedicated storage volumes for this RAC database, which includes separate volumes for OCR, DATA, REDO, FRA, and TEMP. The following table shows the XtremIO volume design for this two-node Oracle RAC production database:
Table 21. XtremlO volume design for two-node Oracle RAC production database

<table>
<thead>
<tr>
<th>Volume name</th>
<th>Number of volumes</th>
<th>Size per volume (GB)</th>
<th>Total size (GB)</th>
</tr>
</thead>
<tbody>
<tr>
<td>C2-OCR</td>
<td>3</td>
<td>50</td>
<td>150</td>
</tr>
<tr>
<td>C2-DATA</td>
<td>4</td>
<td>300</td>
<td>1,200</td>
</tr>
<tr>
<td>C2-REDO</td>
<td>2</td>
<td>100</td>
<td>200</td>
</tr>
<tr>
<td>C2-FRA</td>
<td>1</td>
<td>200</td>
<td>200</td>
</tr>
<tr>
<td>C2-TEMP</td>
<td>1</td>
<td>500</td>
<td>500</td>
</tr>
<tr>
<td>Total</td>
<td>11</td>
<td></td>
<td>2,250</td>
</tr>
</tbody>
</table>

3. Map the RAC production database volumes to the two RAC database servers by mapping the volumes that were created in step 2 to the two Initiator Groups created in step 1.

Refer to Appendix A for the detailed steps to create the initiator groups, volumes, and mappings based on the design listed above for the production database environment.

LAN and SAN switches setup

In the production RAC database environment, the redundant Dell EMC Networking S4048-ON ToR 10 GbE Ethernet switches provide both the Oracle public and the private network connectivity to and from the Oracle RAC database. For details about configuring these redundant LAN switches, refer to
Chapter 4: Production RAC Database Environment Setup

Configuring Dell EMC Networking S4048-ON ToR switches.

Dell EMC Connectrix DS6510-B provides the SAN connectivity between the two-node Oracle RAC database servers and the XtremIO X2 storage array. For details about the recommended zoning configuration, refer to Configuring zoning on FC switches.

Database server setup

Setting up two Oracle RAC database servers consists of the following tasks:

1. Preparing PowerEdge servers. For the initial setup on the PowerEdge database servers, refer to Preparing PowerEdge servers.
2. Configuring the OS, network, and storage
3. Installing Oracle 12c R2 Grid and Oracle 12c R2 RAC databases

In this use case, we deployed RHEL 7.4 as the bare-metal OS to test the production Oracle 12c R2 RAC database in a physical environment.

For detailed steps to install and configure the OS, network and storage disks, refer to the generic Dell EMC knowledge base Wiki article How to deploy Oracle 12c Release 2 Grid and RAC Database on RHEL 7.x.

The following provides a quick overview of the detailed steps that are covered in the generic guide and anything unique to this Ready Solutions for Oracle with XtremIO:

1. Install RHEL 7.4 with base packages.
2. Register the server with Red Hat Network (RHN) and set up the local yum repository by using the RHEL ISO CD.
3. Download and install the Dell EMC Oracle 12c R2 pre-install deployment RPMs for RHEL 7 (go to Dell Oracle Deployment RPMs for Oracle 12cR2 on RHEL7.x.)
4. Set up the Oracle Grid and Database software prerequisites, such as the required OS RPMs, users, groups, and kernel parameters.
5. Set up the Oracle public and private network.
6. Set up entries for Oracle public, SCAN, and VIP networks in the DNS server. Set up private hostname mapping locally in the /etc/hosts file in each of the two database servers.
7. Prepare and configure the XtremIO X2 disks or volumes for Oracle 12c R2 Grid and Database software installation.
   a. Set up multipath using native device mapper.
   b. Partition the disks.
   c. Set up udev rules.
In addition to the configuration and setup previously referenced and provided in the generic Dell EMC Wiki article [How to deploy Oracle 12c Release 2 Grid and RAC Database on RHEL 7.x](https://www.dell.com/support/article/sln302112), the configuration and best practices that are described in the following sections were applied in the two production RAC database servers.

**Note:** Best practices were applied in our test environment using the [Dell EMC XtremIO Storage Array Host Configuration Guide](https://www.dell.com/support/article/sln302112). Refer to this guide for detailed steps on how to apply the best practices when using XtremIO in a Linux environment.

### HBA queue depth settings

The following table lists the default and recommended HBA queue depth settings for a Linux environment:

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Default value</th>
<th>Recommended value</th>
</tr>
</thead>
<tbody>
<tr>
<td>LUN Queue Depth</td>
<td>QLogic: 32, Emulex: 30</td>
<td>QLogic: Keep default value, Emulex: Keep default value</td>
</tr>
<tr>
<td>HBA Queue Depth</td>
<td>QLogic: 32, Emulex: 8192</td>
<td>QLogic: 65535 (maximum), Emulex: 8192 (maximum)</td>
</tr>
</tbody>
</table>

**Note:** We kept the default queue depth values in our physical database servers because we used Emulex HBAs.

### I/O elevator settings

The recommended I/O elevator setting in the RHEL OS running in the database servers connecting to XtremIO X2 storage arrays is either deadline or noop. We do not recommend the cfg I/O elevator setting. In our physical database servers, we used deadline, which is the default I/O elevator setting in RHEL 7.4.

### Multipath configuration

We configured the physical database servers by using Linux Native Multipathing available within the RHEL 7.4 OS. We created the configuration file for the multipath daemon `/etc/multipath.conf` with the following recommended settings:

```bash
devices {
    device {
        vendor               XtremIO
        product              XtremApp
        path_grouping_policy multibus
        path_checker         tur
        path_selector        "queue-length 0"
        rr_min_io_rq         1
        user_friendly_names  yes
        fast_io_fail_tmo     15
        failback             immediate
    }
}
```
Partition alignment in Linux
We partitioned the database disks or XtremIO volumes that are presented to the Linux-based physical database servers by using fdisk with the default starting sector value of 2,048. Partitioning ensures that the starting sector number is a multiple of 16 (16 sectors, at 512 bytes each, is 8 KB); therefore each database disk is correctly aligned with the XtremIO storage LUN striping.

In this solution, we deployed Oracle 12c R2 Grid and RAC Database to test the two-node production database environment.

For detailed steps to configure the prerequisites, 12c R2 Grid and 12c R2 Oracle software, and Oracle 12c R2 database, refer to the generic Dell EMC knowledge base Wiki article How to deploy Oracle 12c Release 2 Grid and RAC Database on RHEL 7.x.

The following provides an overview of the detailed steps that are covered in the generic guide and anything unique to this Ready Solutions for Oracle with XtremIO:

1. Before installing the Oracle 12cR2 Grid and Database, ensure that you have configured the OS, network, and storage prerequisites as described in Configuring OS, network, and storage.

2. Configure and synchronize the system clock settings on the two database servers.

3. Locate the Oracle 12c media kit and run the Oracle Grid Universal Installer on the first database node.
   a. Select and configure an Oracle stand-alone cluster and choose the public, private, SCAN, and VIP networks configured in the previous section.
   b. Add the two database servers as a HUB node.
   c. Create and configure an ASM disk group for OCR and Voting disks by using the Normal redundancy option.
   d. When prompted near the end of the installation, run the root.sh script on both nodes and finish the Grid installation.

4. Locate the Oracle 12c media kit and run the Oracle Database Universal Installer on the first database node.
   a. In the beginning of the installation, select the Install database software only and Oracle Real Application Clusters database installation options.
   b. Select the two appropriate database servers to be part of the two-node RAC database.
   c. Select the appropriate privileged OS groups that were created automatically by the Dell EMC preinstall deployment RPMs described in the previous section.
   d. When prompted near the end of the installation, run the root.sh script, one node at a time, and finish the Oracle Database software installation.

5. Create ASM disk groups for DATA, Fast Recovery Area (FRA), REDO, and TEMP by using the ASM Configuration Assistant (ASMCA) utility.
Chapter 4: Production RAC Database Environment Setup

a. For each of the disk groups, choose the appropriate XtremIO volumes or ASM disks that were described and configured in the previous section.

b. Ensure that you specify the disk group redundancy as **External (None)**.

c. In Ready Solutions for Oracle with XtremIO, we recommend that you create two REDO disk groups, REDO1 and REDO2, each with at least one 50 GB physical XtremIO LUN or ASM disk.

6. As Grid administrator user, change the ASM striping type for FRA, REDO, and TEMP disk groups from coarse to fine-grained.

7. Create the seed database by using the Database Configuration Assistant (DBCA) utility:
   a. Select the **Advanced configuration** option.
   b. Select the database type as **Oracle Real Application Cluster (RAC) database** and template as **General Purpose or Transaction Processing**.
   c. Select the two RAC nodes on which we installed database software and specify the name for the database and its instance.
   d. Optionally, create a container database. The production database in this Ready Solutions for Oracle was tested as a noncontainer database.
   e. For the seed database and FRA storage options, select the file storage type as ASM and the file location as the appropriate DATA and FRA disk groups, respectively, that were created in step 5.
   f. Select **Automatic Shared Memory Management (ASMM)** and configure the SGA and PGA memory sizes, as needed.
   g. In the **Database Storage Option** screen, clear **Use Oracle-Managed Files (OMF)**.
   h. On the **Database Creation Option** screen, click **Customize Storage Locations** to create the Redo Log Groups that are based on the following design recommendation for Ready Solutions for Oracle with XtremIO:

<table>
<thead>
<tr>
<th>Redo log group number</th>
<th>Thread number</th>
<th>Diskgroup location</th>
<th>Redo log file size</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1</td>
<td>+REDO1</td>
<td>5 GB</td>
</tr>
<tr>
<td>2</td>
<td>1</td>
<td>+REDO2</td>
<td>5 GB</td>
</tr>
<tr>
<td>3</td>
<td>1</td>
<td>+REDO1</td>
<td>5 GB</td>
</tr>
<tr>
<td>4</td>
<td>1</td>
<td>+REDO2</td>
<td>5 GB</td>
</tr>
<tr>
<td>5</td>
<td>2</td>
<td>+REDO1</td>
<td>5 GB</td>
</tr>
<tr>
<td>6</td>
<td>2</td>
<td>+REDO2</td>
<td>5 GB</td>
</tr>
<tr>
<td>7</td>
<td>2</td>
<td>+REDO1</td>
<td>5 GB</td>
</tr>
<tr>
<td>8</td>
<td>2</td>
<td>+REDO2</td>
<td>5 GB</td>
</tr>
</tbody>
</table>
This chapter presents the following topics:

- **Overview** .................................................................58
- **XtremIO storage configuration** ........................................58
- **LAN and SAN switches setup** ........................................59
- **ESXi database server setup** ..........................................59
- **Guest OS and Databases configuration** ..............................70
Overview

The deployment of the two virtual databases on a single ESXi host consists of the following tasks:

1. XtremIO storage configuration
   a. Create Initiator Group
   b. Create storage volumes
   c. Map the storage volumes to the ESXi host

2. LAN and SAN switches setup
   a. Configure redundant ToR 10 GbE Ethernet switches
   b. Configure redundant 16 Gbps SAN FC switches, including zoning

3. ESXi host, network, VM, and storage setup
   a. Prepare the PowerEdge server
   b. Install and configure ESXi on the database server
   c. Create a vSphere datacenter, including adding the ESXi database host
   d. Configure a vSphere Distributed Switch
   e. Configure datastores
   f. Create VMs for Oracle Databases
   g. Set up networking for ESXi hosts and VMs
   h. Prepare storage disks for Oracle Standalone databases

4. Guest OS and Databases configuration
   a. Set up the 12cR2 VM Guest OS and Database
   b. Set up the 11gR2 VM Guest OS and Database

XtremIO storage configuration

In this environment setup, the two virtual databases run inside two separate VMs hosted on a single R940-based VMware ESXi host. The ESXi host has four physical HBA ports or initiators that are connected to the XtremIO storage array by redundant FC switches.

On the XtremIO storage array, configure the storage that is based on the design for the physical database environment:

1. Create one Initiator Group that contains the four initiators in the ESXi host.

2. Create storage volumes that are shared by both the virtual databases, which include volumes for Guest OS, OCR, DATA, REDO, FRA, and TEMP. The

Note: Record the four unique World Wide Names (WWN) of the four HBA initiators in the ESXi host. You need these initiator WWNs when you create the two Initiator Groups on the XtremIO storage array.
following table shows the XtremIO volume design for the two databases in the virtual database environment:

Table 24. XtremIO shared volume design for the two virtual databases

<table>
<thead>
<tr>
<th>Volume name</th>
<th>Number of volumes</th>
<th>Size per volume (GB)</th>
<th>Total size (GB)</th>
</tr>
</thead>
<tbody>
<tr>
<td>C3-VM-OS</td>
<td>1</td>
<td>600</td>
<td>600</td>
</tr>
<tr>
<td>C3-OCR</td>
<td>3</td>
<td>100</td>
<td>300</td>
</tr>
<tr>
<td>C3-DATA</td>
<td>4</td>
<td>600</td>
<td>2,400</td>
</tr>
<tr>
<td>C3-REDO</td>
<td>2</td>
<td>100</td>
<td>200</td>
</tr>
<tr>
<td>C3-FRA</td>
<td>1</td>
<td>200</td>
<td>200</td>
</tr>
<tr>
<td>C3-TEMP</td>
<td>1</td>
<td>500</td>
<td>500</td>
</tr>
<tr>
<td>Total</td>
<td>12</td>
<td></td>
<td>4,200</td>
</tr>
</tbody>
</table>

3. Map the two virtual databases volumes to the ESXi host by mapping the volumes that were created in step 2 to the single Initiator Group created in step 1.

Refer to Appendix A for detailed steps to create the initiator groups, volumes, and mappings that are based on the design listed previously for the production database environment.

LAN and SAN switches setup

In the virtual environment consisting of a single ESXi host, the redundant Dell EMC Networking S4048-ON ToR 10 GbE Ethernet switches provide the Oracle public network connectivity to and from the Oracle stand-alone 11gR2 and 12cR2 virtual databases. For details about configuring these redundant LAN switches, refer to
Chapter 5: Virtual Databases Environment Setup

Configuring Dell EMC Networking S4048-ON ToR switches.

The Dell EMC Connectrix DS6510-B switch provides SAN connectivity between the single ESXi virtual database server and the XtremIO X2 storage array. For details about the recommended zoning configuration, refer to Configuring zoning on FC switches.

ESXi database server setup

Before you set up the ESXi database server, ensure that the vCenter Server Appliance (VCSA) VM is installed and set up on the management server. This setup is required to connect to the vSphere Web Client to perform the following tasks:

1. Create a vSphere datacenter, including adding the ESXi database host
2. Configure a vSphere Distributed Switch
3. Configure datastores
4. Create VMs for Oracle Databases
5. Set up networking for ESXi hosts and VMs
6. Prepare storage disks for Oracle Standalone databases

Installing and configuring ESXi on the database server

On the R940-based virtual database server, install ESXi 6.5 U2 by repeating the procedures in Installing ESXi and vCenter Server Appliance on the management server.

Note: In the previously referenced section, ignore the subsection to install the vCenter Server Appliance as it is not necessary to install it again on the virtual database server.

Additional best practices in XtremIO environment

When ESXi 6.5 was installed on the database server, we applied the following applicable best practices for our virtual environment:

Note: We applied best practices by using the Dell EMC XtremIO Storage Array Host Configuration Guide. Refer to this guide for the complete list of best practices for XtremIO in a VMware ESXi host environment and for the detailed steps about how to apply them.

HBA queue depth settings

The following table lists the default and recommended HBA queue depth settings for ESXi 6.5 hosts connecting to XtremIO X2 storage arrays:

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Default value</th>
<th>Recommended value</th>
</tr>
</thead>
<tbody>
<tr>
<td>LUN Queue Depth</td>
<td>QLogic: 64</td>
<td>QLogic: 256</td>
</tr>
<tr>
<td></td>
<td>Emulex: 30</td>
<td>Emulex: 128</td>
</tr>
<tr>
<td>HBA Queue Depth</td>
<td>QLogic: N/A</td>
<td>QLogic: N/A</td>
</tr>
<tr>
<td></td>
<td>Emulex: 8192</td>
<td>Emulex: 8192 (maximum)</td>
</tr>
</tbody>
</table>
We set the LUN queue depth to 256, the recommended value, for the QLogic HBAs used in our virtualized databases server. This value ensures that the XtremIO X2 storage arrays handle an optimal number of SCSI commands (including I/O requests).

**Note:** vSphere no longer reads the QLogic HBA Queue Depth setting and is therefore not relevant when configuring a vSphere host with QLogic HBAs.

### Multipath configuration

Configure the virtual databases ESXi host by using vSphere Native Multipathing (NMP) and these parameter values on the host for optimal performance with XtremIO X2:

- Set the native path selection policy on the XtremIO volumes that are presented to the ESXi hosts to round-robin.
- Set the vSphere NMP round-robin path switching frequency to XtremIO volumes from the default value (1000 I/O packets) to 1.

**Note:** In ESXi 6.5, the default path selection policy is round-robin and the default path switching frequency is 1. Therefore, no change was needed in our virtualized databases server.

### Host parameter settings

Configure the following ESXi host parameters:

- **Disk.SchedNumReqOutstanding**—Determines the maximum number of active storage commands (I/O) allowed at any given time at the VMkernel. For each XtremIO volume presented to the ESXi host, set this parameter value to the recommended value of 256 by running the following CLI commands on the ESXi 6.5 host:

  1. To get the list of all XtremIO volumes:

     ```
     $> esxcli storage nmp path list | grep XtremIO -B1 | grep "\nnaa" | sort | uniq
     ```

  2. To set the value for each volume:

     ```
     $> esxcli storage core device set -d <naa.xxx> -O 256
     
     where <naa.xxx> is the XtremIO volume that is obtained from the command above it.
     ```

- **Disk.SchedQuantum**—Determines the maximum number of consecutive "sequential" I/Os allowed from one VM before switching to another VM. Change this value to 64.

Perform the following steps to create the datacenter and cluster containers inside vSphere:

1. Open a web browser and connect to the vSphere Web Client using the VCSA IP address, as shown below:

   ```
   https://<vCenter Server Administrator FQDN or IP>/vsphere-client
   ```

2. Log in with an account that has administrator privileges.
Chapter 5: Virtual Databases Environment Setup

3. Go to Home > Inventory > Hosts and Clusters.
4. On the navigator menu, right-click the top-level vCenter Server Administrator object and click New Datacenter.
5. Type the name for the datacenter and click OK.

Adding hosts to vCenter

After you create a vSphere datacenter, add the hosts to vCenter by performing the following steps on each of the servers that will be part of the datacenter:

1. Open a web browser and open the vSphere Web Client:
   https://<vCenter Server Administrator FQDN or IP>/vsphere-client
2. Log in with an account that has administrator privileges.
3. Go to Home > Inventory > Hosts and Clusters.
4. Right-click the datacenter object and select Add host.
5. Type the appropriate DNS name or IP address that is assigned to the virtual database server and complete the remainder of the wizard.

Configuring a vSphere Distributed Switch

A vSphere Distributed Switch (VDS) provides centralized VM network administration. In VDS, each ESXi host's virtual switches are abstracted into a large pool and spread across multiple ESXi hosts within the datacenter.

**Note:** Typically, for single ESXi host implementations, standard switches and port groups are sufficient. In this solution, even though we used only one ESXi host, we created distributed switches and port groups to provide the means to easily expand to virtual Oracle RAC environments by using multiple ESXi hosts, if needed.

To configure a VDS:

1. Create the distributed switch.
2. Create corresponding port groups.

To establish the basic virtual network infrastructure for the Oracle database, Ready Solutions for Oracle requires the distributed switches and port groups that are described in the following table.

Table 26. Distributed switches and port groups

<table>
<thead>
<tr>
<th>Distributed switch name</th>
<th>Distributed port group names</th>
<th>Purpose</th>
</tr>
</thead>
<tbody>
<tr>
<td>oraPub</td>
<td>oraPublic</td>
<td>Interfaces for the Oracle public and ‘backup and recovery’ network</td>
</tr>
<tr>
<td></td>
<td>vMotion***</td>
<td>Interfaces for VMware vMotion activity</td>
</tr>
<tr>
<td></td>
<td>oraPub-DVUplinks-61 (Uplink port group)</td>
<td>Connection for two 10 GbE physical ports that Oracle public, vMotion, and ‘backup and recovery’ traffic share on each ESXi host</td>
</tr>
</tbody>
</table>
Chapter 5: Virtual Databases Environment Setup

**Note:** The uplink port group is created by default when you create the distributed switch.

***Note:** A vMotion network is optional for this solution. It is used for an Oracle RAC solution with multiple ESXi hosts and is not required for this solution. If in the future, more ESXi hosts are added, then you can use vMotion to migrate the VMs among the different hosts.

Create distributed switches

Create a VDS on VMware vSphere 6.5 or later as follows:

1. In the vSphere Web Client navigator, right-click the datacenter name and select Distributed Switch > New Distributed Switch.
2. At Name and location, type a name for the VDS (oraPub) and click Next.
3. At Select version, select Distributed Switch 6.5.0 and click Next.
4. At Edit settings:
   a. Select 4 for Number Of Uplinks.
      Uplink ports connect VDS to the physical NICs on associated hosts.
   b. Set Network I/O Control to Enabled.
      Network I/O Control monitors the load over the network and dynamically allocates resources.
   c. Select Create a default port group and click Next.
   d. At the Ready to complete page, review the settings and click Finish.

Create port groups

After you create distributed switches, create port groups:

1. Right-click the VDS (oraPub) and select New Distributed Port Group.
   a. At Select name and location, type a name for the port group (oraPublic) and click Next.
   b. At Configure settings:
      i. For VLAN type, select VLAN.
      ii. For VLAN ID, select the ID.

   **Note:** In Ready Solutions for Oracle with Data Protection, we set VLAN ID 16 for oraPublic (Oracle public and ‘backup and recovery’ traffic) and VLAN ID 99 for vMotion distributed port groups. The two uplink ports shared by oraPublic (Oracle public and ‘backup and recovery’) and vMotion distributed port groups were also tagged with the same VLAN ID 16 and 99 on the two ToR S4048-ON switches to which they connect.
   iii. Under Advanced, select Customize default policies configuration.
   iv. Click Next.
   c. At Ready to complete, review the summary and click Finish.
2. Repeat the preceding step to create the following additional port group:
**Configuring datastores**

VMFS datastores are repositories for VMs. You can set up VMFS datastores for iSCSI-based storage, FC-based storage, and local storage.

**Note:** First install and configure any required adapters and rescan the adapters to discover newly added storage devices.

Create datastores in vSphere 6.5:

1. In the vSphere Web Client, go to **Home > Storage > Datastores.**
2. Click the **Create a new datastore** icon, as shown in the following figure, and then create datastore VM-OS.

![Create a new datastore icon](image)

**Figure 12. Create a new datastore icon**

a. At **Type**, select **VMFS**.

b. At **Name and device selection**, for **Datastore name** type **VM-OS**, scroll to select the XtremIO volume that we created for VM-OS, and then click **Next**.

c. Review the summary, and then click **Finish** to create the datastore.

3. Repeat the preceding steps to create remaining datastores. The datastores design in the virtual databases environment is shown in the following table:

**Table 27. vSphere VM datastore XtremIO X2 storage volume design for OLTP 11gR2 and 12cR2 virtualized databases**

<table>
<thead>
<tr>
<th>Datastore name</th>
<th>Datastore size (GB)</th>
<th>Purpose</th>
</tr>
</thead>
<tbody>
<tr>
<td>C3-VM-OS</td>
<td>600</td>
<td>1 x OS datastore for the 2 guest operating systems (xorb-virt-11g and xorb-virt-12c). Each guest OS Virtual Machine Disk (VMDK) is 250 GB.</td>
</tr>
<tr>
<td>C3-OCR1</td>
<td>100</td>
<td>3 x OCR datastores for normal redundancy OCR/voting disk of Virtualized database.</td>
</tr>
<tr>
<td>C3-OCR2</td>
<td>100</td>
<td></td>
</tr>
</tbody>
</table>
## Creating VMs for Oracle Databases

Create the two VMs, one for 11g R2 and one for 12c R2 database, in the virtual database environment:

1. In vSphere Web Client, create a new VM (VM1) on your ESXi host, as shown in the following figure.

<table>
<thead>
<tr>
<th>Datastore name</th>
<th>Datastore size (GB)</th>
<th>Purpose</th>
</tr>
</thead>
<tbody>
<tr>
<td>C3-OCR3</td>
<td>100</td>
<td>Each OCR VMDK is 48 GB</td>
</tr>
<tr>
<td>C3-DATA1</td>
<td>600</td>
<td>4 x DATA datastores for Oracle DATA disks in Virtualized databases. Each Data VMDK is 298 GB</td>
</tr>
<tr>
<td>C3-DATA2</td>
<td>600</td>
<td></td>
</tr>
<tr>
<td>C3-DATA3</td>
<td>600</td>
<td></td>
</tr>
<tr>
<td>C3-DATA4</td>
<td>600</td>
<td></td>
</tr>
<tr>
<td>C3-REDO1</td>
<td>100</td>
<td>2 x REDO datastores for Oracle REDO disks in Virtualized databases Each REDO VMDK is 48 GB</td>
</tr>
<tr>
<td>C3-REDO2</td>
<td>100</td>
<td></td>
</tr>
<tr>
<td>C3-FRA</td>
<td>200</td>
<td>1 x FRA datastore for Oracle FRA disks in Virtualized database Each FRA VMDK is 98 GB</td>
</tr>
<tr>
<td>C3-TEMP</td>
<td>500</td>
<td>1 x TEMP datastore for Oracle TEMP disks in Virtualized databases Each TEMP VMDK is 248 GB</td>
</tr>
<tr>
<td><strong>Total datastores:</strong></td>
<td><strong>12</strong></td>
<td><strong>4,200</strong></td>
</tr>
</tbody>
</table>
Chapter 5: Virtual Databases Environment Setup

2. Select your ISO image, and configure the VM with the appropriate settings. The following table shows the specific guest OS and VM settings for both the 11g R2 database VM and the 12c R2 database VM. We left all values set to the default except the values that are specified in the table.

Table 28. VM settings for 11g R2 and 12c R2 virtual databases

<table>
<thead>
<tr>
<th>VM setting</th>
<th>11g R2 VM</th>
<th>12c R2 VM</th>
</tr>
</thead>
<tbody>
<tr>
<td>Guest OS</td>
<td>RHEL 6.9</td>
<td>RHEL 7.4</td>
</tr>
<tr>
<td>Virtual CPU (vCPU) count</td>
<td>18</td>
<td>18</td>
</tr>
<tr>
<td>Virtual Memory (vMem) (GB)</td>
<td>140</td>
<td>140</td>
</tr>
<tr>
<td>vMem Reservation (GB)</td>
<td>120</td>
<td>120</td>
</tr>
<tr>
<td>OS Hard Disk 1 Size (GB)</td>
<td>250</td>
<td>250</td>
</tr>
</tbody>
</table>

ESXi networking provides communication between VMs on the same host and on different hosts, and between other virtual and physical hosts. It also manages ESXi hosts and communicates between VMkernel services and the physical network.

To set up networking:

1. Add the cluster hosts to VDS.
2. Add network adapters to VMs.
Adding cluster hosts to VDS


2. Right-click oraPub VDS and click Add and Manage Hosts.
   a. Select Add hosts and click Next.
   b. Click New hosts and select the hosts to add.
   c. Click OK and Next.
   d. Ensure that Manage physical adapters and Manage VMkernel adapters are selected, and then click Next.
   e. On the ESXi host, select the 10 GbE vmnic that is reserved for public and vMotion traffic and assign it to uplink 1, as shown in the following figure, and click OK.

![Select an Uplink for vmnic6](image)

**Figure 14. Assigning an uplink to an adapter**

f. Repeat the preceding step to assign the other 10 GbE vmnic that is reserved for public and vMotion traffic to uplink2.

g. Right-click a host and click New Adapter to add a VMkernel port for vMotion.
   i. Select Select an existing network and click Browse to select the vMotion port group, as shown below.
Adding network adapters to VMs

After adding cluster hosts to VDS, add network adapters to VMs:

1. In the vSphere Web Client, right-click the VM and select Edit Settings.
2. From the New device list box, select Network and click Add.
   The new network adapter appears at the bottom of the list.
3. Expand the new network, and change the following settings:
   a. For the Status setting:
      ▪ Connected—Select this option when the VM is running to connect or disconnect the VM network adapter. This option is not available when the VM is not running.
      ▪ Connect at power on—Select this option to connect the virtual network adapter to the network when the VM is on.
   b. From the Adapter Type list box, select the VMXNET 3 option.
   c. Optionally, select how to assign MAC addresses—Automatic or Manual. Automatic is preferred.
   d. From the New Network type list box, select the appropriate standard or distributed port group that is based on the usage of this adapter. In this Ready Solution, choose the oraPublic distributed port group that was created for the Oracle Public traffic.
4. Click OK to add the network adapters.

Preparing storage disks for Oracle stand-alone databases

Set up volumes and hard disks for 11g R2 VM:

1. In the vSphere Web Client, go to the host, right-click the VM, and select Edit settings.
2. Add a new SCSI controller 1 with the following settings:

![Figure 16. New SCSI controller settings](image)

3. Create two additional SCSI controllers (2 and 3) with the same controller settings that are used in step 2.

4. Add hard disks for VM1:
   a. Select **New Hard Disk**.
   b. Select **Add**.
   c. Expand **New Hard disk** and browse to the **Datastore location**.
   d. Set disk size to **Max allowed**.
   e. Set disk provisioning to **Thick Provision eager Zeroed**.
   f. Set sharing to **No Sharing**.
   g. Select the SCSI controller depending on the purpose of the hard disk, as shown in the following table.

<table>
<thead>
<tr>
<th>Controller</th>
<th>Disk purpose</th>
<th>Number of disks</th>
</tr>
</thead>
<tbody>
<tr>
<td>SCSI 0:0</td>
<td>Guest OS disk</td>
<td>1</td>
</tr>
<tr>
<td>SCSI 1:0 to SCSI 1:3</td>
<td>Standalone database DATA1-4 disks</td>
<td>4</td>
</tr>
<tr>
<td>SCSI 2:0 to SCSI 2:1</td>
<td>Standalone database REDO1-24 disks</td>
<td>2</td>
</tr>
<tr>
<td>SCSI 3:0 to SCSI 3:4</td>
<td>Standalone database OCR1-3 FRA1, and TEMP1</td>
<td>5</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td></td>
<td><strong>12</strong></td>
</tr>
</tbody>
</table>

h. Repeat steps a through g to add more hard disks with the sizes as specified in **Table 27** for this VM.

Set up volumes and hard disks for 12c R2 VM:

1. Repeat steps 1 through 3 in the previous section to create SCSI controllers for your 12c R2 VM similar to the 11g R2 VM by using the same design as provided in Table 29.

2. Add hard disks for VM2:

---

1 You share the datastore used in the previous VM1 for the VM2’s vmdks that are based on this Ready Solutions for Oracle design.
Chapter 5: Virtual Databases Environment Setup

a. Select **New Hard Disk**.
b. Select **Add**.
c. Expand **New Hard disk** and browse to the **Datastore location**. This will be the same datastore as used for VM1 11g R2
d. Set disk size to **Max allowed**.
e. Set disk provisioning to **Thick Provision eager Zeroed**.
f. Set sharing to **No Sharing**.
g. Select the SCSI controller depending on the purpose of the hard disk, as shown in Table 29.
h. Repeat steps a through g to add more hard disks with the sizes as specified in Table 27 for this VM.
Guest OS and Databases configuration

We installed and configured the following two guest operating systems and databases in the virtual environment:

- RHEL 7.4 guest OS in the Oracle 12cR2 stand-alone database VM

  The Dell EMC knowledge base Wiki article [How to deploy Oracle 12c Release 2 standalone Database on RHEL 7.x](#) provides general steps to install and configure the OS, network, storage disks, Oracle 12c R2 Grid, and Oracle 12c R2 Standalone Database. The following section describes specifics for this solution.

- RHEL 6.9 guest OS in the Oracle 11gR2 stand-alone database VM

  The Dell EMC knowledge base Wiki article [How to deploy Oracle 11g Release 2 standalone Database on RHEL 6.x](#) provides general steps to install and configure the OS, network, storage disks, Oracle 11g R2 Grid, and Oracle 11g R2 Standalone Database. The following section describes specifics for this solution.

The following provides a quick overview of the detailed steps and specific information that differs from that described in the two Wiki articles referenced previously:

1. Install RHEL 7.4 and RHEL 6.9 with base packages in the 12cR2 VM and in the 11gR2 VM, respectively.
2. In both VMs, register Red Hat Network (RHN) or set up the local yum repository by using the RHEL ISO CD.
3. To set up the Oracle Grid and Database software prerequisites (required OS RPMs, users, groups, kernel parameters, and so on), either:
   a. Download and install [Dell Oracle Deployment RPMs for Oracle 12cR2 on RHEL7.x](#) for the 12cR2 database setup
   b. Download and install [Dell Oracle Deployment Tar for Oracle 11gR2 on RHEL6.x](#) for the 11gR2 database setup.
4. Set up the Oracle public network.

  **Note:** The virtual network interface enumeration starts with ‘ens’ in the RHEL 7 guest OS and with ‘eth’ in the RHEL 6 guest OS.

5. In the two VMs, prepare and configure the XtremIO X2 virtual disks for Oracle Grid and Database software installation:
   a. Partition the disks.
   b. Set up udev rules.
The following additional best practices are recommended and implemented in the RHEL-based guest operating systems running inside the two database VMs.

**Note:** We applied best practices in our test environment by using the [Dell EMC XtremIO Storage Array Host Configuration Guide](#). Refer to this guide for the complete list of best practices and detailed steps to apply these best practices when using XtremIO in a Linux environment.

### PVSCSI driver

For optimal XtremIO X2 storage performance in a VMware environment, we recommend PVSCSI controllers and driver in the guest VMs. In this Ready Solutions for Oracle, we ensured that the inbox RHEL `vmw_pvscsi` driver module was loaded and used in the guest operating systems.

**Note:** The PVSCSI driver is used only when the SCSI controller type is set to VMware *Paravirtual* in the VM settings.

### PVSCSI LUN Queue Depth and ring-pages settings

The following table shows the default and the recommended `vmw_pvscsi` parameter settings.

**Table 30. PVSCSI parameter settings in guest operating systems**

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Default value</th>
<th>Recommended value</th>
</tr>
</thead>
<tbody>
<tr>
<td><code>vmw_pvscsi.cmd_per_lun</code></td>
<td>RHEL 6: 64</td>
<td>RHEL 6: 254</td>
</tr>
<tr>
<td></td>
<td>RHEL 7: 254</td>
<td>RHEL 7: 254</td>
</tr>
<tr>
<td><code>vmw_pvscsi.ring_pages</code></td>
<td>RHEL 6: 8</td>
<td>RHEL 6: 32</td>
</tr>
<tr>
<td></td>
<td>RHEL 7: 8</td>
<td>RHEL 7: 32</td>
</tr>
</tbody>
</table>

The parameters and their respective recommended values in this table were appended to the kernel boot arguments:

- In the `/boot/grub.conf` file for the RHEL 6-based guest operating system
- In the `/etc/default/grub` file for the RHEL 7-based guest operating system

### Oracle Grid and Database setup

Follow these steps inside the VM to set up two virtual databases:

1. Before installing the Oracle 12cR2 or 11gR2 database, ensure that you have configured the OS, network, and storage prerequisites as described in Guest OS configuration.

2. Configure and synchronize the system clock settings.

3. Locate the Oracle 12c or the Oracle 11g media kit and run the Oracle Grid Universal Installer inside the respective virtual database VM.
   a. Create and configure the ASM disk group for OCR and Voting disks by using the Normal redundancy option.
b. Run the root.sh script to complete the Grid installation.

4. Locate the Oracle 12c or the Oracle 11g media kit and run the Oracle Database Universal Installer inside the respective virtual database VM.
   a. As installation begins, select the **Install database software only** and **single instance database installation** options.
   b. Select the appropriate privileged OS groups that the Dell EMC pre-installation deployment RPMs mentioned in the previous section created automatically.
   c. When prompted, run the root.sh script and complete the Oracle Database software installation.

5. Create ASM disk groups for DATA, Fast Recovery Area (FRA), REDO, and TEMP by using ASM Configuration Assistant (ASMCA) utility.
   a. For each of the disk groups, choose the appropriate XtremIO ASM virtual disks that were configured in the previous section.
   b. Select the disk group redundancy as **External (None)**.
   c. In Ready Solutions for Oracle with XtremIO, we recommend that you create two REDO disk groups, REDO1 and REDO2, each with at least one 50 GB ASM disk.

6. As Grid administrator user, change the ASM striping type for FRA, REDO, and TEMP disk groups from **coarse to fine-grained**.

7. Create the seed database by using Database Configuration Assistant (DBCA) utility.
   a. Select the **Advanced configuration** option.
   b. Select the database type as **Oracle single instance database** and template as **General Purpose or Transaction Processing**.
   c. Optionally, for a 12cR2 database installation, create a container database. The 12cR2 virtual database in this Ready Solutions for Oracle was tested as a noncontainer database.
   d. For the seed database and FRA storage options, select the file storage type as **ASM** and the file location as the corresponding DATA and FRA disk groups, respectively, that were created in step 5.
   e. Select **Automatic Shared Memory Management (ASMM)** and configure the SGA and PGA memory sizes, as needed.

8. Set up the Redo Log Groups based on the following design recommendation for Ready Solutions for Oracle with XtremIO:

   **Table 31. Recommended Redo Log Groups (RLGs) design**

<table>
<thead>
<tr>
<th>Redo log group number</th>
<th>Thread number</th>
<th>Diskgroup location</th>
<th>Redo log file size</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1</td>
<td>+REDO1</td>
<td>5 GB</td>
</tr>
<tr>
<td>2</td>
<td>1</td>
<td>+REDO2</td>
<td>5 GB</td>
</tr>
<tr>
<td>Redo log group number</td>
<td>Thread number</td>
<td>Diskgroup location</td>
<td>Redo log file size</td>
</tr>
<tr>
<td>-----------------------</td>
<td>---------------</td>
<td>--------------------</td>
<td>-------------------</td>
</tr>
<tr>
<td>3</td>
<td>1</td>
<td>+REDO1</td>
<td>5 GB</td>
</tr>
<tr>
<td>4</td>
<td>1</td>
<td>+REDO2</td>
<td>5 GB</td>
</tr>
<tr>
<td>5</td>
<td>2</td>
<td>+REDO1</td>
<td>5 GB</td>
</tr>
<tr>
<td>6</td>
<td>2</td>
<td>+REDO2</td>
<td>5 GB</td>
</tr>
<tr>
<td>7</td>
<td>2</td>
<td>+REDO1</td>
<td>5 GB</td>
</tr>
<tr>
<td>8</td>
<td>2</td>
<td>+REDO2</td>
<td>5 GB</td>
</tr>
</tbody>
</table>

**Note:** For a 12cR2 database, configure the Redo Log Groups from within the DBCA utility itself by clearing the **Use Oracle-Managed Files (OMF)** option in the **Database Storage Option** screen and clicking **Customize Storage Locations** on the **Database Creation Option** screen.

**Note:** For an 11gR2 database, after the DBCA configuration, configure the Redo Logs Groups manually based on the preceding design.
This chapter presents the following topics:

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- **XtremIO storage configuration** ..................................... 75
- **LAN and SAN switches setup** ...................................... 77
- **Configuring the XVC Database server** .......................... 77
- **Take XVC snapshot of PROD database** ......................... 78
- **Create a snapshot database on the XVC server** ................ 83
Chapter 6: XtremIO Virtual Copy (XVC) Database Environment Setup

Overview

The XVC snapshot database deployment process consists of the following tasks, which the following sections describe in detail:

1. Configure XtremIO storage
   a. Create Initiator Group
   b. Create nonsnapshot volumes
   c. Map nonsnapshot volumes to the XVC database server
2. Configure LAN and SAN switches
   a. Configure redundant ToR 10 GbE Ethernet switches
   b. Configure redundant 16 Gbps SAN FC switches, including zoning
3. Configure the XVC Database server
   a. Prepare the PowerEdge server
   b. Configure OS, network, and storage
   c. Install Oracle 12c Grid and Database
4. Take a XVC snapshot on the PROD database
   a. Configure snapshot devices on the XVC server
   b. Take a snapshot of the consistency group
   c. Map the consistency group to the XVC server
5. Create a snapshot database on the XVC server
   a. Prepare the multipath and udev rules for the XVC snapshot volumes
   b. Rename the disk groups of the XVC snapshot volumes
   c. Mount the snapshot database
   d. Change the database files names
   e. Open the snapshot database and change the database name and DBID
   f. Recreate spfile, redo logs and temp files

XtremIO storage configuration

In this environment setup, the two XVC databases run on a single R740-based database server. The XVC database server has four physical HBA ports or initiators that are connected to the XtremIO storage array by redundant FC switches.

On the XtremIO storage array, configure the storage that is based on the design for the XVC databases environment:

1. Create one Initiator Group that contains the four initiators in the R740 XVC database server.
Chapter 6: XtremIO Virtual Copy (XVC) Database Environment Setup

**Note:** Record the four unique World Wide Names (WWN) of the four HBA initiators in the R740 database server. You need these initiator WWNs when you create the Initiator Group on the XtremIO storage array.

2. Install the Oracle 12c R2 grid and database.
3. Mount the snapshot database volumes.
4. Create a few nonsnapshot volumes on XtremIO to set up the prerequisite environment for the two databases. The following table shows both snapshot and nonsnapshot XtremIO volumes that are part of the two XVC databases - DEV XVC and OLAP XVC.

<table>
<thead>
<tr>
<th>Source (PROD) Volume Name</th>
<th>Target XVC databases volume</th>
<th>Quantity</th>
<th>Size per volume (GB)</th>
<th>Total size (GB)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td><strong>Snapshot volumes of PROD for the DEV XVC database</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>DATA</td>
<td>DATA_DEV</td>
<td>4</td>
<td>300</td>
<td>1,200</td>
</tr>
<tr>
<td>REDO</td>
<td>REDO_DEV</td>
<td>2</td>
<td>100</td>
<td>200</td>
</tr>
<tr>
<td>FRA</td>
<td>FRA_DEV</td>
<td>1</td>
<td>200</td>
<td>200</td>
</tr>
<tr>
<td></td>
<td><strong>Snapshot volumes of PROD for the OLAP XVC database</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>DATA</td>
<td>DATA_OLAP</td>
<td>4</td>
<td>300</td>
<td>1,200</td>
</tr>
<tr>
<td>REDO</td>
<td>REDO_OLAP</td>
<td>2</td>
<td>100</td>
<td>200</td>
</tr>
<tr>
<td>FRA</td>
<td>FRA_OLAP</td>
<td>1</td>
<td>200</td>
<td>200</td>
</tr>
<tr>
<td></td>
<td><strong>Nonsnapshot volumes shared by both XVC databases</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>N/A</td>
<td>OCR</td>
<td>3</td>
<td>50</td>
<td>150</td>
</tr>
<tr>
<td>N/A</td>
<td>TEMP</td>
<td>1</td>
<td>100</td>
<td>100</td>
</tr>
</tbody>
</table>

* - If multiple volumes are created with one name, the storage system automatically appends a number to the volume name. For example, DATA_DEV-00, DATA_DEV-01, and so on.

**Note:** Create only the nonsnapshot volumes. The remaining necessary database volumes—DATA, REDO, and FRA—for each of the two XVC databases will be created as snapshot volumes of the production database, as described later in this chapter.

5. Map the nonsnapshot volumes to the XVC database server by mapping the volumes created in step 2 to the single Initiator Group created in step 1.

Refer to Appendix A for detailed steps to create the initiator group, volumes, and mappings based on the preceding design for the XVC database environment.
LAN and SAN switches setup

In the XVC database environment, the redundant Dell EMC Networking S4048-ON ToR 10 GbE Ethernet switches provide Oracle public network connectivity to and from the two XVC databases. For details about configuring these redundant LAN switches, refer to
Configuring Dell EMC Networking S4048-ON ToR switches.

Dell EMC Connectrix DS6510-B switches provide the SAN connectivity between the single-node Oracle XVC database server and the XtremIO X2 storage array. For details about the recommended zoning configuration, refer to Configuring zoning on FC switches.

### Configuring the XVC Database server

**Preparing the PowerEdge server**

To set up the PowerEdge database server, refer to Preparing PowerEdge servers.

**Configuring OS, network, and storage**

For this solution, we deployed RHEL 7.4 as the bare-metal OS to test the single node XVC database in a physical environment.

The generic Dell EMC knowledge base Wiki article How to deploy Oracle 12c Release 2 standalone Database on RHEL 7.x provides detailed steps to install and configure the OS, network, and storage disks.

**Additional best practices in XtremIO environment**

Additional host OS configuration best practices that are implemented in the XVC database server are the same as those implemented in the production database servers, as described in Configuring OS, network, and storage.

**Installing Oracle 12c Grid and Database**

For this solution, we deploy Oracle 12c R2 Grid and Oracle 12cR2 single-node stand-alone database software to test the XVC snapshot copy of the production database.

For detailed steps about how to set up the prerequisites, 12c R2 Grid, 12c R2 Oracle software, and 12c R2 stand-alone database, see How to deploy Oracle 12c Release 2 standalone Database on RHEL 7.x. In this configuration, we create only OCR and TEMP ASM disk groups. The remaining database volumes are based on the XVC snapshots of the PROD database volumes.
Chapter 6: XtremIO Virtual Copy (XVC) Database Environment Setup

Taking XVC snapshots of the PROD database

The following steps describe how to take XVC snapshots of the PROD database:

1. Create a consistency group of PROD database volumes
2. Take a snapshot of the consistency group
3. Map the consistency group to the XVC server

Creating a consistency group

To maintain consistency among the database files when we take the XVC snapshot of the production database, for example, we put all DATA volumes, all REDO volumes, and the FRA volume into one consistency group.

1. Log in to the XtremIO Management Console.
2. From the XtremIO X2 management console, select the Configuration tab, click Consistency Groups, and click New(+) on the menu bar.
3. In the New Consistency Group window, enter a consistency group name and select all the source (PROD) database volumes where the database files are stored, as shown in the following figure. Click **Apply**.

![New Consistency Group](image1)

In a few seconds, the consistency group (CG_PROD in this instance) is created:

![Consistency Group](image2)

Follow these steps to create a snapshot of the consistency group that you created in the previous section.

1. To create an XVC snapshot of the PROD database volumes, create a repurpose copy of the consistency group that contains the PROD database volumes:
Chapter 6: XtremIO Virtual Copy (XVC) Database Environment Setup

a. Select the PROD database's consistency group (CG_PROD in this instance) and click **Create Repurpose Copy**.

b. On the Create Repurpose Copy Window, specify the new Consistency Group Name (example, CG_DEV for the DEV_XVC database) and click **Apply**.
The repurpose copy (CG_DEV) of CG_PROD is created instantly. This CG_DEV itself is a consistency group consisting of seven snapshot volumes of the corresponding seven PROD database volumes.

To map the snapshots to the XVC server:

1. Select the snapshot consistency group CG_DEV and click Mapping on the menu bar.

2. Check and select the initiator group or groups (R740-HBAs in this instance) that contain the XVC database server initiators and click Next.
The Mapping Confirmation window is displayed.

3. Click Apply to create the mapping and verify that the following mapping is established.

Repeat the steps Taking a snapshot of the consistency group and Mapping the snapshots to XVC server for the second snapshot database OLAP XVC.
Creating a snapshot database on the XVC server

This section describes the steps to mount the XVC snapshots of the PROD database volumes that were created in the previous section and re-create the snapshot copy of the PROD database that is based on these XVC snapshots of volumes. The steps that are provided in this section apply to both XVC databases, although we use XVC DEV as the example database.

Perform all the steps below as the root user to detect the snapshot volumes, configure the multipath, and create the new udev rules:

1. To detect the snapshot volumes, rescan the SCSI bus on the XVC database server by running the following command:

   [root#] rescan-scsi-bus.sh

2. Configure the multipath for the XVC snapshot devices by adding the following entries in the /etc/multipath.conf file:

   ```
   multipath {
     wwid 3514f0c5a4c200090
     alias C2_DATA11_DEV
   }
   multipath {
     wwid 3514f0c5a4c200091
     alias C2_DATA12_DEV
   }
   multipath {
     wwid 3514f0c5a4c200092
     alias C2_DATA13_DEV
   }
   multipath {
     wwid 3514f0c5a4c200093
     alias C2_DATA14_DEV
   }
   multipath {
     wwid 3514f0c5a4c200094
     alias C2_FRA_DEV
   }
   multipath {
     wwid 3514f0c5a4c200095
     alias C2_REDO1_DEV
   }
   multipath {
     wwid 3514f0c5a4c200096
     alias C2_REDO2_DEV
   }
   ```

   **Note:** For each device, the WWID is ‘3<NAA Identifier>’.

   In this example, the WWID of C2_DATA11_DEV is ‘3514f0c5a4c200090’ and the NAA Identifier is ‘514f0c5a4c200090’.

3. Reload the multipath configuration file:

   [root#] service multipathd reload
4. To set the proper Oracle permissions to the snapshot devices, create a new udev rules file `/etc/udev/rules.d/60-oracle-asmdevices.rules` and add an entry in it for each snapshot device as follows:

```bash
KERNEL="dm-*", ENV{DM_NAME}="C2_DATA11_DEV?", OWNER="grid", GROUP="asmadmin", MODE="0660"
KERNEL="dm-*", ENV{DM_NAME}="C2_DATA12_DEV?", OWNER="grid", GROUP="asmadmin", MODE="0660"
KERNEL="dm-*", ENV{DM_NAME}="C2_DATA13_DEV?", OWNER="grid", GROUP="asmadmin", MODE="0660"
KERNEL="dm-*", ENV{DM_NAME}="C2_DATA14_DEV?", OWNER="grid", GROUP="asmadmin", MODE="0660"
KERNEL="dm-*", ENV{DM_NAME}="C2_FRA_DEV?", OWNER="grid", GROUP="asmadmin", MODE="0660"
KERNEL="dm-*", ENV{DM_NAME}="C2_REDO1_DEV?", OWNER="grid", GROUP="asmadmin", MODE="0660"
KERNEL="dm-*", ENV{DM_NAME}="C2_REDO2_DEV?", OWNER="grid", GROUP="asmadmin", MODE="0660"
```

5. Reload the udev rules:

```bash
[root#] udevadm trigger
```

---

Renaming and mounting ASM disk groups and ASM disks

1. Log in to the XVC server as the `grid` user (the owner of the Oracle ASM instance).

2. Rename the original PROD ASM disk group name for the DEV XVC database:

```bash
grid$ renamedg dgname=REDO2 newdgname=REDO2_DEV
asm_diskstring=/dev/mapper/* verbose=TRUE

grid$ renamedg dgname=REDO1 newdgname=REDO1_DEV
asm_diskstring=/dev/mapper/* verbose=TRUE

grid$ renamedg dgname=DATA newdgname=DATA_DEV
asm_diskstring=/dev/mapper/* verbose=TRUE

grid$ renamedg dgname=FRA newdgname=FRA_DEV
asm_diskstring=/dev/mapper/* verbose=TRUE
```

3. Mount the renamed ASM disk groups to the ASM instance in restricted mode.

```bash
grid$ asmcmd mount --restrict FRA_DEV
grid$ asmcmd mount --restrict REDO1_DEV
grid$ asmcmd mount --restrict REDO2_DEV
grid$ asmcmd mount --restrict DATA_DEV
```

4. Rename ASM disks for the snapshot volumes. As `grid` user, log in to the ASM instance as `sysasm` and execute the following `alter diskgroup` SQL commands:

```sql
grid$ sqlplus / as sysasm
```
Chapter 6: XtremIO Virtual Copy (XVC) Database Environment Setup

SQL> alter diskgroup REDO2_DEV rename disks all;
SQL> alter diskgroup REDO1_DEV rename disks all;
SQL> alter diskgroup DATA_DEV rename disks all;
SQL> alter diskgroup FRA_DEV rename disks all;

5. Dismount and remount the ASM disk groups by running the following SQL commands:

grid$ sqlplus / as sysasm
SQL> alter diskgroup REDO2_DEV dismount;
SQL> alter diskgroup REDO1_DEV dismount;
SQL> alter diskgroup DATA_DEV dismount;
SQL> alter diskgroup FRA_DEV dismount;

SQL> alter diskgroup REDO2_DEV mount;
SQL> alter diskgroup REDO1_DEV mount;
SQL> alter diskgroup DATA_DEV mount;
SQL> alter diskgroup FRA_DEV mount;

6. Check the status of ASM diskgroups and ASM disks of the snapshot volumes:

grid$ sqlplus / as sysasm

SQL> SELECT d.path, d.name disk_name, g.name group_name, g.state mount_state
FROM v$asm_disk d, v$asm_diskgroup g
WHERE d.group_number = g.group_number and d.path like '%_%DEV%';

<table>
<thead>
<tr>
<th>PATH</th>
<th>DISK_NAME</th>
<th>GROUP_NAME</th>
</tr>
</thead>
<tbody>
<tr>
<td>/dev/mapper/C2_REDO2_DEV1</td>
<td>REDO2_DEV_0000</td>
<td>REDO2_DEV</td>
</tr>
<tr>
<td>MOUNTED</td>
<td></td>
<td></td>
</tr>
<tr>
<td>/dev/mapper/C2_REDO1_DEV1</td>
<td>REDO1_DEV_0000</td>
<td>REDO1_DEV</td>
</tr>
<tr>
<td>MOUNTED</td>
<td></td>
<td></td>
</tr>
<tr>
<td>/dev/mapper/C2_FRA_DEV1</td>
<td>FRA_DEV_0000</td>
<td>FRA_DEV</td>
</tr>
<tr>
<td>MOUNTED</td>
<td></td>
<td></td>
</tr>
<tr>
<td>/dev/mapper/C2_DATA14_DEV1</td>
<td>DATA_DEV_0003</td>
<td>DATA_DEV</td>
</tr>
<tr>
<td>MOUNTED</td>
<td></td>
<td></td>
</tr>
<tr>
<td>/dev/mapper/C2_DATA13_DEV1</td>
<td>DATA_DEV_0002</td>
<td>DATA_DEV</td>
</tr>
<tr>
<td>MOUNTED</td>
<td></td>
<td></td>
</tr>
<tr>
<td>/dev/mapper/C2_DATA12_DEV1</td>
<td>DATA_DEV_0001</td>
<td>DATA_DEV</td>
</tr>
<tr>
<td>MOUNTED</td>
<td></td>
<td></td>
</tr>
<tr>
<td>/dev/mapper/C2_DATA11_DEV1</td>
<td>DATA_DEV_0000</td>
<td>DATA_DEV</td>
</tr>
<tr>
<td>MOUNTED</td>
<td></td>
<td></td>
</tr>
<tr>
<td>/dev/mapper/C2_FRA_DEV1</td>
<td>FRA_DEV_0000</td>
<td>FRA_DEV</td>
</tr>
<tr>
<td>MOUNTED</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

The four new diskgroups are: DATA_DEV, REDO1_DEV, REDO2_DEV and FRA_DEV.
Chapter 6: XtremIO Virtual Copy (XVC) Database Environment Setup

Mounting the snapshot database

1. Prepare the new snapshot database environments as follows:
   a. Create the directory for the database audit file, which is specified by audit_file_dest='/u01/app/oracle/admin/dbdev/adump'
   b. Log in to the PROD database as sysdba and create a pfile from the PROD database:
      SQL> create pfile='/home/oracle/pfile_dbprod.ora' from spfile;
   c. Use the secure copy command scp to copy /home/oracle/pfile_dbprod.ora to the XVC server.
   d. On the XVC database server, edit the pfile_dbprod.ora file by modifying the following database initialization parameters with the new values:
      * .cluster_database=false
      *db_create_file_dest='DATA_DEV'
      *.thread=1
      *.control_files='+DATA_DEV/DBCAP/CONTROLFILE/current.262.986035347', '+FRA_DEV/DBCAP/CONTROLFILE/current.296.986035347'
      *.db_recovery_file_dest='+FRA_DEV

2. Mount the snapshot database as oracle user:
   oracle$ sqlplus / as sysdba
   SQL> startup nomount pfile=pfile_dbcap_new.ora
   ORACLE instance started.
   Total System Global Area 2.1475E+10 bytes
   Fixed Size 22787792 bytes
   Variable Size 7314868528 bytes
   Database Buffers 1.4093E+10 bytes
   Redo Buffers 44318720 bytes
   SQL> alter database mount;
   Database altered.

Changing the database file names

1. Log in to the newly mounted snapshot database and run the following queries to find the current data files and redo log file names:
   SQL> select name from v$datafile;
   SQL> select member from v$logfile;

2. Based on the results of the queries shown in step 1, we can generate the alter database rename database files commands to change the location of the database and redo log files to adapt to the new ASM diskgroup name and location changes. Run these commands in sqlplus. For example:
   SQL> alter database rename file '+DATA/DBCAP/DATAFILE/system.258.986035241' to '+DATA_DEV/DBCAP/DATAFILE/system.258.986035241';
SQL> alter database rename file
+'DATA/DBCAP/DATAFILE/tpcctab.268.986040989' to
+'DATA_DEV/DBCAP/DATAFILE/tpcctab.268.986040989';

SQL> alter database rename file
+'DATA/DBCAP/DATAFILE/sysaux.259.986035277' to
+'DATA_DEV/DBCAP/DATAFILE/sysaux.259.986035277';

SQL> alter database rename file
+'DATA/DBCAP/DATAFILE/undotbs1.260.986035293' to
+'DATA_DEV/DBCAP/DATAFILE/undotbs1.260.986035293';

SQL> alter database rename file
+'DATA/DBCAP/DATAFILE/undotbs2.266.986035373' to
+'DATA_DEV/DBCAP/DATAFILE/undotbs2.266.986035373';

Database altered.

SQL> alter database rename file
+'DATA/DBCAP/DATAFILE/users.261.986035293' to
+'DATA_DEV/DBCAP/DATAFILE/users.261.986035293';

Rename REDO logs files:

SQL> alter database rename file
+'REDO1/DBCAP/ONLINELOG/group_5.262.986037407' to
+'REDO1_DEV/DBCAP/ONLINELOG/group_5.262.986037407';

SQL> alter database rename file
+'REDO2/DBCAP/ONLINELOG/group_6.263.986037413' to
+'REDO2_DEV/DBCAP/ONLINELOG/group_6.263.986037413';

SQL> alter database rename file
+'REDO1/DBCAP/ONLINELOG/group_7.263.986037417' to
+'REDO1_DEV/DBCAP/ONLINELOG/group_7.263.986037417';

SQL> alter database rename file
+'REDO2/DBCAP/ONLINELOG/group_8.261.986037421' to
+'REDO2_DEV/DBCAP/ONLINELOG/group_8.261.986037421';

SQL> alter database rename file
+'REDO1/DBCAP/ONLINELOG/group_9.258.986037557' to
+'REDO1_DEV/DBCAP/ONLINELOG/group_9.258.986037557';

SQL> alter database rename file
+'REDO2/DBCAP/ONLINELOG/group_10.262.986037565' to
+'REDO2_DEV/DBCAP/ONLINELOG/group_10.262.986037565';

SQL> alter database rename file
+'REDO1/DBCAP/ONLINELOG/group_11.259.986037571' to
+'REDO1_DEV/DBCAP/ONLINELOG/group_11.259.986037571';

SQL> alter database rename file
+'REDO2/DBCAP/ONLINELOG/group_12.258.986037575' to
+'REDO2_DEV/DBCAP/ONLINELOG/group_12.258.986037575';
3. As oracle user, log in to the database as sysdba to open the database:
   sqlplus / as sysdba
   SQL> alter database open;

4. Change the database name and DBID:
   a. Shutdown the database:
      SQL> shutdown immediate;
   b. Reset the ORACLE_SID to a new database instance name (dbcdev in this example)
      oracle$ export ORACLE_SID=dbcdev
   c. Run the Oracle DBID utility 'nid' command to change the existing database name (dbcap in this instance) to a new database name (dbcdev in this instance)

      oracle$ which nid
      /u01/app/oracle/product/12.2.0/dbhome_2/bin/nid
      oracle $ export ORACLE_SID=dbcdev
      oracle $ /u01/app/oracle/product/12.2.0/dbhome_2/bin/nid
      TARGET=/ DBNAME=dbcdev

      DBNEWID: Release 12.2.0.1.0 - Production on Tue Sep 25 16:02:41 2018
      Copyright (c) 1982, 2017, Oracle and/or its affiliates. All rights reserved.
      Connected to database DBCAP (DBID=4233973522)
      Connected to server version 12.2.0
      Control Files in database:
          +DATA_DEV/DBCAP/CONTROLFILE/current.262.986035347
          +FRA_DEV/DBCAP/CONTROLFILE/current.296.986035347

      Change database ID and database name DBCAP to DBCDEV? (Y/[N]) => Y

      Proceeding with operation
      Changing database ID from 4233973522 to 3638836129
      Changing database name from DBCAP to DBCDEV
      Control File
          +DATA_DEV/DBCAP/CONTROLFILE/current.262.986035347 - modified
      Control File
          +FRA_DEV/DBCAP/CONTROLFILE/current.296.986035347 - modified
      Datafile
          +DATA_DEV/DBCAP/DATAFILE/system.258.98603524 - dbid changed, wrote new name
Chapter 6: XtremIO Virtual Copy (XVC) Database Environment Setup

Datafile
+DATA_DEV/DBCAP/DATAFILE/tpcctab.268.98604098 - dbid changed, wrote new name
  Datafile
+DATA_DEV/DBCAP/DATAFILE/sysaux.259.98603527 - dbid changed, wrote new name
  Datafile
+DATA_DEV/DBCAP/DATAFILE/undotbs1.260.98603529 - dbid changed, wrote new name
  Datafile
+DATA_DEV/DBCAP/DATAFILE/undotbs2.266.98603537 - dbid changed, wrote new name
  Datafile +DATA_DEV/DBCAP/DATAFILE/users.261.98603529 - dbid changed, wrote new name
  Datafile +DATA_DEV/DBCAP/TEMPFILE/temp.267.98772752 - dbid changed, wrote new name
Control File
+DATA_DEV/DBCAP/CONTROLFILE/current.262.986035347 - dbid changed, wrote new name
  Control File
+FRA_DEV/DBCAP/CONTROLFILE/current.296.986035347 - dbid changed, wrote new name
  Instance shut down

Database name changed to DBCDEV.
Modify parameter file and generate a new password file before restarting.
Database ID for database DBCDEV changed to 3638836129.
All previous backups and archived redo logs for this database are unusable.
Database is not aware of previous backups and archived logs in Recovery Area.
Database has been shutdown, open database with RESETLOGS option.
Successfully changed database name and ID.
DBNEWID - Completed successfully.

5. Update the following parameter in the pfile pfile_dbcap_new.ora to reflect the new database name:
   *
   .db_name='dbcdev'

6. Open the database with resetlogs as shown in the following figure:
7. Drop the old redo logs. Recreate the new redo logs by running these commands as sysdba:

```sql
SQL> ALTER DATABASE ADD LOGFILE GROUP 13 ('+REDO1_DEV') size 1G;
SQL> ALTER DATABASE ADD LOGFILE GROUP 14 ('+REDO2_DEV') size 1G;
SQL> ALTER DATABASE ADD LOGFILE GROUP 15 ('+REDO1_DEV') size 1G;
SQL> ALTER DATABASE ADD LOGFILE GROUP 16 ('+REDO2_DEV') size 1G;
```

**Recreate spfile, redos, and temp file**

1. To create an spfile from a pfile, run this command as sysdba:

   ```sql
   SQL> create spfile='+DATA_DEV/dbcdev/dbcdevspfile.ora' from pfile='/home/oracle/pfile_dbcap_new.ora'
   ```

2. Edit the `$ORACLE_HOME/dbs/initdbcdev.ora` file and update the spfile location in it:

   ```ora
   spfile='+DATA_DEV/dbcdev/dbcdevspfile.ora'
   ```

3. Recreate the TEMP tablespace:

   ```sql
   SQL> CREATE TEMPORARY TABLESPACE TEMP TEMPFILE '+TEMP' size 50G;
   ```

4. Restart the snapshot database:

   ```bash
   oracle$ export ORACLE_SID=dbcdev
   oracle$ sqlplus / as sysdba
   SQL> shutdown immediate;
   SQL> startup;
   ```

   The XVC snapshot database is created and running. Change other database initialization parameters, such as `SGA_TARGET`, as needed.
This chapter presents the following topics:

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Data Domain client and database setup

Setting up the Data Domain client and database for (what) involves three major steps, which are explained in detail in the following sections:

1. Create Data Domain agent
2. Configure Data Domain agent
3. Create RMAN scripts for DD Boost Oracle operations

Installing the Data Domain agent involves two steps:

1. Installing the database application agent software on Linux host
2. Creating a storage unit by using the ddboost storage-unit command

Installing the database application agent software on Linux host

To install the database application agent software on Linux VM, follow these steps:

1. Download the database application agent software for Linux from Dell EMC Online Support, and install the package.
2. Download the database application agent 4.5.x software package from Dell EMC Online Support. Copy or move the agent software to the required database host.
3. On a Linux platform, uncompress and extract the downloaded file by using the gunzip and tar utilities.
4. Use the gunzip and tar commands to uncompress the downloaded file:
   
   # gunzip dbappagent451_linux_x86_64.tar.gz
   # tar -vxuf dbappagent451_linux_x86_64.tar

5. On a RHEL Linux platform, ensure that you have downloaded and installed the compat-libstdc++-33 package.
6. To install the software, type:
   
   rpm -ivh emcdbappagent-4.5.1.0-1.x86_64.rpm

7. To verify that the installation is successful, type:
   
   # rpm -aq | grep -i emc

   [root@c7-tp-vml ~]#
   [root@c7-tp-vml ~]# rpm -aq | grep -i emc
   emcdbappagent-4.5.1.0-1.x86_64
   [root@c7-tp-vml ~]#
8. Log into Data Domain system as the sysadmin user. Verify that the Data Domain file system is enabled and running:

```
Ssh sysadmin@172.16.191.250
# filesys status
```

9. Create the users that are required to enable Data Domain access for the database servers:

```
# user add <username> password <password>
```

For example, for username `rman_backup` and password `oracle`:

```
sysadmin@DD6300# user add rman_backup password oracle
```

**Creating a storage unit**

Create one or more storage units on each Data Domain system to use with the database application agent. Each storage unit name on a single Data Domain system must be unique.

**Note:** Storage unit names are case-sensitive.

Provide the storage unit name when you configure the operations with the database application agent.

1. To create a storage unit, use the `ddboost storage-unit` command:

```
sysadmin@DD6300# ddboost storage-unit create slob_unit_7
ter rman_backup
```

2. Enable app optimized compression:

```
sysadmin@DD6300# mtree option set app-optimized-compression
oracle1 mtree /data/col1/slob_unit_7
```

**Note:** Enable app optimized compression each time you create a new storage unit.

**Setting up the configuration file**

Follow the steps to configure the DD agent.

1. Type these commands on Node1:

```
[root@c7-tp-vm1 ~]# cd /opt/dpsapps/dbappagent/bin/
```
Chapter 7: Data Domain backup solution database or client setup

```
[root@c7-tp-vml bin]# ./ddbmadmin -L -a
LOCKBOX_PATH=/opt/dpsapps/common/lockbox -a
LOCKBOX_OWNER_GID=54321
```

```
[root@c7-tp-vml bin]# ./ddbmadmin -G -a
LOCKBOX_PATH=/opt/dpsapps/common/lockbox -a
LOCKBOX_REMOTE_HOST=c7-tp-vml -a VIRTUAL_HOST=yes
```

2. **Enter this command:**

```
[root@c7-tp-vml bin]# ./ddbmadmin -L
```

```
Provide full pathname for the lockbox, or press Enter to accept the default directory (/opt/dpsapps/common/lockbox): Using the default pathname '/opt/dpsapps/common/lockbox' for lockbox.
Provide a group ID for lockbox ownership, or type 0 to accept the 'root user' group as the lockbox owner: 54321
Deleting lockbox has been found in the directory '/opt/dpsapps/common/lockbox'. Permissions of the lockbox in the directory '/opt/dpsapps/common/lockbox' have been successfully updated with group ownership 54321.
```

3. **Edit the configuration file** oracle_asm_ddbda.cfg **under directory** /opt/dbsapps/dbappagent/config **on c7-tp-vml** as shown in the following figure:
[root@7-cp-vml bin]$ cd /opt/dpsapps/dbappagent/config/
[root@7-cp-vml config]$ vi oracle_asm_dsbda.cfg

******************************************************************************

oracle_asm_dsbda.cfg

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database app agent 4.5

This template is designed to help users to configure the Oracle ASM backup
and restore operations with database application agent. Additional parameters
may be added to the file when required.

Check the product administration guide for a complete list of all the
supported parameters and rules for editing the configuration file.

Make a copy of this file before making any modifications.
To enable a parameter, uncomment or add the parameter in the file and
specify its value.

******************************************************************************

[GENERAL]

ORACLE_GRID_HOME=/u01/app/12.2.0/grid
ORACLE_GRID_SID=asm1
ORACLE_GRID_USER=grid
ORACLE_HOME=/u01/app/oracle/product/12.2.0/dbhome_1
ORACLE_SERVICE=dbs1tp.dbase.lab
ORACLE_USER=sys

ORACLE_OSDBA_USER=oracle
ORACLE_OSD =dbs1tp1
# RMAN_CATALOG_SERVICE =
# RMAN_CATALOG_USER =
# CLIENT =-s7-tcp-scan
# LOCKBOX_PATH =
# PS_PROTECTION_TIMEOUT =

******************************************************************************

[Primary Data Domain]

******************************************************************************

[PRIMARY_SYSTEM]

DDBoost USER =rman backup
DEVICE_HOST =172.16.191.250
#DEVICE_HOST =172.16.20.1
DEVICE_PATH =/slob_unit_7
# DDVDSK_USER =
# VMAX_FASTX_RESTORE_SG =
# RESTOREDEVICE_POST =
# RESTORE_DEVICE_GROUP =
4. Enter this command:

```
[root@c7-tp-vml bin]# ./ddbmadmin -P -z
/opt/dpsapps/dbappagent/config/oracle_asm_ddbda.cfg
```

5. Repeat these steps for other nodes in an RAC environment.
Create the required RMAN script for Oracle Backup Operation using this script.

Run {

    CONFIGURE CHANNEL 1 DEVICE TYPE 'SBT_TAPE' PARMS
    'BLKSIZE=1048576,
    SBT_LIBRARY=/opt/dpsapps/dbappagent/lib/lib64/libddboostora.so,
    SBT_PARMS=(CONFIG_FILE=/opt/dpsapps/dbappagent/config/oracle_asm_ddbda.cfg)' connect sys/oracle@db11tp1;

    CONFIGURE CHANNEL 2 DEVICE TYPE 'SBT_TAPE' PARMS
    'BLKSIZE=1048576,
    SBT_LIBRARY=/opt/dpsapps/dbappagent/lib/lib64/libddboostora.so,
    SBT_PARMS=(CONFIG_FILE=/opt/dpsapps/dbappagent/config/oracle_asm_ddbda.cfg)' connect sys/oracle@db11tp2;

    CONFIGURE CHANNEL 3 DEVICE TYPE 'SBT_TAPE' PARMS
    'BLKSIZE=1048576,
    SBT_LIBRARY=/opt/dpsapps/dbappagent/lib/lib64/libddboostora.so,
    SBT_PARMS=(CONFIG_FILE=/opt/dpsapps/dbappagent/config/oracle_asm_ddbda.cfg)' connect sys/oracle@db11tp1;

    CONFIGURE CHANNEL 4 DEVICE TYPE 'SBT_TAPE' PARMS
    'BLKSIZE=1048576,
    SBT_LIBRARY=/opt/dpsapps/dbappagent/lib/lib64/libddboostora.so,
    SBT_PARMS=(CONFIG_FILE=/opt/dpsapps/dbappagent/config/oracle_asm_ddbda.cfg)' connect sys/oracle@db11tp2;

    CONFIGURE DEVICE TYPE SBT_TAPE PARALLELISM 4 BACKUP TYPE TO BACKUPSET;

    backup device type sbt section size 4G database format '
    %d_%U';

    BACKUP device type sbt archivelog ALL;
}

Creating RMAN scripts for DD Boost Oracle operations
Running and monitoring backups and recovery: Examples

This example shows how to run full database backups:

1. Log in to the database node as Oracle user. For example, log in to C7-TP-VM1:

   ```
   $ cat rman_backup_rac.cmd
   run {
      CONFIGURE CHANNEL 1 DEVICE TYPE 'SBT_TAPE' PARMS
      'BLKSIZE=1048576,
       SBT_LIBRARY=/opt/dpsapps/dbappagent/lib/lib64/libddboostora.so,
       SBT_PARMS=(CONFIG_FILE=/opt/dpsapps/dbappagent/config/oracle_asm_ddbda.cfg)' connect sys/oracle@db11tp1;
      CONFIGURE CHANNEL 2 DEVICE TYPE 'SBT_TAPE' PARMS
      'BLKSIZE=1048576,
       SBT_LIBRARY=/opt/dpsapps/dbappagent/lib/lib64/libddboostora.so,
       SBT_PARMS=(CONFIG_FILE=/opt/dpsapps/dbappagent/config/oracle_asm_ddbda.cfg)' connect sys/oracle@db11tp2;
      CONFIGURE CHANNEL 3 DEVICE TYPE 'SBT_TAPE' PARMS
      'BLKSIZE=1048576,
       SBT_LIBRARY=/opt/dpsapps/dbappagent/lib/lib64/libddboostora.so,
       SBT_PARMS=(CONFIG_FILE=/opt/dpsapps/dbappagent/config/oracle_asm_ddbda.cfg)' connect sys/oracle@db11tp1;
      CONFIGURE CHANNEL 4 DEVICE TYPE 'SBT_TAPE' PARMS
      'BLKSIZE=1048576,
       SBT_LIBRARY=/opt/dpsapps/dbappagent/lib/lib64/libddboostora.so,
       SBT_PARMS=(CONFIG_FILE=/opt/dpsapps/dbappagent/config/oracle_asm_ddbda.cfg)' connect sys/oracle@db11tp1;
   }
   ```

2. Develop or build an RMAN backup script for the environment. For example, the following script (rman_backup_rac.cmd) produces a full backup:

   ```
   $ cat rman_backup_rac.cmd
   run {
      CONFIGURE CHANNEL 1 DEVICE TYPE 'SBT_TAPE' PARMS
      'BLKSIZE=1048576,
       SBT_LIBRARY=/opt/dpsapps/dbappagent/lib/lib64/libddboostora.so,
       SBT_PARMS=(CONFIG_FILE=/opt/dpsapps/dbappagent/config/oracle_asm_ddbda.cfg)' connect sys/oracle@db11tp1;
      CONFIGURE CHANNEL 2 DEVICE TYPE 'SBT_TAPE' PARMS
      'BLKSIZE=1048576,
       SBT_LIBRARY=/opt/dpsapps/dbappagent/lib/lib64/libddboostora.so,
       SBT_PARMS=(CONFIG_FILE=/opt/dpsapps/dbappagent/config/oracle_asm_ddbda.cfg)' connect sys/oracle@db11tp2;
      CONFIGURE CHANNEL 3 DEVICE TYPE 'SBT_TAPE' PARMS
      'BLKSIZE=1048576,
       SBT_LIBRARY=/opt/dpsapps/dbappagent/lib/lib64/libddboostora.so,
       SBT_PARMS=(CONFIG_FILE=/opt/dpsapps/dbappagent/config/oracle_asm_ddbda.cfg)' connect sys/oracle@db11tp1;
      CONFIGURE CHANNEL 4 DEVICE TYPE 'SBT_TAPE' PARMS
      'BLKSIZE=1048576,
       SBT_LIBRARY=/opt/dpsapps/dbappagent/lib/lib64/libddboostora.so,
       SBT_PARMS=(CONFIG_FILE=/opt/dpsapps/dbappagent/config/oracle_asm_ddbda.cfg)' connect sys/oracle@db11tp1;
   }
   ```
Chapter 7: Data Domain backup solution database or client setup

SBT_PARMS=(CONFIG_FILE=/opt/dpsapps/dbappagent/config/oracle_asm_ddbd.be.cfg)' connect sys/oracle@db11tp2;

CONFIGURE DEVICE TYPE SBT_TAPE PARALLELISM 4 BACKUP TYPE TO BACKUPSET;

backup device type sbt section size 4G database format '%d_%U';

BACKUP device type sbt archivelog ALL;

3. As Oracle user, perform the initial full backup for the database to Data Domain with DD Boost by using the following RMAN script:

$ rman target / cmdfile= rman_backup_rac.cmd > rman_backup.log &

4. Monitor the database full backup status using the log file by running the Linux tail command:

$ tail -f rman_backup.log

5. Log in to Data Domain using sysadmin and record the Data Domain backup performance:

sysadmin@DD6300# ddboost show stats interval 2

6. Record the Data Domain compression performance:

sysadmin@DD6300# filesys show compression

7. When the backup is complete, as Oracle user, log in to RMAN to validate the database backup:

[oracle@c7-tp-vml ~] rman target /

RMAN> BACKUP VALIDATE DATABASE;

The system displays the following status:
The Status of each file is **OK**, which means that these files can be restored at any point in time.
Running a database restore

You can restore a database backup if a failure or corruption to the database occurs. Set up and configure RMAN to restore and recover the database from a backup on the Data Domain backup appliance. Also, verify that the database was successfully restored and recovered from the backup database.

1. Put the database in mount mode:
   
   Startup mount

2. Run the following RMAN script to restore the database:

   Run{
   
   CONFIGURE CHANNEL 1 DEVICE TYPE 'SBT_TAPE' PARM 'BLKSIZE=1048576, SBT_LIBRARY=/opt/dpsapps/dbappagent/lib/lib64/libddboostora.so,SBT_PARMS=(CONFIG_FILE=(/opt/dpsapps/dbappagent/config/oracle_asm_ddbda.cfg) connect sys/oracle@db1tp1;
   
   ..... 

   CONFIGURE CHANNEL 2 DEVICE TYPE 'SBT_TAPE' PARM 'BLKSIZE=1048576, SBT_LIBRARY=/opt/dpsapps/dbappagent/lib/lib64/libddboostora.so,SBT_PARMS=(CONFIG_FILE=(/opt/dpsapps/dbappagent/config/oracle_asm_ddbda.cfg) connect sys/oracle@db1tp1;

   CONFIGURE CHANNEL 3 DEVICE TYPE 'SBT_TAPE' PARM 'BLKSIZE=1048576, SBT_LIBRARY=/opt/dpsapps/dbappagent/lib/lib64/libddboostora.so,SBT_PARMS=(CONFIG_FILE=(/opt/dpsapps/dbappagent/config/oracle_asm_ddbda.cfg) connect sys/oracle@db1tp2;
   
   ..... 

   CONFIGURE CHANNEL 4 DEVICE TYPE 'SBT_TAPE' PARM 'BLKSIZE=1048576, SBT_LIBRARY=/opt/dpsapps/dbappagent/lib/lib64/libddboostora.so,SBT_PARMS=(CONFIG_FILE=(/opt/dpsapps/dbappagent/config/oracle_asm_ddbda.cfg) connect sys/oracle@db1tp2;

   restore database;

   release channel 1;

   Release channel 2;

   Release channel 3;

   Release channel 4;

   }

3. Recover the database:

   RECOVER DATABASE TEST UNTIL CANCEL USING BACKUP CONTROLFILE
4. Open the database with by using the resetlogs option:
   
   ```sql
   alter database open resetlogs;
   ```

5. After the database is open for access, run the following RMAN command to validate the database:

   ```sql
   Run{
   CONFIGURE CHANNEL 1 DEVICE TYPE 'SBT_TAPE' PARM 'BLKSIZE=1048576,
   SBT_LIBRARY=/opt/dpsapps/dbappagent/lib/lib64/libddboostora.so,SBT
   _PARMS=(CONFIG_FILE=(/opt/dpsapps/dbappagent/config/oracle_asm_ddb
   da.cfg' connect sys/oracle@db1tp1;
   ......
   CONFIGURE CHANNEL 2 DEVICE TYPE 'SBT_TAPE' PARM 'BLKSIZE=1048576,
   SBT_LIBRARY=/opt/dpsapps/dbappagent/lib/lib64/libddboostora.so,SBT
   _PARMS=(CONFIG_FILE=(/opt/dpsapps/dbappagent/config/oracle_asm_ddb
   da.cfg' connect sys/oracle@db1tp1;
       
   CONFIGURE CHANNEL 3 DEVICE TYPE 'SBT_TAPE' PARM 'BLKSIZE=1048576,
   SBT_LIBRARY=/opt/dpsapps/dbappagent/lib/lib64/libddboostora.so,SBT
   _PARMS=(CONFIG_FILE=(/opt/dpsapps/dbappagent/config/oracle_asm_ddb
   da.cfg' connect sys/oracle@db1tp2;
   ......
   CONFIGURE CHANNEL 4 DEVICE TYPE 'SBT_TAPE' PARM 'BLKSIZE=1048576,
   SBT_LIBRARY=/opt/dpsapps/dbappagent/lib/lib64/libddboostora.so,SBT
   _PARMS=(CONFIG_FILE=(/opt/dpsapps/dbappagent/config/oracle_asm_ddb
   da.cfg' connect sys/oracle@db1tp2;

   validate database check logical;

   release channel 1;
   ......
   Release channel 2;
   Release channel 3;
   Release channel 4;

   }
   ```
After the validation completes, query the v$database_block_corruption to verify that there is no physical and logical corruption in the backup of the data files.

Data Domain provides command line tools to monitor backup and restore performance elements such as backup/restore throughput, network throughput, and deduplication and compression ratios. The following examples demonstrate how to leverage these performance tools to monitor the database backup and restore operations.

**Monitoring backup throughput**

To monitor the backup throughput, log in to the Data Domain system and run the following command during the backup operation:

```bash
$ddboost show state intervals 2
```

This command shows the DD Boost backup real-time performance statistics that are based on a specified interval (in this example, every two seconds.)

The following results show the statistics for a backup operation:

<table>
<thead>
<tr>
<th>Backup KB/s</th>
<th>Post-comp Written KB/s</th>
<th>Network in KB</th>
<th>Restore in KB/s</th>
<th>Network out KB/s</th>
<th>Backup conn</th>
<th>Restore conn</th>
</tr>
</thead>
<tbody>
<tr>
<td>545,611</td>
<td>336,549</td>
<td>336,613</td>
<td>3</td>
<td>3</td>
<td>4</td>
<td>0</td>
</tr>
</tbody>
</table>

The first three columns describe:

- **Backup KB/s**—The throughput by which the database files are scanned by the RMAN and DD Boost on the database server
- **Post-Comp Written KB/s**—The throughput by which the backup data is written into the Data Domain system
- **Network In KB/s**—The network throughput by which the data is sent from the database server or servers to the Data Domain system

**Monitoring restore throughput**

When you restore a database, run the following command to monitor the restore throughput:

```bash
$ddboost show state intervals 2
```

The following results show the statistics for a restore operation.
Chapter 7: Data Domain backup solution database or client setup

Table 34. Restore and network throughputs

<table>
<thead>
<tr>
<th>Backup KB/s</th>
<th>Post-comp Written KB/s</th>
<th>Network in KB</th>
<th>Restore in KB/s</th>
<th>Network out KB/s</th>
<th>Backup conn</th>
<th>Restore conn</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>0</td>
<td>0</td>
<td>1,017,593</td>
<td>1,017,593</td>
<td>0</td>
<td>4</td>
</tr>
</tbody>
</table>

For the restore operation, the output of the command shows the restore throughput, Network Out KB/s (network throughput from the Data Domain system), and the Restore conn (the number of connections of the restore threads).

**Monitoring data compression ratios**

To monitor the Data Domain and DD Boost data compression ratios, run the following command on the DD Boost system after the backup is completed:

```
$filesys show compression
```

This command provides output similar to the following for a full backup:

```
Pre-Comp = Data written before compression
Post-Comp = Storage used after compression
Global-Comp Factor = Pre-Comp / (Size after de-dupe)
Local-Comp Factor = (Size after de-dupe) / Post-Comp
Total-Comp Factor = Pre-Comp / Post-Comp
Reduction % = (Pre-Comp - Post-Comp) / Pre-Comp * 100
```

Pre-Comp is the data scanned by RMAN and DD boost on the database server, while Post-Comp is the amount of the data being backed up and stored in the Data Domain system. The total compression ratio (Total-Comp factor) is:

\[
\text{Pre-Comp}/ \text{Post-Comp} = 1069.6/753.7 = 1.4x
\]

The reduction percentage is:

\[
(\text{Pre-Comp- Post-Comp})/ \text{Pre-Comp} * 100 = (1069.6-753.7)/ 1069.6*100= 29.5%
\]

Two other important compression ratios are:

- **Global-Comp Factor = Pre-Comp/(size after de-dupe) = 1**—Compression ratio that confirms for the full backup, that all the data backed up are unique and the size after deduplication = Pre-Comp = 1069.6 Gib for the full backup.
- **Local-Comp factor**—The compression ratio on the data after deduplication, which is \(\frac{\text{size-after-dedupe}}{\text{Post-Comp}} = \frac{1069.6}{753.7} = 1.4\)
This chapter presents the following topic:

**ProSupport Enterprise Suite**

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**ProSupport Enterprise Suite**

With ProSupport Enterprise Suite, you get the most out of your investment with Dell EMC support expertise and insights. ProSupport Enterprise Suite offers:

- Flexibility to choose the right level of support that is based on the criticality of specific systems
- A central point of contact for all your hardware and software issues
- Broad and deep experience that goes beyond a single system
- Automated proactive and predictive support technologies
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ProSupport provides:

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- Systems maintenance guidance
- Proactive and predictive remote monitoring and automated support through Support Assist and Secure Remote Services to spot problems before they become critical issues²

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² *Availability and terms of Dell EMC Services vary by region and by product. For more information, contact your Dell EMC sales representative."
ProSupport for Software

ProSupport for Software provides 24 x 7 comprehensive software support that is delivered by highly qualified Dell EMC experts.
This chapter presents the following topics:

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VMware documentation ......................................................................................................... 110
Oracle documentation ............................................................................................................ 110
Chapter 9: References

Dell EMC documentation

The following documentation on DellEMC.com or Dell EMC Online Support provides additional and relevant information. Access to these documents depends on your login credentials. If you do not have access to a document, contact your Dell EMC representative.

- Ready Solutions for Oracle with Data Protection Validation Guide
- Dell EMC XtremIO X2 Best Practices On Oracle Database
- Dell EMC XtremIO Storage Product Overview
- Dell EMC XtremIO Storage Array Host Configuration Guide
- Dell EMC Data Domain Systems Hardware Overview and Installation Guide
- Dell EMC Data Domain Operating System 6.0 documentation
- How to deploy Oracle 12c Release 2 Grid and RAC Database on RHEL 7.x
- How to deploy Oracle 12c Release 2 standalone Database on RHEL 7.x
- How to deploy Oracle 11g Release 2 standalone Database on RHEL 6.x

VMware documentation

The following documentation on the VMware website provides additional and relevant information:

- VMware vSphere 6.5 Installation and Setup
- Oracle Databases on VMware Best Practices Guide

Oracle documentation

The following documentation on the Oracle website provides additional and relevant information:

- Oracle Database 12c Release 2 Installation Guide
- Oracle Real Application Clusters 12c Release 2 Installation Guide
- Oracle Grid Infrastructure Installation and Upgrade Guide
- Oracle Database 12c Backup and Recovery User’s Guide
Appendix A: XtremIO Storage Configuration

This appendix presents the following topic:

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Appendix A: XtremIO Storage Configuration

XtremIO storage configuration

The XtremIO X2 management console enables you to configure and manage XtremIO storage arrays. This section provides the steps to accomplish the following tasks on XtremIO X2 storage arrays:

- Creating Initiator Groups
- Creating volumes
- Mapping volumes to host

Creating Initiator Groups

Use the following steps to create an Initiator Group in XtremIO X2:

1. From the XtremIO Management UI, select **Configuration → Initiator Groups** and click **New** to start the wizard.

![Figure 17. XtremIO Management GUI: Create new Initiator Group](image)

2. In the **Create Initiator Group** wizard, enter the initiator group name and click **Next**.
3. In the Initiator Settings tab:
   a. Select all the initiators from the list that belong to the same database server.
   b. Leave the Initiator Name to the default setting or change as needed.

4. For each initiator, select the correct OS type that the database server is running. For example, in case of the physical production and XVC databases server, select Linux as the OS type, and in case of the virtual databases server, select ESXi as the OS type.
5. In the **Summary** tab, review and verify the initiator group details and click **Apply**.

**Figure 20. Create Initiator Group wizard: Summary**

**Creating volumes**

Use the following steps to create volumes in XtremIO X2:

1. From the XtremIO Management GUI, select **Configuration → Volumes** and click **New** to start the wizard.

**Figure 21. XtremIO Management GUI: Create new Volumes**

2. In the **New Volumes** wizard, enter the **Number of Volumes**, **Prefix** for the volumes, (common) **Size** for each volume, and click **APPLY**.
3. In the main Management UI, click **Configuration → Volumes** and verify if all volumes were created, as specified.

Mapping volumes to host

Use the following steps to map volumes to host in XtremIO X2:

1. In the XtremIO Management GUI, under the **Volumes** tab, select all the volumes that need to be mapped to the host server and click **Mapping** to start the mapping wizard.
Figure 24. XtremIO Management GUI: Select volumes to map to host

2. In the Mapping wizard, verify if all listed volumes are as wanted, select the appropriate Initiator Group (server host) to which to map these volumes, and click NEXT.

Figure 25. Mapping wizard: Volume to Initiator Group mapping

3. Verify the mapping and click APPLY.
Figure 26. Mapping wizard: Mapping confirmation