Dell EMC Ready Stack: VMware vSphere and Red Hat Enterprise Linux for High-Performance Database Applications

December 2019
H18023

Deployment Guide

Abstract
This deployment guide describes the requirements, configuration, and deployment of a converged infrastructure that is optimized for high-performance database applications. This solution is based on VMware vSphere and Red Hat Enterprise Linux with Dell EMC PowerEdge servers, XtremIO X2 storage, PowerSwitch S-Series switches, and Data Domain protection.

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Chapter 1: Introduction

Ready Stack solutions overview

Dell EMC Ready Stack solutions are proven, tested, and optimized to help organizations meet long-term data center needs for various mixed workloads. This Ready Stack solution was designed to support high-performance database applications—online analytical processing (OLAP) and online transaction processing (OLTP)—that are deployed on both physical and virtual platforms. This mixed-deployment configuration highlights the range of workloads that this Ready Stack solution can support, enabling workload consolidation, reducing cost, and simplifying management.

This Ready Stack solution provides the simplicity of a complete, yet flexible, validated converged infrastructure (CI) that is based on the following components:

- Dell EMC XtremIO X2 storage
- Dell EMC PowerEdge servers
- Dell EMC PowerSwitch S-Series switches
- Dell EMC Connectrix DS-6600 Series Fibre Channel (FC) switches
- VMware data center virtualization and management product suites that support the VMware Cloud Foundation integrated hybrid cloud platform
- Red Hat Enterprise Linux
- Dell EMC Data Domain DD6300 protection storage system

This Ready Stack solution includes:

- All CI stack components—compute, storage, networking, and data protection—from one trusted vendor
- A reference architecture that incorporates physical topology diagrams and general connectivity guidelines
- Design guidance that focuses on scale, flexibility, and high availability
- Design and deployment guidance that incorporates validation, interoperability testing, and best practices

*Note:* This Ready Stack design is database-vendor-agnostic and can apply to various database applications.

Dell EMC has conducted validation testing, including testing of hardware and software stability as well as feature functionality and interoperability. The validation processes were designed to ensure that this Ready Stack solution provides a stable, highly available platform for your database workloads.

Document purpose and scope

This guide provides basic guidance for deploying this Ready Stack solution for high-performance database applications. For links to related product installation guides, see Chapter 8, References.
This guide provides deployment guidance only. Information about any modifications to the configuration and their potential impact on configuration availability is outside the scope of this document. For detailed information about the Ready Stack architecture, see the Dell EMC Ready Stack: VMware vSphere and Red Hat Enterprise Linux for High-Performance Database Applications Design Guide.

This guide does not include information about existing infrastructure components beyond the components in the Dell EMC Ready Stack. Dell EMC assumes no liability for any issues with existing infrastructure that might occur during a deployment. Although deviations from the described configuration might be made to meet unique requirements, no warranty is implied or given as to the functionality of a Dell EMC Ready Stack that is deployed in a modified configuration.

**Audience**

This guide is for Dell EMC personnel, channel partners, and customers. It provides sample deployment information that Dell EMC Engineering used to test and validate the Ready Stack solution. Deployment of individual technology components that are mentioned in this guide might require specific training, certification, partner competencies, and other prerequisites. Deployment personnel must have prerequisites and a knowledge of data center infrastructure best practices for servers, storage, networking, data protection, power, and cooling. To learn more about product competency training and requirements, contact your Dell EMC Partner, Dell EMC Channel team, or Dell EMC Sales.

We assume that personnel who deploy the solution hardware have general knowledge of Dell EMC PowerEdge servers, the Dell EMC XtremIO X2 storage array, and the Dell EMC Data Domain backup appliance. We also assume that deployment personnel have knowledge of FC network host bus adapters (HBAs), cables, and switches, and Ethernet network cards, cables, and switches. We assume that personnel who deploy the software stack have a working knowledge of VMware software, Red Hat Enterprise Linux, and enterprise database systems. Chapter 8, References, provides links to the related documentation.

This document addresses the deployment steps that are specific to this Ready Stack solution, which is not specific to any one enterprise database product. Procedures that apply to a specific database product might require modification.

**Deployment workflow**

Deployment of this Ready Stack solution consists of three phases:

- **Phase I: Hardware stack setup and configuration**—This phase involves setting up solution hardware components, including PowerEdge servers; Ethernet network switches and cable connections; and the XtremIO X2 storage array, FC network switches, and cable connections. It also includes integrating the Data Domain hardware with the Ready Stack hardware infrastructure.
Chapter 1: Introduction

The following table outlines the 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>
<tbody>
<tr>
<td>1</td>
<td>Server setup</td>
<td>Configure compute server local disks, BIOS, and network adapters.</td>
<td>• Compute components&lt;br&gt;• Management server and components&lt;br&gt;• Preparing the PowerEdge servers&lt;br&gt;• Recommended slots for NICs and HBAs</td>
</tr>
<tr>
<td>2</td>
<td>Network setup</td>
<td>Set up top-of-rack (ToR) network switches, management switch, and network cable connections.</td>
<td>• Data center requirements&lt;br&gt;• Network components&lt;br&gt;• Physical design and connectivity&lt;br&gt;• Configuring Dell EMC PowerSwitch S5248F-ON ToR switches&lt;br&gt;• Configuring the Dell EMC PowerSwitch S4148T-ON switch</td>
</tr>
<tr>
<td>3</td>
<td>XtremIO X2 setup</td>
<td>Configure XtremIO X2 connectivity.</td>
<td>• Storage components&lt;br&gt;• Physical design and connectivity</td>
</tr>
<tr>
<td>4</td>
<td>Data Domain setup</td>
<td>Set up physical connectivity and perform initial appliance setup.</td>
<td>• Backup system components&lt;br&gt;• Setting up the Data Domain backup appliances</td>
</tr>
<tr>
<td>5</td>
<td>FC network setup</td>
<td>Set up FC switches, HBAs, cable connections, and zoning.</td>
<td>• Network components&lt;br&gt;• Recommended slots for NICs and HBAs&lt;br&gt;• Physical design and connectivity&lt;br&gt;• Configuring zoning on FC switches</td>
</tr>
</tbody>
</table>

- **Phase II: Physical and virtual infrastructure installation and configuration**—This phase establishes the physical and virtual environments for running 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 the Red Hat Enterprise Linux operating system, and configuring the network and storage volumes within the operating system. For the virtual environment, the tasks include setting up VMware ESXi on management and database servers, installing VMware vCenter Server Appliance, creating and setting up XtremIO X2 storage volumes, creating virtual machines (VMs), and setting up the storage and network for the VMs. It also provides steps for setting up the Data Domain backup appliance.
Chapter 1: Introduction

The following two tables outline the tasks for deployment 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>
</table>
| 1      | XtremIO X2 configuration | Create Initiator Groups. Create and map storage volumes on XtremIO X2 storage. | • Chapter 4, Production Database Environment Setup  
• Chapter 6, XtremIO Virtual Copy Database Environment Setup |
| 2      | Operating system installation and configuration, including prerequisites for database | Install Red Hat Enterprise Linux on the physical database servers. Configure the operating system, network, and storage volumes. Perform additional configuration based on best practices for XtremIO environments. | • Production database environment setup:  
  ▪ Configuring operating system, network, and storage  
  ▪ Additional best practices in an XtremIO environment (applies to both production and XVC database environments)  
  ▪ *Dell EMC XtremIO Storage Array Host Configuration Guide*  
• XVC database environment setup: Configuring operating system, network, and storage |

**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>
</table>
| 1      | ESXi and vCenter Server Appliance installation | Install ESXi and vCenter Server Appliance on the management server. Install ESXi on the virtual database server. Perform additional configuration based on best practices for XtremIO environments. | • Installing ESXi and deploying vCenter Server Appliance on the management server  
• Installing and configuring ESXi on the database server  
• ESXi database server setup:  
  ▪ Additional best practices in an XtremIO environment  
  ▪ *Dell EMC XtremIO Storage Array Host Configuration Guide* |
| 2      | vSphere data center and host configuration | Configure the vSphere data center and add the ESXi database host. | • Creating a vSphere data center  
• Adding hosts to vCenter |
| 3      | XtremIO X2 configuration | Create Initiator Groups. Create and map storage volumes on XtremIO X2 storage. | Appendix A, XtremIO Storage Configuration |
| 4      | ESXi host virtual switch configuration | Configure virtual distributed switches for database public traffic. | Configuring vSphere Distributed Switch |
| 5      | ESXi host storage configuration | Configure datastores. | Configuring datastores |
| 6      | VM creation | Create VMs for virtual databases. | Creating VMs for databases |
### Phase III: Database configuration

- This phase establishes the production databases on top of the physical infrastructure that was established in phase II. It also establishes the virtual databases on top of the virtual infrastructure that was established in phase II. Tasks in this phase include:
  - Preparing to install the database software
  - Installing the database software in each environment
  - Creating and configuring the databases in each environment
  - For XVC databases, taking XtremIO X2 level snapshots (XVC) of the production database volumes, and integrating and reconfiguring the existing database configuration in the XVC database server to bring up the snapshot database
  - Configuring the databases to integrate and work with the Data Domain backup appliance

The following table outlines the specific tasks for deployment phase III:

<table>
<thead>
<tr>
<th>Task #</th>
<th>Task</th>
<th>Task description</th>
<th>Reference</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Database installation</td>
<td>Install database software. Create a seed database.</td>
<td>• Chapter 4, Production Database Environment Setup</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>• Chapter 5, Virtual Database Environment Setup</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>• Chapter 6, XtremIO Virtual Copy Database Environment Setup</td>
</tr>
<tr>
<td>2</td>
<td>Snapshot creation on the XtremIO array for XVC databases</td>
<td>Create snapshots of the production database for the XVC databases.</td>
<td>Taking XVC snapshots of the PROD database</td>
</tr>
<tr>
<td></td>
<td>Snapshot database creation</td>
<td>Mount snapshot volumes to create snapshot databases on the XVC database server.</td>
<td>Creating a snapshot database on the XVC server</td>
</tr>
<tr>
<td>3</td>
<td>Data Domain client and database setup</td>
<td>Install and configure the Data Domain agent.</td>
<td>Installing the Data Domain agent</td>
</tr>
</tbody>
</table>
We value your feedback

Dell EMC and the author of this document welcome your feedback on the Ready Stack and the Ready Stack documentation. Contact the Dell EMC Solutions team by email or provide your comments by completing our documentation survey.

Author: David Hartman
Contributor: Karen Johnson

Note: For links to additional documentation for this solution, see the Dell EMC Ready Stack Converged Infrastructure.
This chapter presents the following topics:

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Architecture and design overview

Introduction

This XtremIO X2-based Ready Stack solution is designed to consolidate multiple types of mixed-workload database environments in a single system. We tested and validated this Ready Stack solution in the following types of database environments:

- An OLTP production database in a physical environment (two nodes)
- XVC databases in a physical environment (single node)
  - One XVC database that was repurposed from the production database for an OLAP workload
  - One OLTP XVC database that was repurposed from the production database for development
- OLTP databases running on two VMs (single node)

The following figure shows the logical architecture of the consolidated mixed-database environment. The figure shows the multiple layers of infrastructure components in this Ready Stack solution, which includes Data Domain DD6300 as the backup appliance for data protection.

![Logical architecture overview](image)

**Figure 1.  Logical architecture overview**

Server layer

The server layer consists of:

- **R640 management server**—vCenter Server Appliance is deployed as a VM on a single PowerEdge R640 server running ESXi 6.7 U3 as the hypervisor.
- **R940 PROD database servers**—The production database is deployed on two PowerEdge R940 servers running Red Hat Enterprise Linux 7.4 as the bare-metal operating system.
• **R740 XVC database server**—The two stand-alone databases that are repurposed from the production database are deployed on a single PowerEdge R740 server running Red Hat Enterprise Linux 7.4 as the bare-metal operating system.

• **R940 virtual database server**—The two virtual OLTP databases are deployed as separate VMs running Red Hat Enterprise Linux 7.4 as the guest operating system. Both VMs are running on a single PowerEdge R940 server that is installed with the ESXi 6.7 U3 hypervisor.

Each database server has:

• **Two dual-port 10 GbE NICs**—For public and private (PROD servers only) network traffic

• **Two dual-port 16 Gbps HBAs**—For SAN traffic

• **At least one 1 GbE management rNDC or LOM port**—For in-band server management from within the operating system

• **1 GbE dedicated iDRAC Ethernet port**—For out-of-band (OOB) management of the server

**Switch layer**

The switch layer consists of:

• **Two 10 GbE ToR switches**—Redundant S5248F-ON top-of-rack (ToR) LAN switches that support the public, private, and backup traffic

• **Two 32 Gbps FC switches**—Redundant DS-6620-B switches for FC SAN traffic and connectivity between the database servers and the storage array

• **One 1 GbE Management switch**—A 1U S4148T-ON switch for the management traffic

**Storage layer**

The storage layer consists of:

• **XtremIO X2 array**—XtremIO X2 is the FC SAN storage that consolidates all the databases. The XtremIO X2 array consists of a two X-Brick cluster. Each X-Brick block has two storage controllers, and each storage controller has two front-end 16 Gbps FC ports.

• **Data Domain DD6300 appliance**—For database backup and recovery, we tested the solution 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.

**Physical design overview**

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

**Physical design and connectivity**

The following figure shows the physical design and redundant connectivity between the database servers, 10 GbE ToR switches, 1 GbE management switch, XtremIO X2 cluster, and the DS-6620B fabric switches:
Figure 2. Physical design and connectivity

The DD6300 backup appliance (not shown) is connected to the 10 GbE public network.

The SAN design features redundant components and connectivity at every level to ensure that there is no single point of failure. This design enables the database server to reach the storage array even if any of the following components fail:

- One or more HBA ports
- One HBA
- One FC switch
- One XtremIO front-end port or storage controller
- One XtremIO X-Brick
Virtual network design

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

The main components of the design are:

- **Public VDS**—We created one VDS, which contains two distributed port groups:
  - The public port group provides the virtual interfaces for database public traffic for the two 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 vCenter Server Appliance.
  - The VM network port group provides the 1 GbE virtual interfaces for in-band management of the database VMs.

The management traffic is routed through the 1 GbE physical rNDC or LOM port on the server that is connected to the external management switch.

Figure 3. Virtual network design in the ESXi virtual database host
## Validated components

### Overview

The tables in this section describe the components of this Ready Stack solution, including validated software and firmware versions.

**Note:** Newer and updated BIOS, firmware, and driver versions, if available, are supported. For the latest versions, go to [Dell EMC Online Support](https://www.dell.com/). 

The following table lists the major solution hardware components:

<table>
<thead>
<tr>
<th><strong>Table 5. Major hardware components</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Component</strong></td>
</tr>
</tbody>
</table>
| Database servers | • 2 Dell EMC 4S PowerEdge R940 servers for physical production databases  
• 1 Dell EMC 4S PowerEdge R940 for virtual databases  
• 1 Dell EMC 2S PowerEdge R740 for physical XVC databases |
| LAN switches | 2 Dell EMC PowerSwitch S5248F-ON 10 GbE switches |
| SAN switches | 2 Dell EMC Connectrix DS-66200-B 32 Gbps FC switches |
| Management | • 1 Dell EMC PowerSwitch S4148T-ON 1 GbE switch  
• 1 Dell EMC 2S PowerEdge R640 server |
| Storage array | Dual X-Brick XtremIO X2 cluster |

The following tables list the hardware, firmware, and driver details of the database server components that were validated:

<table>
<thead>
<tr>
<th><strong>Table 6. Physical production database server components</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Component</strong></td>
</tr>
<tr>
<td>Servers</td>
</tr>
<tr>
<td>Chassis</td>
</tr>
<tr>
<td>Processors per server</td>
</tr>
<tr>
<td>Memory per server</td>
</tr>
<tr>
<td>Local disks per server</td>
</tr>
<tr>
<td>RAID controller</td>
</tr>
<tr>
<td>iDRAC</td>
</tr>
<tr>
<td>rNDC</td>
</tr>
<tr>
<td>Add-on NICs per server</td>
</tr>
<tr>
<td>HBAs per server</td>
</tr>
<tr>
<td>Power supplies per server</td>
</tr>
</tbody>
</table>
Table 7. Production database servers: PowerEdge R940 firmware and Red Hat Enterprise Linux 7 drivers

<table>
<thead>
<tr>
<th>Component</th>
<th>Version</th>
</tr>
</thead>
<tbody>
<tr>
<td>BIOS</td>
<td>1.6.13</td>
</tr>
<tr>
<td>Lifecycle Controller and iDRAC9 Enterprise</td>
<td>Firmware (FW): 3.30.30.30</td>
</tr>
<tr>
<td>Emulex LPe31002-M6-D DP 16 Gbps 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 (megaraid_sas)</td>
</tr>
<tr>
<td>Delta 1,600 W power supplies</td>
<td>FW: 00.3D.67</td>
</tr>
</tbody>
</table>

Table 8. Physical XVC database server components

<table>
<thead>
<tr>
<th>Component</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Server</td>
<td>1 Dell EMC PowerEdge R740</td>
</tr>
<tr>
<td>Chassis</td>
<td>8 x 2.5 in. SAS/SATA hard drives for 2-CPU configuration</td>
</tr>
<tr>
<td>Processors</td>
<td>2 Intel Xeon Gold 6136 12c 3.0 GHz</td>
</tr>
<tr>
<td>Memory</td>
<td>768 GB (24 x 32 GB DR DDR4 2,667 MT/s RDIMMs)</td>
</tr>
<tr>
<td>Local disks</td>
<td>3 x 1.2 TB 10 K SAS 12 Gbps 2.5 in. hard drives (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 1 Gb + 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 Emulex LPe16002B-M6-D DP 16 Gbps FC HBAs</td>
</tr>
<tr>
<td>Power supplies</td>
<td>2 x 1,100 W</td>
</tr>
</tbody>
</table>

Table 9. XVC database server: PowerEdge R740 firmware and Red Hat Enterprise Linux 7 drivers

<table>
<thead>
<tr>
<th>Component</th>
<th>Version</th>
</tr>
</thead>
<tbody>
<tr>
<td>BIOS</td>
<td>1.6.13</td>
</tr>
<tr>
<td>Lifecycle Controller and iDRAC9 Enterprise</td>
<td>FW: 3.30.30.30</td>
</tr>
<tr>
<td>Emulex LPe16002B-M6-D DP 16 Gbps FC HBAs</td>
<td>FW: 02.03.02; driver: 11.4.258.2 (lpfc)</td>
</tr>
<tr>
<td>Broadcom 5720 DP 1 Gb + 57412 DP 10 Gb 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 1,100 W power supplies</td>
<td>FW: 00.1D.7D</td>
</tr>
</tbody>
</table>
Table 10. Virtualized database server components

<table>
<thead>
<tr>
<th>Component</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Server</td>
<td>1 Dell EMC PowerEdge R940</td>
</tr>
<tr>
<td>Chassis</td>
<td>2.5 in. with up to 8 hard drives</td>
</tr>
<tr>
<td>Processors</td>
<td>4 Intel Xeon Gold 6150 18c 2.7 GHz</td>
</tr>
<tr>
<td>Memory</td>
<td>1,536 GB (48 x 32 GB DR DDR4 2,667 MT/s RDIMMs)</td>
</tr>
<tr>
<td>Local disks</td>
<td>8 x 1.6 TB SAS 12 Gbps 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 Intel X710 DP 10 Gb SFP+ NICs</td>
</tr>
<tr>
<td>HBAs</td>
<td>2 QLogic QLE2692 DP 16 Gbps FC HBAs</td>
</tr>
<tr>
<td>Power supplies</td>
<td>2 x 2,000 W</td>
</tr>
</tbody>
</table>

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

<table>
<thead>
<tr>
<th>Component</th>
<th>Version</th>
</tr>
</thead>
<tbody>
<tr>
<td>BIOS</td>
<td>1.6.13</td>
</tr>
<tr>
<td>Lifecycle Controller and iDRAC9 Enterprise</td>
<td>FW: 3.30.30.30</td>
</tr>
<tr>
<td>QLogic QLE2692 DP 16 Gbps 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>

In this solution, we recommend that you use a dedicated management server to install vCenter Server Appliance, Dell EMC OpenManage Essentials, or other centralized management software applications. The following table lists the management server and its components:

Table 12. Management server and components

<table>
<thead>
<tr>
<th>Category</th>
<th>Components</th>
</tr>
</thead>
<tbody>
<tr>
<td>Server</td>
<td>1 Dell EMC PowerEdge R640 Server</td>
</tr>
<tr>
<td>Chassis</td>
<td>2.5 in. with up to 8 hard drives and 3 PCIe slots</td>
</tr>
<tr>
<td>Processors</td>
<td>2 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 Gbps 2.5 in. hard drives (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>
Chapter 2: Architecture, Design, and Solution Components Overview

The following table lists the network switches:

**Table 13. Network and fabric components**

<table>
<thead>
<tr>
<th>Component</th>
<th>Version</th>
</tr>
</thead>
<tbody>
<tr>
<td>OOB—Dell EMC PowerSwitch S4148T-ON switch (S3048-ON may also be used)</td>
<td>Firmware 3.33.5.1-19, A00 OS 10.4.3.0</td>
</tr>
<tr>
<td>ToR—Dell EMC PowerSwitch S5248F-ON switch (leaf)</td>
<td>Firmware 3.40.5.1-11, A00 OS 10.4.3.0</td>
</tr>
<tr>
<td>Dell EMC PowerSwitch Z9264F-ON switch (spine, if needed)</td>
<td></td>
</tr>
<tr>
<td>2 Dell EMC Connectrix DS-6620B switches</td>
<td>Fabric OS 8.2.1a</td>
</tr>
</tbody>
</table>

The following table lists the hardware details of the storage array:

**Table 14. 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 X 2-S X-Brick cluster</td>
</tr>
<tr>
<td>Operating system version</td>
<td>6.1.0-99_X2</td>
</tr>
<tr>
<td>Number of active/active controllers</td>
<td>4</td>
</tr>
<tr>
<td>Number of front-end FC ports</td>
<td>8</td>
</tr>
<tr>
<td>Number of 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>Number of InfiniBand switches</td>
<td>2</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>1*</td>
</tr>
<tr>
<td>Active tier disks (in use)</td>
<td>11 x 3.64 TiB (40.03 TiB) SAS hard drives</td>
</tr>
<tr>
<td>Active tier disks (spare)</td>
<td>1 x 3.64 TiB SAS hard drive</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 disks*</td>
<td>60 x 2.73 TiB (163.8 TiB) SAS hard drives</td>
</tr>
<tr>
<td></td>
<td>56 active (152.9 TiB) + 4 spare (10.9 TiB)</td>
</tr>
<tr>
<td>System disks</td>
<td>Not applicable</td>
</tr>
</tbody>
</table>

* The expandable storage disks in DS60 were available but not used in the testing.
Software requirements

The following table specifies the software versions of the components that were validated:

Table 16. Solution software

<table>
<thead>
<tr>
<th>Category</th>
<th>Software</th>
<th>Version</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ready Stack</td>
<td>VMware ESXi</td>
<td>6.7 U3: Build 14320388 Dell version: A00</td>
</tr>
<tr>
<td></td>
<td>VMware vCenter Server Appliance</td>
<td>6.7 U3: Build 14387737</td>
</tr>
<tr>
<td></td>
<td>Red Hat Enterprise Linux (physical and guest operating system)</td>
<td>7.4, kernel version: 3.10.0-693.el7.x86_64</td>
</tr>
<tr>
<td></td>
<td>Dell EMC XtremIO X2 storage operating system</td>
<td>XIOS version: 6.2.1-36</td>
</tr>
<tr>
<td>Data Domain backup appliance (DD6300)</td>
<td>Operating system</td>
<td>6.0.1.30-570211</td>
</tr>
<tr>
<td></td>
<td>DD Boost for Enterprise Applications</td>
<td>4.5.1.0-1</td>
</tr>
<tr>
<td>Management software</td>
<td>Dell EMC Virtual Storage Integrator (VSI)</td>
<td>8.0</td>
</tr>
<tr>
<td></td>
<td>Dell EMC Storage Analytics (ESA)</td>
<td>4.6</td>
</tr>
<tr>
<td></td>
<td>Dell EMC OpenManage Integration for VMware vCenter</td>
<td>4.2</td>
</tr>
</tbody>
</table>

Data center requirements

To support this Ready Stack solution, the environment must include:

- An existing Ethernet infrastructure with which to integrate. Dell EMC PowerSwitch S5248F-ON switches support 10/25 GB and 40/100 GB 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.
Chapter 3 Compute, Management, Network, and Data Protection Component Setup

This chapter presents the following topics:

Preparing for component setup ................................................................. 23
Preparing the PowerEdge servers .............................................................. 23
Configuring Dell EMC PowerSwitch S5248F-ON ToR switches .............. 25
Configuring the Dell EMC PowerSwitch S4148T-ON switch ................... 32
Installing ESXi and deploying vCenter Server Appliance on the management server ................................................................. 34
Configuring zoning on FC switches ......................................................... 40
Setting up the Data Domain backup appliances ....................................... 42
Preparing for component setup

This chapter describes the required steps for initial setup of the compute, management, network, and data protection components. Review the procedures with your site networking team before performing them.

Preparing the PowerEdge servers

Introduction

To prepare the PowerEdge servers for the production, XVC, virtual, and management environments, follow the procedures in this section to:

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

Configuring local disk drives

The following table lists the software that is hosted on the local disk drives of the PowerEdge database servers. The database data itself resides on the XtremIO X2 storage array.

Table 17. Server-hosted software

<table>
<thead>
<tr>
<th>Server type</th>
<th>Hosted on disk drives</th>
</tr>
</thead>
<tbody>
<tr>
<td>Physical database servers</td>
<td>• Bare-metal operating system</td>
</tr>
<tr>
<td></td>
<td>• Database management software</td>
</tr>
<tr>
<td>ESXi server</td>
<td>• VMs</td>
</tr>
<tr>
<td></td>
<td>• Database management software</td>
</tr>
<tr>
<td>Management server</td>
<td>Management software</td>
</tr>
</tbody>
</table>

We recommend the following local disk drive configuration for each of the PowerEdge servers:

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

The following Dell EMC Knowledge Base articles provide information about creating a VD:

- 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](#)

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](#).
We recommend the following BIOS settings for the PowerEdge servers:

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

The slot recommendations in this section are based on the chassis type that we used in testing. The chassis type that we used is noted in each of the tables in this section. If you choose a different chassis type, the NICs and HBAs that are shipped from the factory are populated in the recommended PCIe slots for that server.

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

**Table 18. 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>NIC 1</td>
<td>Broadcom 57412 DP 10 Gb SFP+ PCIe</td>
<td>3</td>
</tr>
<tr>
<td>NIC 2</td>
<td>Broadcom 57412 DP 10 Gb SFP+ PCIe</td>
<td>6</td>
</tr>
<tr>
<td>HBA 1</td>
<td>Emulex LPe31002-M6-D DP 16 Gbps FC</td>
<td>2</td>
</tr>
<tr>
<td>HBA 2</td>
<td>Emulex LPe31002-M6-D DP 16 Gbps FC</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 database server:

**Table 19. Virtual database 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>NIC 1</td>
<td>Intel X710 DP 10 Gb SFP+ PCIe</td>
<td>3</td>
</tr>
<tr>
<td>NIC 2</td>
<td>Intel X710 DP 10 Gb SFP+ PCIe</td>
<td>6</td>
</tr>
<tr>
<td>HBA 1</td>
<td>QLogic QLE2692 DP 16 Gbps FC</td>
<td>2</td>
</tr>
<tr>
<td>HBA 2</td>
<td>QLogic QLE2692 DP 16 Gbps FC</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 database server:

### Table 20. XVC database 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>NIC 1*</td>
<td>Broadcom 5720 DP 1 Gb + 57412 DP 10 Gb NetXtreme-E rNDC</td>
<td>rNDC or LOM</td>
</tr>
<tr>
<td>HBA 1</td>
<td>Emulex LPe16002B-M6-D DP 16 Gbps FC</td>
<td>1</td>
</tr>
<tr>
<td>HBA 2</td>
<td>Emulex LPe16002B-M6-D DP 16 Gbps FC</td>
<td>7</td>
</tr>
</tbody>
</table>

* We used one of the 10 GbE ports on the rNDC for database public traffic.

## Configuring Dell EMC PowerSwitch S5248F-ON ToR switches

### Introduction

The PowerSwitch S5248F-ON ToR switches support the database public and private interconnect traffic. They also support the database backup and recovery traffic by providing the interconnectivity between the database servers and the Data Domain backup appliance.

This section provides the recommended configuration of the S5248F-ON ToR switches to support the solution. Your environment might require additional configuration, including configuring the communication to the core data center network. For detailed configuration instructions, see the switch configuration guides at [PowerSwitch S5248F-ON](#) on Dell EMC Online Support.

### Configuration steps

Configure the S5248F-ON ToR switches as follows, in accordance with recommended best practices.

**Caution:** Ensure that the personnel who are responsible for network management in your environment have reviewed the Spanning Tree Protocol (STP) configuration. Incorrect settings might cause network issues. The values that are provided here are examples only.

1. 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.

2. Enable Simple Network Management Protocol (SNMP):
   a. Configure Virtual Link Trunking (VLT) between the two S5248F-ON switches, using at least two of the 100 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. 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 data center network.

3. Enable the Spanning Tree Edge Port feature.

4. Create a port channel on both S5248F-ON switches by using the port that connects to the S4148T-ON management switch. Ensure that the port channel is configured as a VLT peer link aggregation group (LAG) on both switches.

5. Enable jumbo frames (MTU 9216) on the ports to be used for the database private interconnect traffic.

6. Configure the network traffic for the database public, backup and recovery, private interconnect, and private management on separate VLANs.

The following tables show an example of a VLAN configuration for the different traffic types:

**Table 21. Switch hostnames example**

<table>
<thead>
<tr>
<th>Switch</th>
<th>Hostname</th>
<th>VLT backup address</th>
<th>VLT ports</th>
</tr>
</thead>
<tbody>
<tr>
<td>S4148T-ON</td>
<td>SWOOB</td>
<td>Not applicable</td>
<td>Not applicable</td>
</tr>
<tr>
<td>S5248F-ON-Top</td>
<td>SW1</td>
<td>192.168.1.253/24</td>
<td>Ethernet 1/1/53–1/1/54</td>
</tr>
<tr>
<td>S5248F-ON-Bottom</td>
<td>SW2</td>
<td>192.168.1.252/24</td>
<td>Ethernet 1/1/53–1/1/54</td>
</tr>
</tbody>
</table>

**Table 22. VLAN information example**

<table>
<thead>
<tr>
<th>Network type</th>
<th>VLAN ID*</th>
<th>SS5248F-ON-Top IP CIDR</th>
<th>SS5248F-ON-Bottom IP CIDR</th>
<th>VRRP IP address</th>
<th>VRRP group</th>
<th>S4148T-ON IP address</th>
</tr>
</thead>
<tbody>
<tr>
<td>OOB</td>
<td>100</td>
<td>172.90.100.252/24</td>
<td>172.90.100.253/24</td>
<td>172.90.100.254</td>
<td>1</td>
<td>172.90.100.25</td>
</tr>
<tr>
<td>Management</td>
<td>110</td>
<td>172.90.110.252/24</td>
<td>172.90.110.253/24</td>
<td>172.90.110.254</td>
<td>2</td>
<td>Not applicable</td>
</tr>
<tr>
<td>VM migration</td>
<td>120</td>
<td>172.90.120.252/24</td>
<td>172.90.120.253/24</td>
<td>172.90.120.254</td>
<td>3</td>
<td>Not applicable</td>
</tr>
<tr>
<td>DB private</td>
<td>130</td>
<td>172.90.130.252/24</td>
<td>172.90.130.253/24</td>
<td>172.90.130.254</td>
<td>4</td>
<td>Not applicable</td>
</tr>
<tr>
<td>DB public, backup</td>
<td>140</td>
<td>172.90.140.252.24</td>
<td>172.90.140.253/24</td>
<td>172.90.140.254</td>
<td>5</td>
<td>Not applicable</td>
</tr>
</tbody>
</table>

* The VLAN IDs are examples. Network administrators can use VLAN IDs that conform to their network policies and standards if the database public and private networks are on two separate VLANs.

**Table 23. Customer network services example**

<table>
<thead>
<tr>
<th>Service</th>
<th>IP address</th>
</tr>
</thead>
<tbody>
<tr>
<td>DNS</td>
<td>172.90.110.250</td>
</tr>
</tbody>
</table>
### Table 24. Switch port-mapping example

<table>
<thead>
<tr>
<th>Component</th>
<th>S5248F-ON-Top</th>
<th>S5248F-ON-Bottom</th>
<th>S4148T-ON</th>
</tr>
</thead>
<tbody>
<tr>
<td>Server</td>
<td>NIC Port 1</td>
<td>NIC Port 2</td>
<td>iDRAC</td>
</tr>
<tr>
<td>Management</td>
<td>Ethernet 1/1/1</td>
<td>Ethernet 1/1/1</td>
<td>Ethernet 1/1/1</td>
</tr>
<tr>
<td>Prod DB 1</td>
<td>Ethernet 1/2/1</td>
<td>Ethernet 1/2/1</td>
<td>Ethernet 1/2/1</td>
</tr>
<tr>
<td>Prod DB 2</td>
<td>Ethernet 1/3/1</td>
<td>Ethernet 1/3/1</td>
<td>Ethernet 1/3/1</td>
</tr>
<tr>
<td>XVC DB</td>
<td>Ethernet 1/4/1</td>
<td>Ethernet 1/4/1</td>
<td>Ethernet 1/4/1</td>
</tr>
<tr>
<td>Virtual DB</td>
<td>Ethernet 1/5/1</td>
<td>Ethernet 1/5/1</td>
<td>Ethernet 1/5/1</td>
</tr>
</tbody>
</table>

Perform the following tasks on each of the S5248F-ON switches:

1. Using the RJ45-to-serial-port cable included with your switch, connect one end of the cable to your workstation and the other end to the RS-232 console port of the switch.

   The following figure shows the console and management ports on the back of the switch. The console port is on the upper right near the fans and power supplies.

2. Using terminal emulation software, configure the COM port:
   - 115200 baud rate
   - No parity/no flow control
   - 8 data bits/1 stop bit

3. When the connection is successful, enter configuration mode by running the following command:

   OS10# configure terminal

4. Configure the hostname and time zone, and set a username and password for EXEC mode by running the following commands:

   OS10(config)# hostname <hostname>
   SW1(config)# username <username> password <password> role sysadmin
   SW1(config)# clock timezone <timezone, for example, CST -6 0>
5. Configure routing to your default gateway, and save the configuration by running the following commands:

   SW1(config)# ip route 0.0.0.0/0 <core network gateway>
   SW1(config)# do write memory

Configure the management interface

The Virtual Link Trunking interconnect (VLTi) heartbeat uses the management interface on the back of the PowerSwitch S5248F-ON switch. Each S5248F-ON switch is connected to the S4148T-ON switch with a Cat 5e Ethernet network cable. To configure the management interface, enter configuration mode on each switch and follow these steps:

1. Configure the management port by running the following commands:

   SW1(config)# interface mgmt 1/1
   SW1(conf-if-ma-1/1/1)# no ip address dhcp
   SW1(conf-if-ma-1/1/1)# ip address 172.90.100.252/24
   SW2(conf-if-ma-1/1/1)# no ip address dhcp
   SW2(conf-if-ma-1/1/1)# ip address 172.90.100.253/24
   SW1(conf-if-ma-1/1/1)# exit

2. Enable STP by running the following commands.

   Caution: Ensure that the personnel who are responsible for network management in your environment have reviewed the configuration for STP. Incorrect settings might cause network issues. The values that are provided here are examples only.

   SW1(config)# spanning-tree mode rstp
   SW1(config)# spanning-tree rstp priority 16384
   SW2(config)# spanning-tree mode rstp
   SW2(config)# spanning-tree rstp priority 32768

Configure the VLANs

This section describes how to configure the VLANs on the S5248F-ON switches. The examples show how to configure each VLAN in the site survey. Server NIC ports 1 and 2 are used for all traffic. If your configuration does not use spine/leaf network architecture or if you do not want VLAN traffic to be routed by the S5248F-ON switches, skip the commands in **bold italics**.

Follow these steps on each S5248-ON switch:

1. Configure the OOB VLAN:

   SW1(config)# interface vlan 100
   SW1(conf-if-vl-100)# description “Out-Of-Band VLAN”
   **SW1(config-if-vl-100)# ip address 172.90.100.252/24**
   SW1(conf-if-vl-100)# mtu 9000
   **SW1(config-if-vl-100)# vrrp-group 1**
   SW1(config-if-vl100-vrid-1)# virtual-address 172.90.100.254
   SW1(config-if-vl100-vrid-1)# exit
   SW1(config-if-vl-100)# no shutdown
   SW1(config-if-vl-100)# exit
   SW1(config)# do write
2. Configure the management VLAN:

```plaintext
SW1(config)# interface vlan 110
SW1(conf-if-vl-110)# description "Management VLAN"
SW1(conf-if-vl-110)# ip address 172.90.110.252/24
SW1(conf-if-vl-110)# mtu 9000
SW1(conf-if-vl-110)# vrrp-group 2
SW1(conf-if-vlan110-vrid-2)# virtual-address 172.90.110.254
SW1(conf-if-vlan110-vrid-2)# exit
SW1(conf-if-vl-110)# no shutdown
SW1(conf-if-vl-110)# exit
SW1(config)# do write
```

3. Configure the VM migration VLAN:

```plaintext
SW1(config)# interface vlan 120
SW1(conf-if-vl-120)# description "VM migration VLAN"
SW1(conf-if-vl-120)# ip address 172.90.120.252/24
SW1(conf-if-vl-120)# mtu 9000
SW1(conf-if-vl-120)# vrrp-group 3
SW1(conf-if-vlan120-vrid-3)# virtual-address 172.90.120.254
SW1(conf-if-vlan120-vrid-3)# exit
SW1(conf-if-vl-120)# no shutdown
SW1(conf-if-vl-120)# exit
SW1(config)# do write
```

4. Configure the DB Private VLAN:

```plaintext
SW1(config)# interface vlan 130
SW1(conf-if-vl-130)# description "DB Private VLAN"
SW1(conf-if-vl-130)# ip address 172.90.130.252/24
SW1(conf-if-vl-130)# mtu 9000
SW1(conf-if-vl-130)# vrrp-group 4
SW1(conf-if-vlan130-vrid-4)# virtual-address 172.90.130.254
SW1(conf-if-vlan130-vrid-4)# exit
SW1(conf-if-vl-130)# no shutdown
SW1(conf-if-vl-130)# exit
SW1(config)# do write
```

5. Configure the DB Public VLAN:

```plaintext
SW1(config)# interface vlan 140
SW1(conf-if-vl-140)# description "DB Public VLAN"
SW1(conf-if-vl-140)# ip address 172.90.140.252/24
SW1(conf-if-vl-140)# mtu 9000
SW1(conf-if-vl-140)# vrrp-group 5
SW1(conf-if-vlan140-vrid-5)# virtual-address 172.90.140.254
SW1(conf-if-vlan140-vrid-5)# exit
SW1(conf-if-vl-140)# no shutdown
SW1(conf-if-vl-140)# exit
SW1(config)# do write
```
6. To verify that all the settings have been recorded, review the configuration from enable mode by running the following command:

   SW1# show running-config

7. Repeat the preceding steps to configure the bottom S5248F-ON switch in the configuration.

Configure the VLTi ports

On each switch, configure the ports to be used for VLTi traffic as follows:

1. Run the following commands:

   SW1(config)# interface range ethernet 1/1/53-1/1/54
   SW1(conf-range-eth1/1/53-1/1/54)# description VLTi
   SW1(conf-range-eth1/1/53-1/1/54)# no switchport
   SW1(conf-range-eth1/1/53-1/1/54)# exit

2. Create the VLT domain and add the discovery interfaces:

   SW1(config)# vlt-domain 1
   SW1(conf-vlt-1)# backup destination 192.168.1.253
   SW2(conf-vlt-1)# backup destination 192.168.1.252
   SW1(conf-vlt-1)# discovery-interface ethernet 1/1/53-1/1/54
   SW1(conf-vlt-1)# do write memory

3. Ensure that the VLT domain is properly configured by running the following command in enable mode:

   SW1# show vlt 1 | find Status

   The following output is displayed:

   VLTi Link Status
   port-channel1000 : up
   VLT Peer
   Unit ID  System MAC Address  Status  IP Address    Version
   -----------------------------------------------
   1        54:bf:64:be:f7:40   up      192.168.1.253  2.0

4. Run the following commands to configure the ports that the servers are connected to on the switch.

   In this example, ports Ethernet 1/1/1 through Ethernet 1/1/16 are in use on each switch.

   SW1(config)# interface range ethernet 1/1/1-1/1/16
   SW1(conf-range-eth1/1/1-1/1/16)# no ip address
   SW1(conf-range-eth1/1/1-1/1/16)# mtu 9000
   SW1(conf-range-eth1/1/1-1/1/16)# switchport mode trunk
   SW1(conf-range-eth1/1/1-1/1/16)# switchport access vlan 100
   SW1(conf-range-eth1/1/1-1/1/16)# switchport trunk allowed
   vlan 110,120,130,140
   SW1(conf-range-eth1/1/1-1/1/16)# spanning-tree port type edge
   SW1(conf-range-eth1/1/1-1/1/16)# spanning-tree guard root
   SW1(conf-range-eth1/1/1-1/1/16)# no shutdown
5. Verify that the ports are configured correctly by running the following command:

```
SW1(conf-range-eth1/1/1-1/1/16)# show config
```

The output for each port is as follows:

```
interface ethernet1/1/1
  no shutdown
  switchport mode trunk
  switchport access vlan 100
  switchport trunk allowed vlan 110,120,130,140
  mtu 9000
  flowcontrol receive off
  spanning-tree guard root
  spanning-tree port type edge
```

Configure the port channel

The S4148T-ON switch connects to the network through the S5248F-ON switches using a port channel consisting of one interface on each S5248F-ON switch. On each switch, configure the port channel and port as follows:

1. Configure the port channel by running the following commands:

   ```
   SW1(config)# interface port-channel 101
   SW1(conf-if-po-101)# description "OOB uplink"
   SW1(conf-if-po-101)# no shutdown
   SW1(conf-if-po-101)# switchport mode trunk
   SW1(conf-if-po-101)# switchport trunk allowed vlan 100,110,120,130,140
   SW1(conf-if-po-101)# mtu 9000
   SW1(conf-if-po-101)# vlt-port-channel 101
   SW1(conf-if-po-101)# exit
   ```

2. Configure the port that will be used for the port channel by running the following commands:

   ```
   SW1(config)# port-group 1/1/12
   SW1(conf-pg-1/1/12)# mode Eth 10g-4x
   SW1(conf-pg-1/1/12)# exit
   SW1(config)# interface ethernet 1/1/48:1
   SW1(conf-if-eth1/1/48:1)# no shutdown
   SW1(conf-if-eth1/1/48:1)# description "OOB uplink"
   SW1(conf-if-eth1/1/48:1)# channel-group 101 mode active
   SW1(conf-if-eth1/1/48:1)# mtu 9000
   SW1(conf-if-eth1/1/48:1)# exit
   ```

---

1 You can further isolate port traffic by restricting which VLANs are allowed.
Configuring the Dell EMC PowerSwitch S4148T-ON switch

The S4148T-ON switch serves as the OOB management switch for the Ready Stack. You can use a single switch because this connectivity is not considered critical for workload operations.

Configure the S4148T-ON switch

1. Using the RJ45-to-serial-port cable that is included with your switch, connect one end of the cable to your workstation and the other end to the RS-232 console port of the switch, as shown in the following figure:

![RS-232 Console Port](image)

Figure 5. Serial port

2. Using terminal emulation software, configure the COM port:
   - 115200 baud rate
   - No parity/no flow control
   - 8 data bits/1 stop bit

3. When the connection is successful, enter configuration mode by running the following command:

   ```
   OS10# configure terminal
   ```

4. Configure the hostname and time zone, and set a username and password for EXEC mode by running the following commands:

   ```
   OS10(config)# hostname SWOOB
   SWOOB(config)# username <username> password <password> role sysadmin
   SWOOB(config)# clock timezone <timezone, example CST -6 0>
   ```

5. Configure routing to your default gateway, and save the configuration by running the following commands:

   ```
   SWOOB(config)# ip route 0.0.0.0/0 <core network gateway>
   SWOOB(config)# do write
   ```

Configure the VLANs

This section describes how to configure the VLANs on the S4148T-ON switch. The examples show how to configure each VLAN.

Follow these steps:

1. Configure the OOB VLAN:

   ```
   SWOOB(config)# interface vlan 100
   SWOOB(conf-if-vl-100)# description “out-of-band VLAN”
   ```
Chapter 3: Compute, Management, Network, and Data Protection Component Setup

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2. To verify that all the settings have been recorded, review the configuration by running the following command from enable mode:

   SWOOB# show running-config

Configure the management interface

Configure the ports that the management servers’ iDRAC cards are connected to on the switch. In this example, ports 1/1 to 1/3 are used for the management server’s iDRAC.

1. Run the following commands:

   SWOOB(config)# interface range ethernet 1/1/1-1/1/3
   SWOOB(conf-range-eth1/1/1-1/1/3)# no shutdown
   SWOOB(conf-range-eth1/1/1-1/1/3)# no ip address
   SWOOB(conf-range-eth1/1/1-1/1/3)# switchport access vlan 100
   SWOOB(conf-range-eth1/1/1-1/1/3)# spanning-tree port type edge
   SWOOB(conf-range-eth1/1/1-1/1/3)# mtu 9000

2. Verify that the ports are properly configured by running the following command:

   SWOOB(conf-range-eth1/1-1/1/3)# show configuration

   The following output is displayed for each port:

   interface ethernet1/1/1
   no shutdown
   switchport access vlan 100
   mtu 9000
   flowcontrol receive on
   spanning-tree port type edge
   !
   ...

Configure the port channel and ports

The S4148T-ON switch connects to the network through the PowerSwitch S5248F-ON VLT domain using a port channel consisting of two 10 GbE ports on the S4148T-ON switch. To configure the port channel and ports:

1. Configure the OOB VLAN on the switch by running the following commands:

   SWOOB(config)# interface vlan 100
   SWOOB(conf-if-vl-100)# description “out-of-band VLAN”
   SWOOB(conf-if-vl-100)# no shutdown
   SWOOB(conf-if-vl-100)# ip address 172.90.100.25/24
   SWOOB(conf-if-vl-100)# mtu 9000
   SWOOB(conf-if-vl-100)# exit
   SWOOB(config)# do write
2. Create the port channel by running the following commands:

```
SWOOB(config)# interface port-channel 101
SWOOB(config-if-po-101)# description “OOB uplink”
SWOOB(config-if-po-101)# no shutdown
SWOOB(config-if-po-101)# switchport mode trunk
SWOOB(config-if-po-101)# switchport trunk allowed vlan 100
SWOOB(config-if-po-101)# mtu 9000
SWOOB(config-if-po-101)# exit
```

3. Configure the ports that will be used for the port channel by running the following commands:

```
SWOOB(config)# interface range ethernet 1/1/49-1/1/50
SWOOB(conf-range-eth1/1/49-1/1/50)# description “OOB uplink”
SWOOB(conf-range-eth1/1/49-1/1/50)# no shutdown
SWOOB(conf-range-eth1/1/49-1/1/50)# channel-group 101 mode active
SWOOB(conf-range-eth1/1/49-1/1/50)# mtu 9000
SWOOB(conf-range-eth1/1/49-1/1/50)# exit
```

4. Verify that the port channel to the S5248F-ON switch is up by running the following command:

```
SW00B# show interface port-channel summary
LAG  Mode      Status Uptime  Ports
 10   L2-HYBRID up     2 days  Eth 1/1/49 (Up) Eth 1/1/50 (Up)
```

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

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

Although you can install ESXi locally or remotely, this section describes how to install it 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 deploy vCenter Server Appliance on the management server, follow the procedures in this section to:

1. Ensure that you have met the prerequisites to complete the installation and deployment.
2. Mount the ESXi image.
3. Install ESXi.
4. Configure the ESXi management network.
5. Deploy vCenter Server Appliance.
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To complete the procedures in this section, you need:

- iDRAC IP addresses or FQDNs
- iDRAC credentials
- iDRAC Enterprise license applied on all nodes
- Dell EMC customized ESXi 6.7 image

For information about downloading the image, see [VMware vSphere ESXi 6.7.x on Dell EMC PowerEdge Systems Image Customization Information](#). Note the image location on your system for your use when you mount the virtual media. The location must be available while you install ESXi on all the servers.

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

### Prerequisites

Mounting the ESXi image

Mount the customized ESXi 6.7 ISO 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

   Next to *Virtual Console Preview*, click *Launch* to open the remote console, and 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 6.7 ISO image:
   a. Select *Virtual Media*, and then select *Map CD/DVD*.
   b. Click *Browse* and locate the customized ESXi 6.7 ISO image, select the image, and then click *Open*.
6. On the *Virtual Media – Map CD/DVD* page, click *Map Device*.
7. From the Virtual Console menu bar, select *Next Boot > Virtual CD/DVD/ISO*.
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 has been mounted.
Chapter 3: Compute, Management, Network, and Data Protection Component Setup

**Installing ESXi**

Install ESXi:

1. In the iDRAC Virtual Console, on the **Welcome to VMware ESXi 6.7.0 Installation** page, 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:

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

   **Figure 6. Selecting the installation disk**

4. If an **ESXi Found** message is displayed, use the cursor keys to select **Install**, press the spacebar, and then press Enter to perform a fresh installation.

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

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

7. At **Confirm Install**, press F11 to install ESXi 6.7.

8. When the installation is completed, 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.

**Configuring the ESXi management network**

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**, enter 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 7. Status of network adapters*

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 page.

6. Select **VLAN (optional)** from the menu, and then press Enter.

7. On the **VLAN (optional)** page, enter the VLAN ID for the management network and press Enter.

8. Select **IPv4 Configuration** and press Enter.

9. On the **IPv4 Configuration** page, select **Set static IPv4 address and network configuration**, and then press the spacebar.

10. Enter 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** page, enter 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 the changes and restart the management network.

15. Select **Test Management Network**.

    The **Test Management Network** page displays the items that will be tested.
Deploying vCenter Server Appliance

This section describes how to deploy vCenter Server Appliance with an embedded Platform Services Controller.

Prerequisites

To deploy vCenter Server Appliance, you need:

- 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 IP address that is fully resolvable (forward and reverse lookup) by DNS

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, go to \vcsa-udi-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.
Chapter 3: Compute, Management, Network, and Data Protection Component Setup

8. Enter the requested information for the first management host, as indicated in the following figure:

   ![Management host details](image)

   **Figure 9. 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**, enter 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 page 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, enter 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, enter the NTP server information, and click **Next**.

19. Enter 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 then 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. The recommended configuration ensures that a path is always available for the 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 storage controllers after the recommended zoning configurations are created on the redundant FC switches. It shows the logical view of the two-node production database environment. We use the same design and configuration for the XVC database and the virtual database servers.

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, as shown in the following figure:

![Logical Connectivity View](image)

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.

   For example:
   ```
   DS6620B_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 server environment (physical).
   - **N1** represents the node number (node 1).
   ```
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:

```
```

where:

- \textit{XIOX2} represents XtremIO X2.
- \textit{X2} represents X-Brick number 2.
- \textit{SC2} represents the controller number 2.
- \textit{P3} represents the port number on the front-end HBA within the controller.

As shown in Figure 10, 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 create four front-end XtremIO FC port or target aliases on each FC switch.

3. Create zone sets.

As shown in Figure 10, 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:

```
DS6620B_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:

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

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 create two zone sets per database server. In this solution, because we have four database servers, we create eight zone sets per FC.

4. Run the \texttt{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:

```
DS6620B_U36:admin> cfgcreate "DBZONE_RS-DB-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;"
```

On each FC, switch we create two zone sets per database server. Because this solution has four database servers, the zone configuration for each FC switch contains eight zone sets, as shown in this example.

6. Enable the zone configuration as follows:

```
DS6620B_U36:admin> cfgenable DBZONE_RS-DB-XIOX2_CONFIG
```

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

### Setting up the Data Domain backup appliances

**Introduction**

This section provides the initialization and setup steps for the Data Domain DD6300 backup appliances that are used in the commercial and enterprise backup solutions.

**Initializing the Data Domain system**

**Accepting the End User License Agreement**

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.

Later, to redisplay and accept the EULA, run:

```
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 for initial system configuration and basic network connectivity.

---

**Note:** You can start the CLI configuration wizard manually by running the `config setup` command.

**Configuring the management network**

Configure the management network as follows:

1. At the Network Configuration prompt, type `yes` to configure the system for network connectivity.

2. At the Use DHCP prompt, type `yes` to configure DHCP (Dynamic Host Configuration Protocol) to dynamically obtain network parameters (such as, the
hostname, domain name, and IP addresses) from a DHCP server; otherwise, type no to configure the parameters manually.

3. At the following prompt, enter an FQDN for the hostname, or accept the hostname if the system discovered it:

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

4. At the following prompt, enter the Domain Name System (DNS) domain name—for example, yourcompany.com—or accept the domain name if the system discovered it:

   Domainname Enter your DNS domainname []:

5. At the following prompts, enable and configure each Ethernet interface, accepting or declining 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. In the next section, we set up the other ports by 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]:

6. At the following prompt, enter the IP address of the default routing gateway or accept the default gateway if the system discovered it:

   Default Gateway

   Enter the default gateway IP address:

   192.168.10.1

7. At the IPv6 Default Gateway prompt, enter the IPv6 address of the default routing gateway or accept the IPv6 address of the default gateway if the system discovered it. If IPv6 is not in use, leave the field empty, and press Enter to continue.

8. At the DNS Servers prompt, take one of the following actions:

   - Enter IP addresses for up to three DNS servers for resolving hostnames; for multiple addresses, use a comma-separated or space-separated list.
   - Enter a space for no DNS servers.
   - Accept the IP addresses of the DNS servers if the system discovered them.
9. When the summary of the network settings is displayed, take one of the following actions:

- Enter **Save** to accept the settings.
- Enter **Cancel** to reject the settings and exit to the CLI.
- Enter **Retry** to display your previous responses for each prompt; press Enter to accept the displayed value or enter a new value.

The following configuration is a generic example of the Data Domain hostname and network interfaces:

<table>
<thead>
<tr>
<th>Pending Network Settings</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hostname</td>
</tr>
<tr>
<td>Domain name</td>
</tr>
<tr>
<td>Default Gateway</td>
</tr>
<tr>
<td>DNS Server List</td>
</tr>
</tbody>
</table>

| Port Enable 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     |
| ethMa | yes    | yes | no   | 192.168.10.181 | 255.255.255.0|
| ethMb | no     | no  | n/a  | n/a     | n/a     |
| ethMc | no     | no  | n/a  | n/a     | n/a     |
| ethMd | no     | no  | n/a  | n/a     | n/a     |
| ethMe | no     | no  | n/a  | n/a     | n/a     |
| ethMF | no     | no  | n/a  | n/a     | n/a     |

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

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

11. Open a browser and enter the newly configured management IP address to continue the setup using the Data Domain management UI.

**Using the Data Domain management UI to set up licenses and back up the network**

1. Log in to the Data Domain web UI.
2. On the **Licenses** page of the Configuration wizard, when asked if you want to configure the licenses, click **Yes** to set up the licenses or **No** to skip the setup.
3. On the **Network** page, click **Yes** to configure the network, which is used for the database backup.
4. On the **General** page under **Network**, select **Manually Configure**, and enter the hostname, domain name, and gateway, as shown in the example in the following figure:

![Figure 11. Network configuration](image)

5. On the **Interfaces** page under **Network**, enable the interface that you are using for your backup network and provide a static IP and netmask, as shown in the following example:

![Figure 12. Interface settings](image)

In our solution, we used two interfaces, *eth3a* and *eth3b*. The interfaces must be on the same subnet as your public IP address for the Data Domain appliance to communicate with the database servers.

6. On the **DNS** page under **Network**, select or enter your DNS, and then click **Next**.
7. On the Summary page under Network, review the summary and click Submit to update the network settings.

![Network settings summary](image)

Figure 13. Network settings summary

8. Do not configure anything else. Click No when prompted to configure the file system, system settings, and so on.

**Enabling the file system**

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:

   ```bash
   sysadmin@DD6300# filesystem enable
   Please wait...
The filesystem is already enabled.
The filesystem is now enabled.
   ```

2. Verify that the file system is enabled:

   ```bash
   sysadmin@DD6300# filesystem show space
   ```
Enabling DD Boost software

To enable DD Boost software, on the side panel in the Data Domain UI, go to Protocols > DD Boost and click Enable.

The following figure shows that the DD Boost software is enabled:

![Data Domain System Manager showing DD Boost status](image)

Figure 14. Data Domain System Manager showing DD Boost status

Add Interface Groups

After you enable DD Boost for Enterprise Applications, add Interface Groups:

1. Go to the IP Network tab and select the default Interface Groups.
2. Add the IP addresses of the interfaces to which you previously assigned IP addresses.

The following figure shows the interfaces:

![IP network addresses for interfaces](image)

Figure 15. IP network addresses for interfaces
Chapter 4: Production Database Environment Setup

This chapter presents the following topics:

- Overview of production database environment setup ........................................49
- Configuring XtremIO storage .............................................................................49
- Setting up the database servers ........................................................................50
Overview of production database environment setup

This chapter describes the necessary steps to configure the production database environment. The production database environment consists of a two-node DBMS cluster running a single, shared database instance. The underlying operating systems are deployed on bare-metal hosts. The design is not DBMS-specific or operating-system-specific and can be deployed using any combination of supported configurations. The goal of this Ready Stack solution is to demonstrate a mixed workload environment, from an operating system perspective (physical and virtual deployments), a DMBS workload perspective (OLTP and OLAP), and a storage perspective (production database instances combined with snapshot-based database instances). This highly mixed environment demonstrates the consolidation capabilities of the platform.

Deployment of the two-node production database in a physical environment consists of the following tasks:

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

2. Set up the database servers:
   a. Prepare PowerEdge servers.
   b. Configure operating system, network, and storage volumes.
   c. Install the DBMS application, and create the database.

Configuring XtremIO storage

In this environment setup, the 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.

**Note:** For detailed steps to create the Initiator Groups, volumes, and mappings that are based on the previously described design for the production database environment, see Appendix A.

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

   Record the four unique World Wide Names (WWNs) 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.
Chapter 4: Production Database Environment Setup

2. Create dedicated storage volumes for the clustered database, which includes separate volumes for OCR, DATA, REDO, FRA, and TEMP.²

The following table shows the XtremIO volume design for this two-node 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 production database volumes to the two database servers by mapping the volumes that you created in step 2 to the two Initiator Groups that you created in step 1.

Setting up the database servers

Introduction

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

1. Configure the operating system, network, and storage.
2. Deploy the cluster and database.

Configuring operating system, network, and storage

In this use case, we deployed Red Hat Enterprise Linux 7.4 as the bare-metal operating system to test the production database in a physical environment.

The following steps provide a high-level overview of the detailed steps:

1. Install Red Hat Enterprise Linux 7.4 with base packages.
2. Register the server with Red Hat Network (RHN) and set up the local yum repository by using the Red Hat Enterprise Linux ISO CD.
3. Download and install any applicable DBMS preinstallation deployment RPMs for Red Hat Enterprise Linux 7.
4. Set up the DBMS software prerequisites, such as the required operating system RPMs, users, groups, and kernel parameters.
5. Set up the DBMS public and private network.
6. Set up entries for DBMS 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.

² Volume requirements vary, depending on the DBMS being deployed.
7. Prepare and configure the XtremIO X2 disks or volumes for the DBMS software installation.
   a. Set up multipathing by using the native device mapper.
   b. Partition the disks.
   c. Set up udev rules.

Additional best practices in an XtremIO environment

In the two production database servers, we applied the configuration best practices that are described in this section.

Note: In our test environment, we applied best practices in accordance with the information in the Dell EMC XtremIO Storage Array Host Configuration Guide. See that guide for details about how to apply the best practices when using XtremIO storage 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 26. HBA queue depth settings in Linux-based servers

<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 Red Hat Enterprise Linux operating system 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 Red Hat Enterprise Linux 7.4.

Multipath configuration

We configured the physical database servers by using Linux Native Multipathing available within the Red Hat Enterprise Linux 7.4 operating system. 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
  }
}
```
Chapter 4: Production Database Environment Setup

Deployment Guide

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.

Deploying the cluster and database

This solution supports a two-node production database environment. See your DBMS vendor documentation for detailed installation procedures. While installation, configuration requirements, and deployment steps vary, depending on the DBMS, the general deployment procedures are as follows:

1. Before installing the DBMS cluster and database, ensure that you have configured the operating system, network, and storage prerequisites as described in Configuring operating system, network, and storage.

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

3. Install and configure the cluster by locating the media kit and running the cluster installer on the first database node.
   a. Select and configure a stand-alone cluster, and choose the public, private, SCAN, and VIP networks that you previously configured.
   b. Add the two database servers to the cluster.
   c. Create and configure any disk groups for quorum voting disks, based on availability requirements.
   d. Run any applicable post-installation scripts.

4. Install and configure the database by locating the media kit and running the database installer on the first database node.
   a. Install the database software and applicable options.
   b. Select the two database servers to be part of the two-node database.
   c. Select the privileged operating system groups that were created automatically by the Dell EMC preinstallation deployment RPMs that you downloaded and installed in the previous section, Configuring operating system, network, and storage.
   d. Run any applicable post-installation scripts.

5. Create any applicable disk groups by using the appropriate utility:
   a. For each of the disk groups, choose the appropriate XtremIO volumes or disks that were described and configured in the previous section.
   b. If applicable, specify the disk group redundancy options.
6. If applicable, change the striping type for system disk groups, based on vendor guidance.

7. Create the seed database by using the appropriate DBMS utility:
   a. Select the database type as clustered and use a general-purpose or transaction-processing template.
   b. Select the two nodes that contain the installed database software and specify the name for the database and its instance.
   c. Select the file storage type and the file location for the disk groups that were created in step 5.
   d. Configure database memory sizes, as needed.
   e. Configure any appropriate storage options such as log groups.

The following table shows the recommended redo log groups:

<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 of virtual database environment setup** ........................................... 55
- **Configuring XtremIO storage in the virtual database environment** ............... 55
- **LAN and SAN connectivity in the virtual database environment** ................... 56
- **Setting up the ESXi database server** ............................................................... 56
- **Configuring the guest operating systems and databases** ............................. 66
Overview of virtual database environment setup

This chapter describes the steps that are required to configure the environment for two OLTP database instances that are running in separate VMware 6.7 VMs, which are on a single PowerEdge R940 server. The vCenter instance running on the R640 management server manages the VMs.

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

1. Configure XtremIO storage:
   a. Create the Initiator Group.
   b. Create the storage volumes.
   c. Map the storage volumes to the ESXi host.
2. Set up the LAN and SAN switches:
   a. Configure redundant ToR 10 GbE switches.
   b. Configure redundant 16 Gbps SAN FC switches, including zoning.
3. Set up the ESXi host, network, VMs, and storage:
   a. Prepare the PowerEdge server.
   b. Install and configure ESXi on the database server.
   c. Create a vSphere data center, including adding the ESXi database host.
   d. Configure a vSphere Distributed Switch.
   e. Configure datastores.
   f. Create VMs for the databases.
   g. Set up networking for ESXi hosts and VMs.
   h. Prepare storage disks for the databases.
4. Configure the guest operating system and databases.

Configuring XtremIO storage in the virtual database environment

In this environment setup, the two virtual databases run within two separate VMs hosted on a single R940-based 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 array, configure the storage that is based on the design for the physical database environment as follows.

Note: For detailed steps to create the Initiator Groups, volumes, and mappings that are based on the previously described design for the production database environment, see Appendix A.
Chapter 5: Virtual Database Environment Setup

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

2. Create storage volumes that are shared by both the virtual databases, which include volumes for the guest operating system and database (OCR, DATA, REDO, FRA, and TEMP). The following table shows the XtremIO volume design for the two databases in the virtual database environment:

<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 database volumes to the ESXi host by mapping the volumes that you created in step 2 to the single Initiator Group that you created in step 1.

LAN and SAN connectivity in the virtual database environment

In the virtual environment consisting of a single ESXi host, the redundant Dell EMC Networking S5248F-ON ToR 10 GbE switches provide the public network connectivity to and from the virtual databases.

The Dell EMC Connectrix DS-6620-B switch provides SAN connectivity between the single ESXi virtual database server and the XtremIO X2 storage array.

Setting up the ESXi database server

Prerequisite

Before you set up the ESXi database server, ensure that the vCenter Server Appliance VM is installed and set up on the management server. This setup is required to connect to the vSphere Web Client to perform the tasks in this section.

Introduction

To set up the ESXi database server, follow the procedures in this section to:

1. Install and configure ESXi.
2. Create a vSphere data center.
3. Add the ESXi database host to the vSphere data center.
4. Configure a vSphere Distributed Switch.
5. Configure datastores.
6. Create VMs for the databases.
7. Set up networking for ESXi hosts and VMs.
8. Prepare storage disks for databases.

On the R940-based virtual database server, install ESXi 6.7 U3 by repeating the procedures in Installing ESXi and deploying vCenter Server Appliance on the management server. However, disregard the section about deploying vCenter Server Appliance because it has already been installed. Installing vCenter Server Appliance again on the virtual database server is unnecessary.

Additional best practices in an XtremIO environment

When ESXi 6.7 U3 was installed on the database server, we applied the following applicable best practices for our virtual environment.

**Note:** In our test environment, we applied best practices in accordance with the information in the Dell EMC XtremIO Storage Array Host Configuration Guide. See that guide for the complete list of best practices for XtremIO in a VMware ESXi host environment and for details about how to apply them.

HBA queue depth settings

The following table lists the default and recommended HBA queue depth settings for ESXi 6.7 U3 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, Emulex: 30</td>
<td>QLogic: 256</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Emulex: 128</td>
</tr>
<tr>
<td>HBA Queue Depth</td>
<td>QLogic: Not applicable,</td>
<td>QLogic: Not applicable</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 that we used in our virtualized database 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 so the setting is not relevant when you are configuring a vSphere host with QLogic HBAs.

Multipath configuration

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

- 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 (1,000 I/O packets) to 1.
Note: In ESXi 6.7 U3, the default path selection policy is round-robin and the default path switching frequency is 1. Therefore, no change was needed in our virtualized database server.

Host parameter settings
Configure the following ESXi host parameters:

- **Disk.SchedNumReqOutstanding**—Determines the maximum number of active storage commands (I/O) that are allowed at any given time at the VMkernel. For each XtremIO volume that is presented to the ESXi host, set this parameter to the recommended value of 256 by running the following CLI commands on the ESXi 6.7 U3 host:
  
  a. To get the list of all XtremIO volumes:

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

  b. 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 preceding command.

- **Disk.SchedQuantum**—Determines the maximum consecutive sequential I/O that is allowed before switching from one VM to another VM. Change this value to 64.

Creating a vSphere data center

To create the data center and cluster containers inside vSphere:

1. Open a web browser and connect to the vSphere Web Client as follows, using the vCenter Server Appliance IP address:

   ```
   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. On the navigator menu, right-click the top-level vCenter Server Administrator object and click **New Datacenter**.

5. Enter the name for the data center and click **OK**.

Adding hosts to vCenter

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

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 data center object and select **Add host**.

5. Enter the DNS name or IP address that is assigned to the virtual database server and complete the remainder of the wizard.
VDS provides centralized VM network administration. In VDS, virtual switches of each ESXi host are abstracted into a large pool and spread across multiple ESXi hosts within the data center.

**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 the environment by using multiple ESXi hosts, if needed.

To configure a VDS:

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

The following table describes the distributed switches and port groups for the basic virtual network infrastructure for the databases:

<table>
<thead>
<tr>
<th>Distributed switch name</th>
<th>Distributed port group names</th>
<th>Purpose</th>
</tr>
</thead>
<tbody>
<tr>
<td>DBPub</td>
<td>DBPublic</td>
<td>Interfaces for the database public and backup and recovery network</td>
</tr>
<tr>
<td></td>
<td>vMotion*</td>
<td>Interfaces for vSphere vMotion activity</td>
</tr>
<tr>
<td></td>
<td>DBPub-DVUplinks-61</td>
<td>Connection for two 10 GbE physical ports that the database public, vMotion, and backup and recovery traffic share on each ESXi host</td>
</tr>
</tbody>
</table>

* A vMotion network is used for a solution with multiple ESXi hosts and is not required for this solution. If you add more ESXi hosts later, then you can use vMotion to migrate the VMs among the hosts.

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

### Creating distributed switches

Create a VDS on VMware vSphere 6.7 U3 or later as follows:

1. In the vSphere Web Client navigator, right-click the data center name and select **Distributed Switch > New Distributed Switch**.
2. At **Name and location**, enter a name for the VDS (DBPub) and click **Next**.
3. At **Select version**, select **Distributed Switch 6.7.0** 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 then click **Next**.
   d. At the **Ready to complete page**, review the settings and click **Finish**.
Chapter 5: Virtual Database Environment Setup

Creating port groups
After you create distributed switches, create port groups:

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

   Note: We set VLAN ID 16 for DBPublic (database public and backup and recovery traffic) and VLAN ID 99 for vMotion distributed port groups. The two uplink ports that are shared by DBPublic and vMotion distributed port groups were also tagged with the same VLAN ID 16 and 99 on the two ToR S5248F-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:
   vMotion on DBPub

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 6.7 U3:

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:

   ![Figure 16. Creating a datastore](image)
Chapter 5: Virtual Database Environment Setup

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

2. Repeat the preceding steps to create additional datastores.

The following table provides the details of the datastore design in the virtual database environment:

<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 datastore for the 2 guest operating systems (xorb-virt-1 and xorb-virt-2). Each guest operating system Virtual Machine Disk (VMDK) is 250 GB.</td>
</tr>
<tr>
<td>C3-OCR1</td>
<td>100</td>
<td>3 datastores for a cluster voting disk of virtualized databases. Each VMDK is 48 GB.</td>
</tr>
<tr>
<td>C3-OCR2</td>
<td>100</td>
<td></td>
</tr>
<tr>
<td>C3-OCR3</td>
<td>100</td>
<td></td>
</tr>
<tr>
<td>C3-DATA1</td>
<td>600</td>
<td>4 datastores for data disks in virtualized databases. Each 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 datastores for redo disks in virtualized databases. Each 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 datastore for recovery disks in virtualized databases. Each VMDK is 98 GB.</td>
</tr>
<tr>
<td>C3-TEMP</td>
<td>500</td>
<td>1 datastore for temp disks in virtualized databases. Each VMDK is 248 GB.</td>
</tr>
</tbody>
</table>

3. Datastore requirements vary, depending on DBMS.

Create the two database VMs:

1. In vSphere Web Client, create a VM (VM1) on your ESXi host, as shown in the following figure:
Chapter 5: Virtual Database Environment Setup

Figure 17. Creating a VM

2. Select your ISO image, and configure the VM.

The following table shows the specific guest operating system and VM settings for both VMs. We left all values set to the default except the values that are specified in the table.

Table 32. VM settings for virtual databases

<table>
<thead>
<tr>
<th>VM setting</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Guest operating system</td>
<td>Red Hat Enterprise Linux 7.4</td>
</tr>
<tr>
<td>Virtual CPU (vCPU) count</td>
<td>18</td>
</tr>
<tr>
<td>Virtual Memory (vMem) (GB)</td>
<td>140</td>
</tr>
<tr>
<td>vMem Reservation (GB)</td>
<td>120</td>
</tr>
<tr>
<td>OS Hard Disk 1 Size (GB)</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 DBPub VDS and click Add and Manage Hosts.
   a. Select Add hosts, and then 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:

```
<table>
<thead>
<tr>
<th>Uplink</th>
<th>Assigned Adapter</th>
</tr>
</thead>
<tbody>
<tr>
<td>Uplink 1</td>
<td>--</td>
</tr>
<tr>
<td>Uplink 2</td>
<td>--</td>
</tr>
<tr>
<td>Uplink 3</td>
<td>--</td>
</tr>
<tr>
<td>Uplink 4</td>
<td>--</td>
</tr>
<tr>
<td>(Auto-assign)</td>
<td></td>
</tr>
</tbody>
</table>
```

Figure 18. 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 uplink 2.

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 in the following figure:
Chapter 5: Virtual Database Environment Setup

Figure 19. Selecting the port group

ii Click OK, and then click Next.

iii At Port group properties, select VMotion traffic and click Next.

iv Select Use Static IPV4 settings, provide the details, and then click Finish.

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.

      Choose the DBPublic distributed port group that was created for the database public traffic.

4. Click OK to add the network adapters.
Set up volumes and hard disks for VM1:

1. In the vSphere Web Client, go to the host, right-click the VM, and select **Edit settings**.

2. Add a SCSI controller 1 with the following settings:

   ![New SCSI controller settings](image)

   **Figure 20. New SCSI controller settings**

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

4. Add hard disks for VM1:
   b. Select **Add**.
   c. Expand **New hard disk** and browse to the datastore location.
   d. Set the 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 operating system disk</td>
<td>1</td>
</tr>
<tr>
<td>SCSI 1:0 to 1:3</td>
<td>Standalone database DATA1–4 disks</td>
<td>4</td>
</tr>
<tr>
<td>SCSI 2:0 to 2:1</td>
<td>Standalone database REDO1–24 disks</td>
<td>2</td>
</tr>
<tr>
<td>SCSI 3:0 to 3:4</td>
<td>Standalone database OCR1–3, FRA1, and TEMP1</td>
<td>5</td>
</tr>
<tr>
<td></td>
<td><strong>Total</strong></td>
<td><strong>12</strong></td>
</tr>
</tbody>
</table>

   h. Repeat steps a through g to add more hard disks for this VM, with the sizes that are specified in **Table 31**.

Set up volumes and hard disks for VM2:

1. Repeat steps 1 through 3 in the previous section to create SCSI controllers for your VM by using the same design as provided in **Table 33**.
Chapter 5: Virtual Database Environment Setup

2. Add hard disks for VM2:
   a. Select **New Hard Disk**.
   b. Select **Add**.
   c. Expand **New Hard disk** and browse to the **Datastore location** (the same datastore as used for VM1).
   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 33.
   h. Repeat steps a through g to add more hard disks for this VM, with the sizes that are specified in Table 31.

Configuring the guest operating systems and databases

**Configuring the guest operating systems**

Configure the guest operating systems as follows:

1. Install Red Hat Enterprise Linux 7.4 with base packages in the VMs.
2. In both VMs, register RHN or set up the local yum repository by using the Red Hat Enterprise Linux ISO CD.
3. Set up the database software prerequisites (required operating system RPMs, users, groups, kernel parameters, and so on).
4. Set up the database public network.

   **Note:** The virtual network interface enumeration starts with *ens* in the Red Hat Enterprise Linux 7 guest operating system.

5. In the two VMs, prepare and configure the XtremIO X2 VDs for the database software installation:
   a. Partition the disks.
   b. Set up *udev* rules.

**Guest operating system best practices in the XtremIO environment**

The following additional best practices are recommended and implemented in the Red Hat Enterprise Linux based guest operating systems running inside the two database VMs.

   **Note:** In our test environment, we applied best practices in accordance with the information in the *Dell EMC XtremIO Storage Array Host Configuration Guide*. Refer to that guide for details about how to apply the best practices when using XtremIO storage in a Linux environment.

---

4 For VM2 VMDKs, share the same datastore as specified for VM1.
**PVSCSI driver**

For optimal XtremIO X2 storage performance in a VMware environment, we recommend using VMware Paravirtual SCSI (PVSCSI) controllers and the PVSCSI driver in the guest VMs. We ensured that the in-box Red Hat Enterprise Linux `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 recommended `vmw_pvscsi` parameter settings:

<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 7: 254</td>
<td>RHEL 7: 254</td>
</tr>
<tr>
<td><code>vmw_pvscsi.ring_pages</code></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 `/etc/default/grub` file for the Red Hat Enterprise Linux 7 based guest operating system.

---

### Setting up the virtual databases

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

1. Before installing the database, ensure that you have configured the operating system, network, and storage prerequisites as described in Configuring the guest operating systems and databases.
2. Configure and synchronize the system clock settings.
3. Locate the DBMS media kit and run the appropriate installer inside the respective virtual database VM.
   a. Install the database software only with the single instance database installation options.
   b. Select the appropriate privileged operating system groups that were automatically created by the Dell EMC preinstallation deployment RPMs.
4. If using application disk management, create disk groups for the database volumes by using the appropriate utility:
   a. For each of the disk groups, choose the appropriate XtremIO VDs that were configured in Configuring the guest operating systems.
   b. Select a disk group redundancy level.
5. Select the striping type for disk groups (we chose striping: fine-grained).
6. Create the seed database by using the appropriate utility:

---

5 The installation procedure varies, depending on the DBMS being deployed. See your product documentation for details.
Chapter 5: Virtual Database Environment Setup

7. Set up the log groups based on the following recommended design:

Table 35. Recommended design of redo log groups

<table>
<thead>
<tr>
<th>Redo log group number</th>
<th>Thread number</th>
<th>Disk group 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>

a. Select a single-instance database type and specify it as General Purpose or Transaction Processing.

b. For the seed database and recovery storage options, select the file storage type and the file location of the corresponding disk groups that were created in step 5.

c. Configure database engine parameters, as needed.
Chapter 6 XtremIO Virtual Copy Database Environment Setup

This chapter presents the following topics:

- Overview of XVC database environment setup ............................................... 70
- Configuring XtremIO storage in the XVC database environment .................... 71
- LAN and SAN connectivity in the XVC database environment ....................... 72
- Configuring the XVC database server ............................................................ 72
- Taking XVC snapshots of the PROD database .............................................. 73
- Creating a snapshot database on the XVC server ......................................... 75
Overview of XVC database environment setup

This chapter describes the steps that are required to deploy and configure the stand-alone OLAP and OLTP databases, which were created from snapshots that were taken and managed by XVC. XVC enables instant, highly efficient database copies that can then be mounted and used as normal database instances.

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

1. Configure XtremIO storage:
   a. Create an Initiator Group.
   b. Create non-snapshot volumes.
   c. Map non-snapshot volumes to the XVC database server.

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

3. Configure the XVC database server:
   a. Prepare the PowerEdge server.
   b. Configure the operating system, network, and storage.
   c. Install the DBMS and database.

4. Take an 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.\(^6\)
   f. Re-create any DBMS system files as required.

---

\(^6\) The specific steps depend on the DBMS that is being installed.
Configuring XtremIO storage in the XVC database environment

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 array, configure the storage 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.
   Record the four unique WWNs of the four HBA initiators in the R740 database server for use when you create the Initiator Group on the XtremIO storage array.

2. Install the DBMS and database.

3. Mount the snapshot database volumes.

4. Create a few non-snapshot volumes on XtremIO to set up the prerequisite environment for the two databases.

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

The following table shows both snapshot and non-snapshot 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>Name* (prefix)</th>
<th>Quantity</th>
<th>Size per volume (GB)</th>
<th>Total size (GB)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Snapshot volumes of PROD for the DEV XVC database</td>
<td>DATA</td>
<td>4</td>
<td>300</td>
<td>1,200</td>
</tr>
<tr>
<td></td>
<td></td>
<td>REDO</td>
<td>2</td>
<td>100</td>
<td>200</td>
</tr>
<tr>
<td></td>
<td></td>
<td>FRA</td>
<td>1</td>
<td>200</td>
<td>200</td>
</tr>
<tr>
<td></td>
<td>Snapshot volumes of PROD for the OLAP XVC database</td>
<td>DATA</td>
<td>4</td>
<td>300</td>
<td>1,200</td>
</tr>
<tr>
<td></td>
<td></td>
<td>REDO</td>
<td>2</td>
<td>100</td>
<td>200</td>
</tr>
<tr>
<td></td>
<td></td>
<td>FRA</td>
<td>1</td>
<td>200</td>
<td>200</td>
</tr>
<tr>
<td></td>
<td>Non-snapshot volumes shared by both XVC databases</td>
<td>Not applicable</td>
<td>OCR</td>
<td>3</td>
<td>50</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Not applicable</td>
<td>TEMP</td>
<td>1</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.
5. Map the non-snapshot volumes to the XVC database server by mapping the volumes that you created in step 4 to the single Initiator Group that you created in step 1.

For detailed steps to create the Initiator Group, volumes, and mappings that are based on the preceding design for the XVC database environment, see Appendix A.

LAN and SAN connectivity in the XVC database environment

In the XVC database environment, the redundant Dell EMC Networking S5248F-ON ToR 10 GbE switches provide database public network connectivity to and from the two XVC databases.

Dell EMC Connectrix DS-6620-B switches provide the SAN connectivity between the single-node XVC database server and the XtremIO X2 storage array.

Configuring the XVC database server

Preparing the PowerEdge server

To set up the PowerEdge database server, see Preparing the PowerEdge servers.

Configuring operating system, network, and storage

We used Red Hat Enterprise Linux 7.4 as the bare-metal operating system to test the single-node XVC database in a physical environment, as described in Configuring operating system, network, and storage.

Additional best practices in an XtremIO environment

Additional configuration best practices for the host operating system that are implemented in the XVC database server are the same as the best practices that are implemented in the production database servers. For details, see Configuring operating system, network, and storage.

Installing the database

For this solution, we deployed a single-node stand-alone database software to test the XVC snapshot copy of the production database.

In this configuration, we create only the required (OCR and TEMP) disk groups. The remaining database volumes are based on the XVC snapshots of the PROD database volumes.
Taking XVC snapshots of the PROD database

To take XVC snapshots of the PROD database, follow the procedures in this section to:

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.

To maintain consistency among the database files when taking the XVC snapshot of the production database, put all database volumes into one consistency group as follows:

1. Log in to the XtremIO management console.
2. From the management console, click the Configuration tab, click Consistency Groups, and then click the New(+) icon.
3. In the New Consistency Group window:
   a. Enter a consistency group name.
   b. Select all the source (PROD) database volumes where the database files are stored, as shown in the following figure:

   ![Figure 21. Specifying source database volumes](image)

   c. Click Apply.
Within a few seconds, the consistency group (CG_PROD in this instance) is created:

![Figure 22. New consistency group](image)

**Taking a snapshot of the consistency group**

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:
   a. Select the PROD database consistency group (CG_PROD in this instance) and click the Repurpose icon.
   b. In the Create Repurpose Copy window, specify the new Consistency Group Name (for example, CG_DEV for the DEV_XVC database), and click Apply.

The repurpose copy (CG_DEV) of CG_PROD is created instantly. CG_DEV itself is a consistency group that consists of seven snapshot volumes of the corresponding seven PROD database volumes, as shown in the following figure:

![Figure 23. Snapshot (repurpose copy) of consistency group](image)
To map the consistency group to the XVC server:

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

2. Select the Initiator 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:

   ![Figure 24. Consistency group mapping](image)

4. Repeat the steps in **Taking a snapshot of the consistency group** and **Mapping the consistency group to the XVC server** for the second snapshot database OLAP XVC.

### Creating a snapshot database on the XVC server

#### Introduction

This section describes the steps to mount the XVC snapshots of the PROD database volumes that you created previously. The steps that are provided in this section apply to both XVC databases, although we use XVC DEV as the database example.

#### Configuring multipath and udev rules

Perform the following steps as the **root** user to detect the snapshot volumes, configure the multipath, and create the udev rules:

1. Detect the snapshot volumes by running the following command, which rescans the SCSI bus on the XVC database server:

   ```bash
   [root#] rescan-scsi-bus.sh
   ```
Chapter 6: XtremIO Virtual Copy Database Environment Setup

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

   **Note:** For each device, the WWID is \( 3 < NAA \text{ Identifier} \). In this example, the WWID of `C2_DATA11_DEV` is `3514f0c5a4c200090` and the NAA Identifier is `514f0c5a4c200090`.

   ```
   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
   }
   ```

3. Reload the multipath configuration file:

   `[root#] service multipathd reload`

4. To set the proper database permissions to the snapshot devices, create a udev rules file `/etc/udev/rules.d/60-database.rules` and add an entry in the file for each snapshot device as follows:

   ```
   KERNEL="dm-*", ENV{DM_NAME}="C2_DATA11_DEV?", OWNER="dba", GROUP="dbadmin", MODE="0660"
   KERNEL="dm-*", ENV{DM_NAME}="C2_DATA12_DEV?", OWNER="dba", GROUP="dbadmin", MODE="0660"
   KERNEL="dm-*", ENV{DM_NAME}="C2_DATA13_DEV?", OWNER="dba", GROUP="dbadmin", MODE="0660"
   KERNEL="dm-*", ENV{DM_NAME}="C2_DATA14_DEV?", OWNER="dba", GROUP="dbadmin", MODE="0660"
   ```
Renaming and mounting disk groups and disks

Depending on the type of DBMS and features implemented, you might have to change the disk-mapping structures, including renaming and remounting. See your vendor documentation for information about how to use snapshot volumes for new database instances.

Depending on the DBMS being deployed, the process of mounting the snapshot volumes and preparing the databases might vary. The following steps are general instructions; consult your specific product documentation for details.

1. Prepare the new snapshot database environments as follows:
   a. Create the directory for any database audit files.
   b. Create or copy any necessary initialization parameter files from the PROD database.
   c. On the XVC database server, edit the files by modifying initialization file parameters with the updated values for cluster status, database name, and so on.

2. Mount the snapshot database using the appropriate user ID.

Changing the database file names

Change the database file names as follows:

1. Log in to the newly mounted snapshot database and determine the current datafiles and log file names.
2. Change the location of the database and log files to reflect the new disk group name and location.
3. Using the correct credentials, log in to the database to open the database.
4. Change the database name and DBID.
5. Update the database initialization/settings to reflect the new name.
   Reset/drop/re-create the former redo/transaction logs.

Updating system configuration settings

Update the system configuration settings as follows:

1. Update or create the relevant system initialization files (spfile).
2. Re-create the TEMP tablespace.
3. Restart the snapshot database.

The XVC snapshot database is created and running. Change other database initialization parameters as needed.
Chapter 7 Data Domain Backup Solution

This chapter presents the following topics:

- Installing and configuring the Data Domain system ........................................ 79
- Running and monitoring backups and recovery .................................................. 81
Installing and configuring the Data Domain system

Introduction

The processes for installing, configuring, integrating, and validating a Data Domain DD6300 system for data protection of databases are based on the specific operating system and DBMS being installed. However, the general concept and flow are similar.

For details about implementing data protection, see your DBMS vendor documentation and DD6300 Appliance on Dell EMC Online Support.

For details about installing and configuring the DD Boost agents for your environment, see the Dell EMC Database Application Agent Installation and Administration Guide.

To set up the Data Domain environment, follow the procedures in this section to accomplish these tasks:

1. Install the Data Domain agent.
2. Configure the Data Domain agent.
3. Create scripts for DD Boost operations.

Installing the Data Domain agent involves these steps:

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

Installing the database application agent software on Linux host

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

3. Download the appropriate database application agent software package, and then copy or move the agent software to the required database host.

You can obtain the software package at https://support.emc.com/downloads/23107?siteLocale=en_US.

4. On a Linux platform, uncompress and extract the downloaded file by using the gunzip and tar utilities.

5. On a Red Hat Enterprise Linux platform, ensure that you have downloaded and installed the compat-libstdc++-33 package.

6. Use RPM to install the DD Boost software.

7. Log in to Data Domain system as the sysadmin user and verify that the Data Domain file system is enabled:

   # filesys status

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

   # user add <username> password <password>
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.

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

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

To create a storage unit:

1. **Run the `ddboost storage-unit` command:**
   ```bash
   sysadmin@DD6300# ddboost storage-unit create slob_unit_7
   user db_backup
   ```

2. **To enable application-optimized compression (if applicable), run the `mtree` command:**
   ```bash
   sysadmin@DD6300# mtree option set app-optimized-compression
   oracle1 mtree /data/col1/slob_unit_7
   ```

   **Note:** Enable application-optimized compression each time you create a storage unit.

Configuring the Data Domain agent

Configure the Data Domain agent as follows:

1. **Run the following commands on the DBMS nodes:**
   ```bash
   [root@dbhost1 ~]# cd /opt/dpsapps/dbappagent/bin/
   [root@dbhost1 bin]# ./ddbmadmin -L -a
   LOCKBOX_PATH=/opt/dpsapps/common/lockbox -a
   LOCKBOX_OWNER_GID=54321
   [root@dbhost1 bin]# ./ddbmadmin -G -a
   LOCKBOX_PATH=/opt/dpsapps/common/lockbox -a
   LOCKBOX_REMOTE_HOST=c7-tp-vm1 -a VIRTUAL_HOST=yes
   [root@dbhost1 bin]# ./ddbmadmin -L
   ```

2. **If applicable, edit the DD Boost agent configuration file with information about the new storage unit.**

3. **If applicable, update the DD Boost agent configuration by running the `ddbmadmin -P -z` command, referencing the DD Boost agent configuration file:**
   ```bash
   [root@dbhost1 bin]# ./ddbmadmin -P -z <config file>
   ```

4. **Repeat the preceding steps for the other DBMS nodes in the environment that you want to protect.**
If your DBMS environment requires script integration (as with Oracle), you can use templates in the agent download that are specific to your environment. You can then customize the scripts accordingly. For further guidance, see the Dell EMC Database Application Agent Installation and Administration Guide.

### Running and monitoring backups and recovery

#### Running full database backups

While database backup and recovery steps are highly dependent on the DBMS installed, the general process is as follows:

1. Create or define the backup script or configuration specific to your environment.
2. Perform the initial full database backup to Data Domain with the DD Boost software.
3. Monitor the job status window or log files.
4. Log in to the Data Domain system using sysadmin and record the Data Domain backup performance:
   ```
   sysadmin@DD6300# ddboost show stats interval 2
   ```
5. Review the Data Domain compression performance:
   ```
   sysadmin@DD6300# filesys show compression
   ```
6. When the backup is complete, validate the database backup using the appropriate method for your DBMS.

#### Running a database restore

The DD6300 affords simple, efficient, and quick database recovery if database failure or corruption occurs. Although recovery procedures vary, depending on the DBMS deployed, the general process is as follows:

1. Configure the backup job or scripts, or both, to restore and recover the database from a backup on the Data Domain backup appliance.
2. Run the restore.
3. Verify that the database was successfully restored from the backup database.

The DD Boost agent provides additional details about database recovery and includes template scripts that can be modified to your specific configuration. Consult your DBMS documentation for vendor-specific recovery details.

#### Monitoring backup and restore

The Data Domain system 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 use 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:

```
$ddboost show stats interval 2
```
This command shows the DD Boost backup real-time performance statistics that are based on a specified interval (in this example, every 2 seconds.)

The following results show the statistics for a backup operation:

Table 37. Backup and network throughputs for a full backup

<table>
<thead>
<tr>
<th>Backup KB/s</th>
<th>Post-comp Written KB/s</th>
<th>Network in KB/s</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 DBMS and the DD Boost software 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:

```
$ddboost show stats interval 2
```

The following results show the statistics for a restore operation:

Table 38. 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
```

For a full backup, this command provides output that is similar to the following example:
Pre-Comp is the data that is scanned by the DBMS and DD Boost software 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:

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

The reduction percentage is:

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

Two other important compression ratios are:

- **Global-Comp Factor** = \( \frac{\text{Pre-Comp}}{\text{size after de-dupe}} \) = 1—Compression ratio that, for the full backup, confirms that all the data backed up is unique and the size after deduplication = Pre-Comp = 1069.6 Gib for the full backup

- **Local-Comp factor**—Compression ratio on the data after deduplication, which is \( \frac{\text{size-after-de-dupe}}{\text{Post-Comp}} = \frac{1069.6}{753.7} = 1.4 \)
This chapter presents the following topics:

Dell EMC documentation .............................................................. 85
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Dell EMC documentation

The following Dell EMC documentation 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.

- Dell EMC Ready Stack: VMware vSphere and Red Hat Enterprise Linux for High-Performance Database Applications Design Guide
- Dell EMC PowerEdge R640 Installation and Service Manual
- Dell EMC PowerEdge R740 Installation and Service Manual
- Dell EMC PowerEdge R940 Installation and Service Manual
- Knowledge Base: iDRAC9
- Dell EMC XtremIO X2 All-Flash Array (product web page)
- Dell EMC XtremIO Storage Array Host Configuration Guide
- OS10 Enterprise Edition User Guide
- PowerSwitch S4148T-ON: Manuals & documents
- PowerSwitch S5248F-ON: Manuals & documents
- Connectrix DS-6620B: Documentation
- Dell EMC Data Domain DD6300, DD6800, and DD9300 Systems Hardware Overview and Installation Guide
- Data Domain 6.2 Documentation Info Hub
- Dell EMC Database Application Agent Installation and Administration Guide

VMware documentation

For additional and relevant information from VMware, see VMware vSphere 6.7 Documentation Center.

Red Hat documentation

For additional and relevant information from Red Hat, see Product Documentation for Red Hat Enterprise Linux 7.
This appendix presents the following topic:

Configuring XtremIO X2 arrays

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Configuring XtremIO X2 arrays

Introduction

The XtremIO X2 management console enables you to configure and manage XtremIO storage arrays. Follow the procedures in this section to accomplish these tasks:

1. Create Initiator Groups.
2. Create volumes.
3. Map volumes to the host.

Creating Initiator Groups

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

1. From the XtremIO management console, select Configuration → Initiator Groups and click New to start the wizard.
2. In the Create Initiator Group wizard, enter the Initiator Group name, and click Next.
3. On the Initiator Settings tab:
   - Select all the initiators that belong to the same database server.
   - Leave the Initiator Name to the default setting or change it as needed.
4. For each initiator, select the operating system type that the database server is running.

   For example, for the physical production and XVC database server, select Linux as the operating system type; for the virtual database server, select ESXi as the operating system type.
5. On the Summary tab, review and verify the Initiator Group details and click Apply.

Creating volumes

Create volumes in XtremIO X2 as follows:

1. From the XtremIO management console, select Configuration > Volumes and click the New icon to start the wizard.
2. In the New Volumes wizard, enter the Number of Volumes, Prefix for the volumes, and (common) Size for each volume, and then click Apply.
3. On the main page of the management console, select Configuration > Volumes and verify if all volumes were created.

Mapping volumes to the host

Map volumes to the host in XtremIO X2 as follows:

1. In the XtremIO management console, under the Volumes tab, select all the volumes that need to be mapped to the host server; click the Mapping icon, as shown in the following figure, to start the mapping wizard:
Figure 25. XtremIO management console: Initiating the Mapping wizard

2. In the Mapping wizard, verify the information about the listed volumes; select the appropriate Initiator Group (server host) to which to map the volumes, as shown in the following figure, and then click Next:

![Mapping wizard: Volume to Initiator Group mapping](image)

Figure 26. Mapping wizard: Volume to Initiator Group mapping

3. On the Mapping – Confirmation page, verify the mapping and click Apply.