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Hitachi Storage Adapter
for Oracle VM

User's Guide

v06.2.0

Hitachi Data Systems

Contents

Hitachi Storage Adapter for Oracle VM User's Guide

Preface

This document describes how to use Hitachi Storage Adapter for Oracle VM with Oracle VM and Hitachi storage subsystems.

With Oracle's storage-connect plug-in framework, Oracle provides default generic plug-in for storage access. In generic plug-in Oracle VM, the standard operations are passive as they can detect and use only storage elements offered to the Oracle VM Servers. For example, a generic storage subsystem plug-in can detect only LUNs on the storage host. The generic plug-in has only a single access group to define which servers can access the storage elements.

The Hitachi Storage Adapter provides interactive storage management operations such as creating LUNs, configuring access groups for storage access management, and creating clones for Oracle VM.

This preface includes the following information:

- [Intended Audience](#)
- [Software Version](#)
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Note The use of Hitachi Storage Adapter for Oracle VM and all other Hitachi Data Systems products is governed by the terms of your agreement(s) with Hitachi Data Systems.

Intended Audience

The intended audiences for this guide are database and system administrators who have a solid understanding of Linux and database principles.

Software Version

This document revision applies to the implementation of Hitachi Storage Adapter version 06.2.0 for Oracle VM

Release Notes

In the current release, the Adapter supports Logical Unit (LUN) discovery, provisioning, and replication.

Release notes are included on the documentation CD. Release notes contain requirements and may contain late-breaking product information not available in this user's guide. Ensure that you review the release notes before installation.

Document Organization

The following table provides an overview of the contents and organization of this document. Click the chapter title in the left column to go to that chapter. The first page of each chapter provides links to the sections in that chapter.

Chapter	Description
Getting Started	The chapter introduces the Hitachi Storage adapter for Oracle VM product for Oracle VM Server implementation with Hitachi external storage systems.
Hardware and Software Requirements	This chapter gives hardware and software information about the Hitachi products and services along with the Oracle Platform requirements.
Installation and Setup	This chapter gives information about the installation steps and configuration settings required for managing the Hitachi Storage.
Managing Oracle VM Servers	The chapter provides information about managing the Oracle VM servers.
Managing Hitachi Storage	The chapter gives a detailed understanding on the adapter methods to create, delete, and clone the Logical Units (LUNs) for the storage subsystems.
Logging	Explains logging file, path, and functionalities
Troubleshooting	This chapter contains problems and recommended workarounds.

Chapter	Description
References and Terms	Additional resources, abbreviations, and glossary.

Referenced Documents

We mention the following documents or think they will useful.

- Oracle VM 3 Quick Start Guide
- Python 2.6.4 Reference Guide
- *Hitachi Virtual Storage Platform User and Reference Guide*, MK-90RD7042
- *Hitachi Command Control Interface Installation and Configuration Guide*, MK-90RD7008
- *Hitachi Command Control Interface User and Reference Guide*, MK-90RD7010.
- *Hitachi Command Control Interface Command Reference Guide*, MK-90RD7009

Document Conventions

This document uses the following typographic conventions.

Convention	Description
Bold	Indicates text on a window, other than the window title, including menus, menu options, buttons, fields, and labels. **Example**: Click **OK**.
Italic	Indicates a variable, which is a placeholder for actual text provided by the user or system. Example: **copy** source-file target-file **Note**: Angled brackets (<>) also indicate variables.
screen/code	Indicates text that is on screen or entered by the user; or commands, URLs, and file paths entered by user or displayed on user screen. Example: **# pairdisplay -g oradb**
<> angled brackets	Indicates a variable, which is a placeholder for actual text provided by the user or system. Example: **# pairdisplay -g <group>** **Note**: Italic font also indicates variables.
[] square brackets	Indicates optional values. Example: [a | b] indicates that you can choose a, b, or nothing.
{ } braces	Indicates required or expected values. Example: { a | b }

Convention	Description
	indicates that you must choose either a or b.
| vertical bar	Indicates that you have a choice between two or more options or arguments. Examples: [a | b] indicates that you can choose a, b, or nothing. { a | b } indicates that you must choose either a or b.

This document uses the icons below to draw attention to information.

Icon	Label	Description
	Note	Calls attention to important and/or additional information.
	Tip	Provides helpful information, guidelines, or suggestions for performing tasks more effectively.
	Caution	Warns the user of adverse conditions and/or consequences (for example, disruptive operations).
	WARNING	Warns the user of severe conditions and/or consequences (for example, destructive operations).

Convention for Storage Capacity Values

Physical storage capacity values (for example, disk drive capacity) are calculated based on the values below.

Physical Capacity Unit	Value
1 KB	1,000 bytes
1 MB	$1,000^2$ bytes
1 GB	$1,000^3$ bytes
1 TB	$1,000^4$ bytes
1 PB	$1,000^5$ bytes
1 EB	$1,000^6$ bytes

Logical storage capacity values (for example, logical device capacity) are calculated based on the values shown in the table below.

Logical Capacity Unit	Value
1 KB	1,024 (2^{10}) bytes
1 MB	1,024 KB or $1,024^2$ bytes
1 GB	1,024 MB or $1,024^3$ bytes
1 TB	1,024 GB or $1,024^4$ bytes
1 PB	1,024 TB or $1,024^5$ bytes
1 EB	1,024 PB or $1,024^6$ bytes
1 BLOCK	512 BYTES

Getting Help

The Hitachi Data Systems Support Center staff is available 24 hours a day, seven days a week. To reach us, please visit the support web site for current telephone numbers and other contact information: http://www.hds.com/services/support/. If you purchased this product from an authorized HDS reseller, contact that reseller for support.

Before calling the Hitachi Data Systems Support Center, please provide as much information about the problem as possible, including:

- The circumstances surrounding the error or failure.
- The exact content of any error message(s) displayed on the host system(s).

Comments

Please send us your comments on this document: doc.comments@hds.com. Include the document title, number, and revision, and refer to specific section(s) and paragraph(s) whenever possible.

Thank you! (All comments become the property of Hitachi Data Systems Corporation.)

Getting Started

This chapter introduces the Hitachi Storage Adapter for Oracle VM implementation with Hitachi storage subsystems.

☐ [Introduction to Virtualization Technology](#)

☐ [About Oracle VM](#)

☐ [Hitachi Storage Adapter for Oracle VM](#)

Introduction to Virtualization Technology

Virtualization evolved from time-sharing machines that allowed a large group of users to share computer resources for specified time intervals. **Virtualization** technology allows abstraction of physical hardware to create **logical units (LUNs)** of hardware resources (such as a CPU, memory, disks, file storage, applications, and networking) and to assign the resources to multiple independent systems at the same time.

Hypervisor Virtualization

A hypervisor, also called a virtual machine manager, is a type of software program that runs directly on the host machine's hardware and controls the hardware and the guest operating systems.

The hypervisor provides multiple operating systems with a common virtual platform to share the virtualized hardware resources on a single hardware host. Each guest operating system appears to have the host's processor, memory, and other resources all to itself. However, the hypervisor is actually controlling the host processor(CPU) and allocating resources as needed to each guest operating system and making sure that the guest operating systems (called virtual machines) cannot disrupt each other.

Any virtual environment created runs directly on the hypervisor, not on the host operating system, and hence runs directly on the hardware. This is the **native** or **bare metal** hypervisor.

The following figure represents a hypervisor-enabled virtual machine environment.
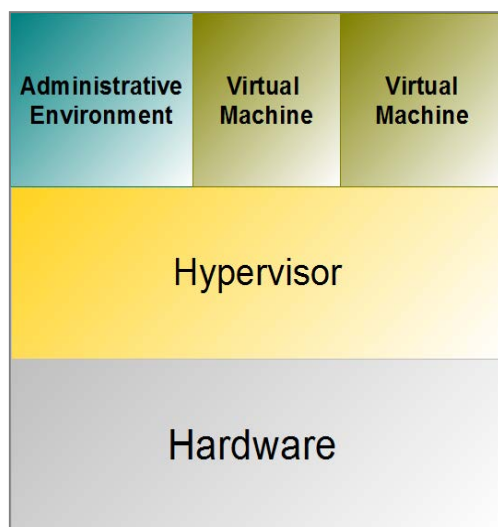
In cloud computing terminology, virtualization enables an **Infrastructure as a Service (IaaS)** user interface. In addition, with the latest release Oracle VM acts like the building block of cloud as it introduces new virtualization management and cloud resource management capabilities with Oracle Enterprise Manager.

About Oracle VM

Oracle VM is a platform that enables you to deploy operating systems and application software within a supported virtualization environment. Oracle VM includes:

- Oracle VM Manager, a web application used to manage virtual machines, other resources, and Oracle VM server.
- Oracle VM Server, a platform for running virtual machines.

Oracle VM Storage Connect Framework

The Oracle VM Storage Connect framework provides a storage discovery and provisioning API that enables the provisioning and management of storage platforms directly from within Oracle VM Manager.

Figure 1gives an overview of the Oracle VM Storage Connect Framework, which runs from dom0 of the Oracle VM Server. The Oracle VM Server application uses the Xen Hypervisor. The Oracle VM Manager application connects to Oracle VM Server through an agent running on Oracle VM Server and manages the virtual machine environment.

The external storage systems can be any of the following:

- iSCSI network protocol based Storage Area Network (SAN)
- Fibre Channel SAN
- Network Attached Storage (NAS) is file-based storage using the Network File System (NFS)

To execute generic Oracle Storage Connect plug-in operations, only access host or Fibre Channel connectivity is required. iSCSI typically requires a host name or IP address with a port number.

The non-generic Oracle VM Storage Connect Plug-in for Hitachi Storage operations requires a username and password, granting Oracle VM Manager direct access to the configuration of the storage hardware.
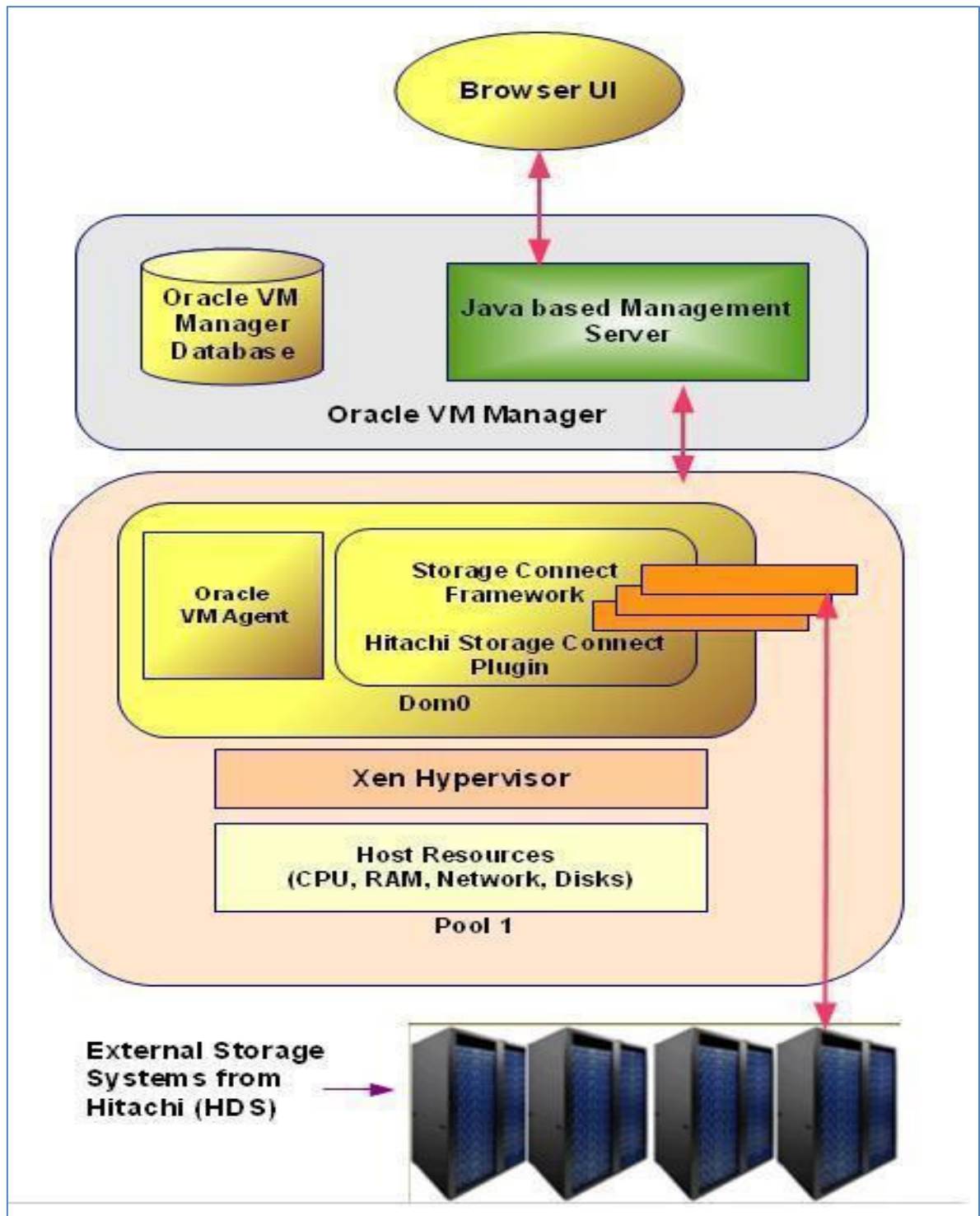
Figure 1   Oracle VM Storage Connect Framework Architecture

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Oracle VM Manager

The Oracle VM Manager is a web application you use to manage Oracle VM Servers, virtual machines, and resources. With Oracle VM Manager, you can:

- Configure and manage Oracle VM Servers
- Configure and manage networks
- Configure and manage storage
- Configure and manage resources such as virtual machine images, virtual machine templates, assemblies, and installation media
- Create virtual machines from installation media, a virtual machine template, an assembly, or a virtual machine image
- Manage virtual machines, including powering on and off, deleting, and live migrating
- Import virtual machines created with Oracle VM or another solution for server virtualization

User Interface

The following figure shows the Oracle VM Manager user interface. The left pane is the **navigation pane.** The right pane is called the **management pane.** The bottom right is called the **jobs pane.**
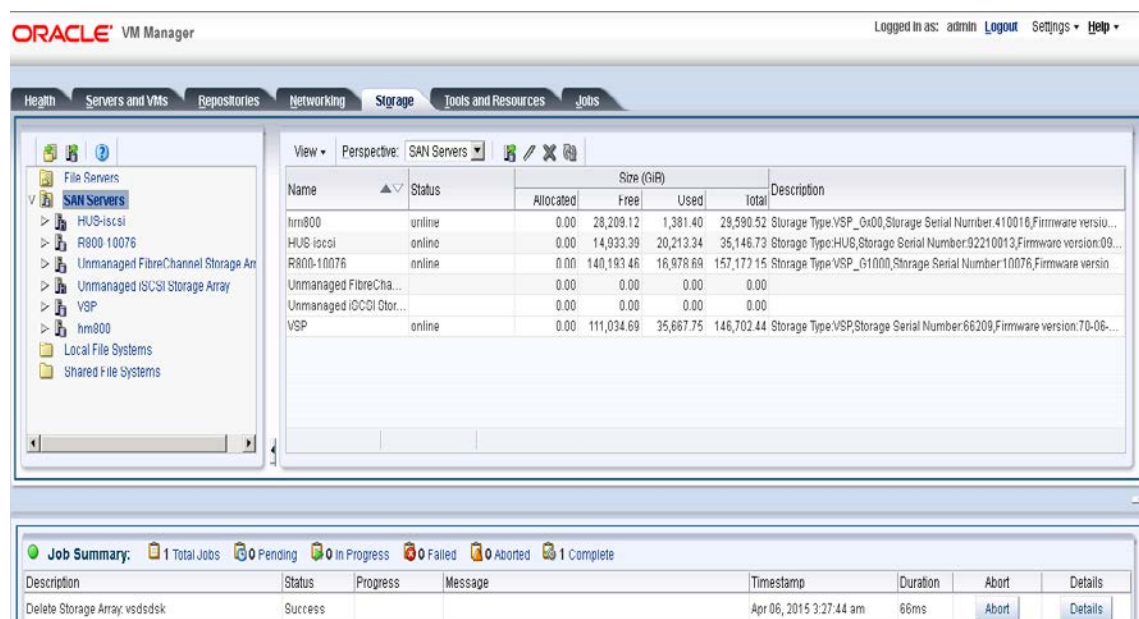
The **navigation pane** allows you to select and move between resource objects in the navigation tree. The navigation views let you choose the display of the navigation pane directly above. The navigation menu and toolbar let you perform operations that are context-sensitive to the currently displayed view in the navigation pane.

The **management pane** shows tasks, tools, and tabs that are context-sensitive to the currently displayed view in the navigation pane. The tabs denote similar tasks and information.

The **jobs pane** displays messages, status, and results of tasks that initiated by using any of the tools or menus in any of the panes or views. Jobs do not pertain to scheduled tasks, and the jobs pane is not context-sensitive.

Oracle VM Server

Oracle VM Server is a self-contained virtualization environment designed to provide a lightweight, secure, server-based platform for running virtual machines. Oracle VM Server for x86 is a product that offers scalable, low-cost server virtualization.

Oracle VM Server includes Oracle VM Agent and has its foundation in an updated version of the underlying Xen hypervisor technology. It also includes a Linux kernel with support for a broad array of devices, file systems, and software RAID volume management. At least one Oracle VM Server is required, and several are needed to take advantage of clustering.

The Linux kernel is run as dom0 to manage one or more dom (User) virtual machines, each of which could be Linux, Oracle Solaris, or Microsoft Windows.

Note	Please check **http://www.oracle.com/us/technologies/ virtualization/oraclevm/specifications/index.html** for the Oracle guest support matrix.

Oracle VM Templates

Oracle VM Server can create virtual machines using Oracle VM Templates. These provide an innovative approach to deploying a fully configured software stack by offering pre-installed and pre-configured software images.

Use of Oracle VM Templates eliminates installation and configuration costs and reduces ongoing maintenance costs, thus helping organizations achieve faster time to market and lower cost of operations.

Hitachi Storage Adapter for Oracle VM

The Hitachi Storage Adapter for Oracle VM enables storage administrators to monitor and manage Hitachi storage subsystems through the following main operations:

- Collect information on storage systems, disks, LUNs, and storage pools
- Provision LUNs and configure the mapping with access groups
- Decommission LUNs and un-configure access groups

◉ Replicate the LUNs (only cloning is supported)

For VSP/HUS VM storage, the Hitachi Storage Adapter contains sets of processes, rules, and configurations. Each operation is supported by Oracle VM Storage Connect, which has a corresponding method in the Adapter. Hitachi Storage Adapter provides interfaces to configure the following Hitachi subsystems: AMS, HUS, VSP, HUS VM, VSP G1000 VSP Gx00 (Fx00) Unified.

Adapter Features

These Hitachi Storage Adapter for Oracle VM features assume that you have configured Oracle VM server and registered it with Oracle VM Manager.

Use Case Scenarios

No.	Example	Scenario
1	Create a virtual machine on a physical device from the Hitachi storage subsystem. * * * * * * * * * * * * * * * * * Use case: A storage administrator wants to create a new virtual machine, but at the same time, the administrator wants to use the replication capabilities of the Hitachi storage system.	Procedure: 1. The storage administrator registers the Hitachi storage subsystem and uses the Oracle VM Manager console to create a new physical device (LUN). 2. The administrator creates a new virtual machine on the newly created physical device.
2	Create a new host group. * * * * * * * * * * * * * * * * * Use case: A storage administrator wants to map LUNs to the new server in his network.	Procedure: 1. Storage administrator creates a host group/access group from Oracle VM Manager GUI. 2. The administrator can then map new LUNs to this host group by following the procedure in scenario #1.
3	Clone a virtual machine. * * * * * * * * * * * * * * * * * Use case: A storage administrator wants to create a similar VM to an existing VM that resides on a Hitachi storage system.	Procedure: 1. He uses the Oracle VM manager console to clone the virtual machine. 2. The Hitachi storage adapter internally uses the Hitachi storage subsystem's capabilities to perform cloning operation.

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Architecture
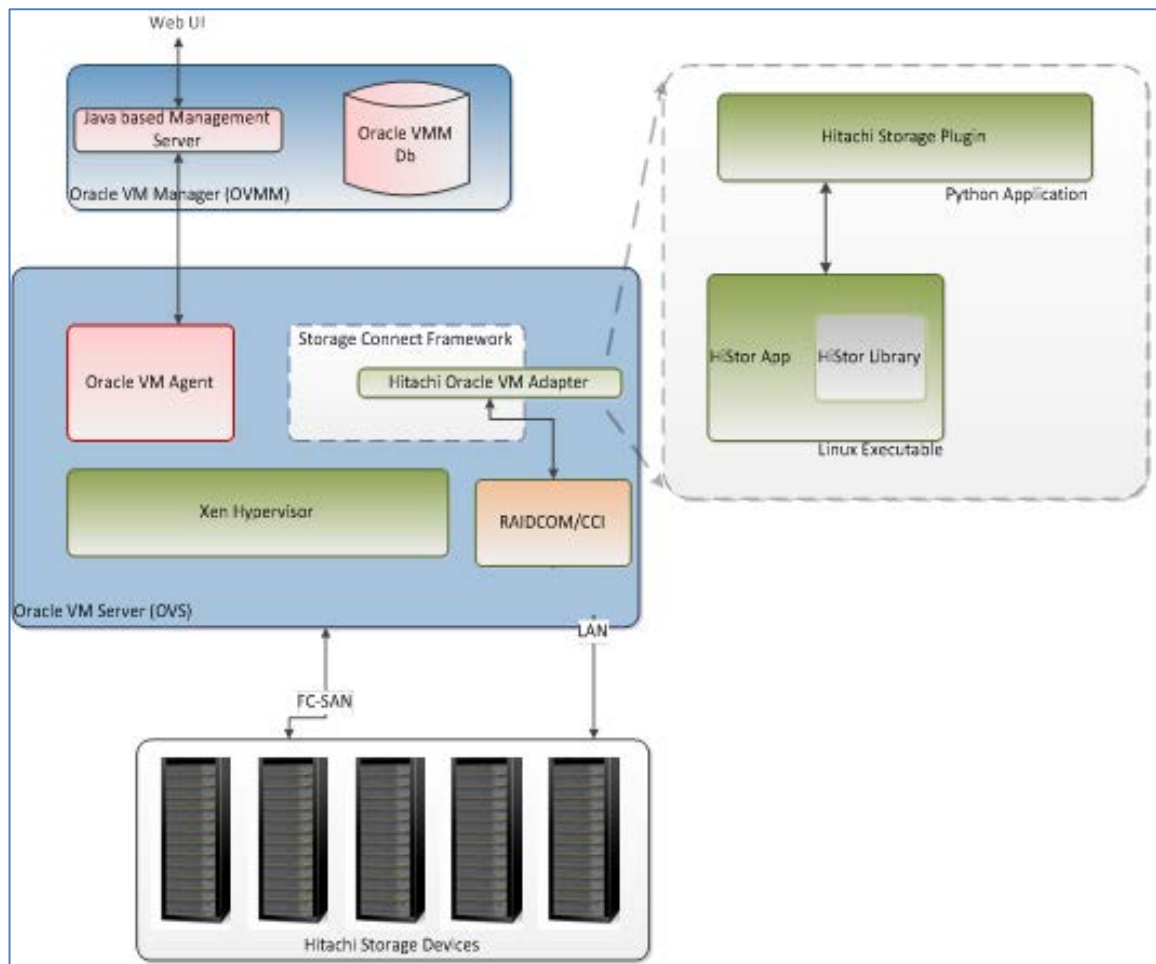
Figure 2 Various software components in an Oracle Storage Connector environment around the Hitachi adapter.

Hitachi Storage Plug-in (Python application) and HiStorApp are components of Hitachi adapter for SAN server for Oracle VM.

The Oracle VM Manager provides a user interface for managing Oracle VM Servers and resources. The Hitachi Storage Adapter must be installed on the Oracle VM Server. This adapter interacts with the Hitachi subsystems AMS, HUS, VSP, HUS VM, VSP Gx00 Unified & VSP Fx00.

Hardware and Software Requirements

This chapter familiarizes you with the Hardware and Software environments required for the Hitachi Storage adapter for Oracle VM.

- ☐ System Requirements and Support
- ☐ Pre-installation Setup Requirements
- ☐ Configure HUVM with VSP G1000

System Requirements and Support

| Note | This release supports only the software and hardware listed here. Please refer to the release notes for the latest information. |

Hardware Requirements

Supported Host Platforms	Systems with x86_64; 64-bit processors. Dual-core CPU or multiple CPUs are recommended to run multiple guests.
Minimum Memory	1GB
Recommended Memory	2GB
Number of Supported Guests	Based on the amount of physical memory in the server and the amount of memory allocated to each guest.
CPUs Supporting Hardware Virtualized Guests	For hardware virtualized (unmodified) guest operating systems (for example, Microsoft Windows), a CPU with hardware virtualization support is required. You may have to enable this feature in the BIOS. Refer to your processor documentation for information on whether your processor supports hardware virtualization and how to enable it in the BIOS.
Maximum Number of CPUs	Oracle VM: 160 CPUs (threads) Guests: 128 virtual CPUs
Maximum Memory	Oracle VM Server: 4TB

Software Requirements

Requirement
Oracle VM Server 3.3 or 3.4 installed
Oracle VM manager 3.3 or 3.4 installed
Command Control Interface (CCI) 01-36-03/04 or higher must be installed and configured. See the *Hitachi Command Control Interface Installation and Configuration Guide for instructions.*

OS Version	Supported
Oracle VM Server 3.3	X
Oracle VM Server 3.4	X
Client-Oracle VM	X

Operating System

Storage Model

Model	MicroVersion	Supported
Hitachi Unified Storage VM	73-03-38-00/00	X
Virtual Storage Platform	70-06-33-00/00	X
Virtual Storage Platform-G1000	80-03-01-00/00	X
Hitachi Adaptable Modular Storage	08C3/R-Y or newer	X
Hitachi Unified Storage(HUS130)	0980/P-S	X
Virtual Storage Platform Fx00 Unified	83-03-01-40/00	X
Virtual Storage Platform Gx00 Unified	83-03-20-40/01	X

Replication Software

Replication Software	Category	Supported
ShadowImage	VSP, HUS, AMS, HUS-VM, VSP G1000, VSP Fx00 & Gx00 Unified, H-UVM	X

Replication Configuration

Configuration	Supported
1-to-N	X

Host Interface

Interface	Supported
FC	X
iSCSI	X

Volume Type

Volume Type	Supported
Normal	X
HDP/HDT/HRT	X

Pre-installation Setup Requirements

Configure the storage subsystem as shown below.

No.	Item	Configuration
1	Licenses for Program Product	The required licenses for Program Products are: ▪ LUN Manager ▪ ShadowImage
2	Host Ports	When FC is used: ▪ Hostgroup Security is enabled on all the ports. ▪ LU Mapping mode is enabled.

AMS/HUS Environment Configurations

#	Item	Description
1	Account Authentication	▪ If you use the Account Authentication function. Select Storage Administrator (View and Modify) from the role check box in the Storage Management Software account addition window. ▪ For the characters and can be used for username and password as well as the number of characters can be entered, refer to the Account Authentication User's Guide.

VSP/HUS-VM/VSP G1000 Environment Configurations

Item	Description
Creating a user authentication account for storage administration	The storage system must have the same username and password when using multiple storage systems of the VSP/HUS, VM/VSP G1000, and VSP Gx00. Example: When employing storage system A or B, enter the same username (USER01 for example) and password (Ex: ****),as shown below. <table><tr><th>Storage</th><th>Username</th><th>Password</th></tr><tr><td>Storage A</td><td>User1</td><td>****</td></tr><tr><td>Storage B</td><td>User1</td><td>****</td></tr></table>

Configure HUVM with VSP G1000

Hitachi Storage adapter for Oracle VM supports Hitachi Universal Volume Manager (HUVM), which works with the VSP-G1000 platform.

When a system consists of multiple storage subsystems, a single host must usually connect to each subsystem. As a system administrator, you typically connect each system to the hosts, a process that may require several different types of procedures.

With HUVM, you configure the connection from the host to the VSP G1000 storage system, and then manipulate mapped volumes in an external storage system. You treat the mapped volumes in the same way as you do volumes in the VSP G1000 storage system.

Operations among storage systems can also involve varied procedures. However, with Universal Volume Manager, you perform them with the same Hitachi software as when you use VSP G1000 systems.

When HUVM Resource Group is added as SAN storage, the following information displays

1. HDP/HRT/PARITY logical units mapped to Resource Group

2. Access Groups mapped to a Resource Group

3. Access Groups which do not have any logical units residing in them.

4. Volume Groups which are mapped to a resource group

Note	To support HUVM, the Command Device should reside on the Hitachi storage subsystem.

Supported HUVM Configurations

This section outlines the HUVM configurations currently supported by the adapter. For further information, see *Hitachi Virtual Storage Platform G1000/Hitachi Universal Volume Manager User's Guide*, MK-92RD8024-XX.

Configuration #1
physical

Server
Adapter

VSP
(SN:00001)

Meta
resource

Configuration #2

Server
Adapter

VSP G1000
(SN:311111)

[V-BOX#0]
RSG#0
VSP G1000
(SN:311111)

Configuration #3
with multi v-boxes

Server
Adapter

VSP G1000
(SN:311111)

[V-BOX#0]
RSG#0
VSP G1000
(SN:311111)

[V-BOX#1]
RSG#1
VSP G1000
(SN:322222)

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Oracle VM 3.4System Requirements

To install Oracle VM, ensure that there are two systems with static IP addresses: one for Oracle VM Server and the other for Oracle VM Manager.

Oracle VM Server installs directly on server hardware with x86 or x86_64 processors that support Physical Address Extension (PAE), and it does not require a host operating system; Oracle VM Server 3 requires 64-bit hardware.

Oracle VM Manager is a Java application-based management server running on Linux. As its management repository, Oracle VM Manager uses an Oracle database that you can install either on the management server or on a separate server.

Note	We recommend that you install the Oracle VM Server on a machine with a static IP address, so that the host always receives the same IP address. The behavior of the Oracle VM Server host is undefined if used in an environment where the IP addressing is dynamic.

Installation and Setup

This chapter runs through the installations and configuration setting required for the adapter to function.

Install RPM

This is not part of the Oracle VM Server default installation, but you must deploy it separately via **yum**. To install the RPM loader on the Oracle VM Server:

Configure **yum** and then run **yum install glibc,** so that the Linux loader runs the Hitachi storage adapter RPM package.

Installing Dependent Library Files

Some of the dependent library files must be installed separately. For example, **libstdc++.so.6**, **libz.so.1**, and so on.

Dependent OVS Libraries

library name
/lib/ld-linux.so.2
libc.so.6
libcom_err.so.2
libcrypt.so.1
libcrypto.so.10
libcurl.so.4
libdl.so.2
libfreebl3.so
libgcc_s.so.1
libgssapi_krb5.so.2
libidn.so.11
libk5crypto.so.3

library name
libkeyutils.so.1
libkrb5.so.3
libkrb5support.so.0
liblber-2.4.so.2
libldap-2.4.so.2
libm.so.6
libnspr4.so
libnss3.so
libnssutil3.so
libplc4.so
libplds4.so
libpthread.so.0

library name
libresolv.so.2
librt.so.1
libsasl2.so.2
libselinux.so.1
libsmime3.so
libssh2.so.1
libssl.so.10
libssl3.so
libstdc++.so.6
libz.so.1
linux-gate.so.1

1. To install these libraries, configure **yum** to the appropriate Oracle repository on OVS machine.

   Then install the libraries by running:

   ▣ **Yum install libstdc++**

   ▣ **Yum install zlib**

2. To confirm that all the dependencies have been resolved, issue this command:

   export LD_LIBRARY_PATH=/opt/storage-connect/plugins/hitachi/storage/lib

```
ldd /opt/storage-connect/plugins/hitachi/storage/bin/hiStorApp
```

No entry for the above command should say, "Not found."

Storage Subsystem Latency

Any modify operation that changes the state of the subsystem takes
20 seconds or more after the API call is returned. This delay is because of
storage microcode behavior.

RAID Manager Configuration

To use the Hitachi Adapter with any RAID subsystem, you must configure the
Command Device (CMD) and RAID Manager (CCI).

Software requirements include the following:

RAID Manager: version 01-36-03/04 or higher Command Device
Configuration

Use the Hitachi Storage Navigator to configure the Command Device (CMD).
Refer to the screenshot below for an example of how to set the CMD attributes.

| Note | Set user Authentication to **Enable** to use the Hitachi Adapter. |
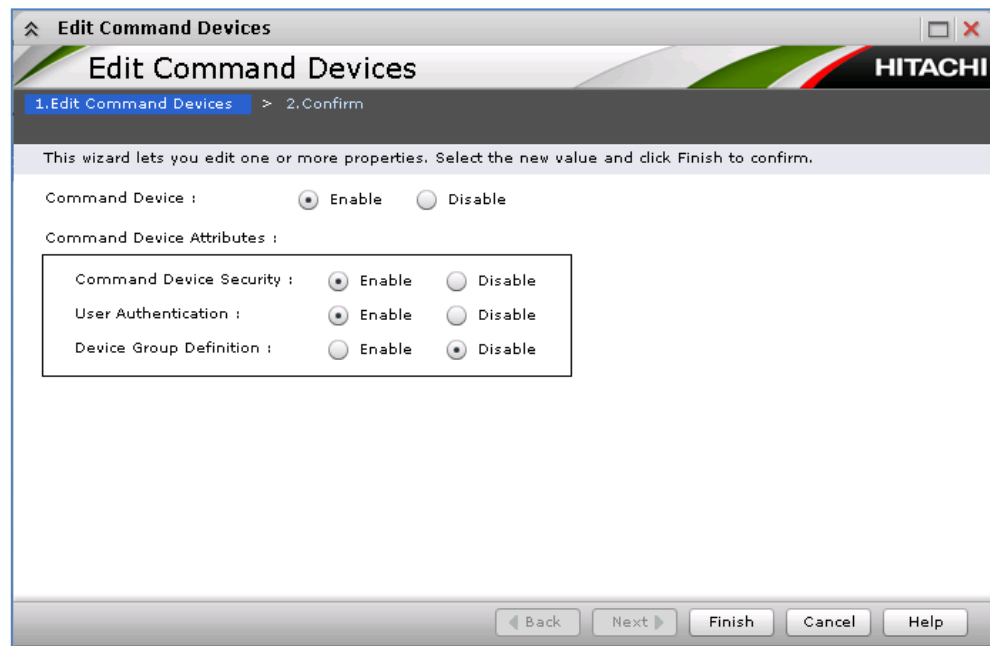
CCI Commands Using the In-band Method

Hitachi Command Control Interface commands are usually run "in-band," which refers to the method for transferring commands from the host server to the command device using the same data path as the disk I/O (FC). The VSP and later family of storage arrays also support an "out-of-band" command transfer method which uses LAN. The Hitachi Storage Adapter for Oracle VM Manager always use the in-band approach for best performance. For more information about in-band vs out-of-band operation, refer to the Hitachi Command Control Interface User and Reference Guide for your storage system model.

RAID Manager Configuration on an Oracle Linux Server

1. Confirm the RAID Manager version:

   # raidar -h
   Model: RAID-Manager/Linux
   Ver&Rev: 01-36-03/04

2. In the folder /etc, create or link to an instance configuration file for a subsystem. Name the configuration file with **horcm<instance number>.conf**. For example, the configuration file **/etc/horcm0.conf** is for the instance 0

3. Edit the configuration file as shown below:

   HORCM_CMD
   #dev_namedev_namedev_name
   /dev/sdf   #VSP 66033
   /dev/sde   #VSP 66034

4. Start an instance by executing **horcmstart.sh <horcm instance number>**:

   >horcmstart.sh 0
   confirm the instance working:
   #raidcom get command_status -I0 –s 66033 -login
   <uid><password>
   HANDLESSB1SSB2ERR_CNTSerial#Description00c9--066033-
   #raidcom get command_status -I0 –s 66034 -login
   <uid><password>
   HANDLESSB1SSB2ERR_CNTSerial#Description
   00c4--066034

5. On the host server, configure the RAID Manager HORCM instance. Keep these facts in mind:

- ▣ Hitachi Adapter for Oracle VM requires a HORCM instance for all subsystems on which the adapter operates.
- ▣ RAID Manager requires a single login for all storage subsystems listed in one configuration file. Individual logins require different configuration files.
- ▣ Hitachi Adapter with HUVM support for Oracle VM requires a HORCM instance with all the physical storage command devices added to on single HORCM instance. The username/password for all the physical storage devices should be same.

For brief instructions on configuring RAID Manager on a Linux server (Oracle VM server), see the *Hitachi Command Control Interface Installation and Configuration Guide.*

RAID Manager Configuration on an Oracle VM Server

For RAID Manager configuration on an Oracle VM server, follow the guidelines below.

When using an Oracle VM operating system, consult the Oracle VM Server Command Device requirements that include the following:

- ▣ **/usr/lib/RMLIB** folder. This folder must have Read/Write/Execute permissions for the person executing the adapter and must exist prior to use of the adapter if a command device is present.
- ▣ **/usr/lib/RMLIB/RLSYSLK** file. This file must have Read/Write/Execute permissions for the user executing the API. The API creates the file, but you may create it preemptively as a 0-length file in order to set the proper permissions.
- ▣ The command device itself must have Read/Write/Execute permissions for the person executing the API or it is ignored.

Retry Policy

Because Hitachi storage devices calls are asynchronous and only one person can run the command at a given point, sometimes the call may take more than a few seconds. On these occasions, the adapter retries the calls. The default retry settings are:

- ▣ Max retries: 8
- ▣ Initial wait time: 10000 milliseconds
- ▣ Subsequent wait time multiplier: 1.0
- ▣ Subsequent additional wait time to add: 10000 milliseconds
- ▣ Maximum wait time between retries: 60000 milliseconds

Install Oracle VM Manager

Before you start to install Oracle VM Manager, download the software from
http://edelivery.oracle.com/oraclevm

Use the following link to access the installation and upgrade guide for Oracle
VM Manager:
http://docs.oracle.com/cd/E20065_01/doc.30/e18548/toc.htm#BEGIN

If you want to install Oracle VM Manager in a virtualized environment, do not
install it on Oracle VM Server (dom0) directly. Install it into a virtual machine
running on an Oracle VM Server.

Install the Hitachi Storage Adapter RPM

The Hitachi Storage Adapter is distributed as a single Linux RPM package.
Oracle recommends the RPM specification used to create the adapter RPM. The
Hitachi Adapter RPM must be installed on each Oracle VM Server that uses the
particular storage subsystem. The top-level installation directory for the
adapter is:

> **/opt/storage-connect/plugins/hitachi/**

To install the Hitachi Storage Adapter, use the following procedure:

Run **rpm -i osc-hitachi-storage-06.2.0-0.el6.x86_64.rpm** command
from the Oracle VM Server to install the adapter.

> The **/opt/storage-connect** folder is installed in the local file system of
> the Oracle VM Server. Storage Connect are a set of plug-ins that allows
> Oracle VM Manager to communicate with the storage.

> In the user-interface of the Oracle VM Manager, there are two options to
> choose for creating and configuring logical units (LUNs) for use, these are:
> - Oracle Connect Plug-in: This is a generic plug-in from Oracle.
> - Hitachi Adapter: This is a non-generic, vendor-specific plug-in
>   from Hitachi.

Run the **rpm – qpl** command from the Oracle VM Server to view the content of
the installed folder.

Run **rpm – qa | grep osc| grep hitachi** to view all the Hitachi adapters
installed on the physical host.

Uninstall Hitachi Adapter RPM

To uninstall the Hitachi Adapter, use the following procedure:

1. Before uninstalling the RPM, make sure that there are no UI instances of this adapter. If there are any, remove them and then uninstall the RPM.

2. Run **rpm –e osc-hitachi-storage-06.2.0-0.el6.x86_64** to uninstall the adapter from the Oracle VM Server.

Configure Oracle VM Manager for the Adapter

The Hitachi adapter operations require an additional admin host, with optional administrative username and password, granting Oracle VM Manager direct access to the configuration of the storage hardware. This is configured in the Oracle VM Manager.

Managing Oracle VM Servers

This Oracle VM Server allows virtualization to take place and permits the adapter to interact with the Oracle VM Manager application for using the Hitachi Storage.

- ⊡ Introduction to Oracle VM Servers
- ⊡ Logging in to Oracle VM Manager
- ⊡ Discovering Oracle VM Servers
- ⊡ Registering Fibre Channel-based Storage in Oracle VM Manager
- ⊡ Registering iSCSI-based Storage in Oracle VM Manager
- ⊡ Deleting Oracle VM Servers in VM Manager

Introduction to Oracle VM Servers

The Oracle VM Server environment consists of one or more Oracle VM servers that are grouped into a **Server Pool**. Oracle VM Manager can manage one or more such server pools.

The **Oracle VM Server** allows hardware resources such as CPUs, memory, networks, and storage to become flexible resource pools from which you can build virtual machines.

The **Oracle VM Manager** lets you create, clone, share, configure, boot, and migrate Oracle VM Servers.

Oracle VM Server provides a server-based platform for running guest virtual machines. **Oracle VM Server** is **XEN hypervisor** based and includes **Oracle VM Agent** to communicate with Oracle VM to manage guest virtual machines. With each Oracle VM Server, one or more server pool roles are associated as listed below:

The **Server Pool Master** is the core of the server pool operations. It acts as the contact point for the server pool to Oracle VM Manager and as the dispatcher to other Oracle VM Servers in the server pool.

The **Utility Server** is responsible for I/O-intensive operations such as copying or moving files. Its function focuses on creation and removal operations of the Virtual Machines, Oracle VM Servers, and Server Pools.

The **Virtual Machines Server**'s primary function is to run virtual machines, thus acting as a hypervisor.

Server Pools

A server pool is an autonomous region that contains one or more Oracle VM Servers. A server pool presents a unified view of the storage in which the virtual machines reside. Each server pool must have its own shared storage (including NFS-like Shared FileSystem Access).

Storage

A shared storage resource is mounted on each Oracle VM Server in a server pool to store virtual machines, external resources, and data files. In order to perform live migration of virtual machines, each Oracle VM Server must have shared access to storage. Discovering Oracle VM Servers is the first step to creating a server pool using Oracle VM Manager.

Before creating a Server Pool with External Storage, finish discovering servers, configuring network resources, and creating a pool of MAC addresses. Then you are ready to create a Server Pool by using any or all of the three different protocols (NFS, iSCSI, or FCP).

Create a server pool

1. Discover Oracle VM Servers as a resource.

2. Edit existing network resources.

3. Create an additional network as a resource.

4. Create virtual machines as a resource.

5. Register Storage as a resource.

6. Create Oracle VM server pool.

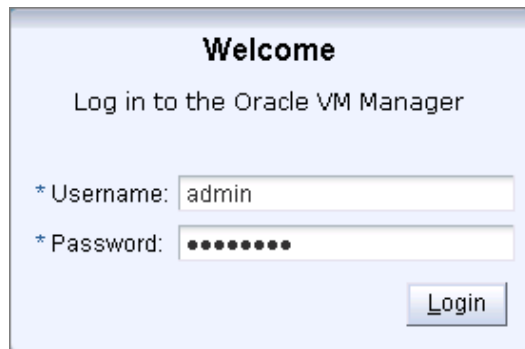7. Assign storage repository to the Oracle VM servers of a server pool.

Logging into Oracle VM Manager

All the work of registering a storage subsystem, create and present LUNs from an iSCSI/Fibre Channel storage subsystem to the Oracle VM Servers, is done without logging into any of the Oracle VM Servers, using the Oracle VM Manager.

Log into the Oracle VM Server

1. To open the Login page of Oracle VM Manager, enter the following address in a Web browser: *http[s]://hostname:port/ovm/console*

2. Log in to Oracle VM Manager with administrator's credentials. For example:

   Username= **admin** and Password = **abcd**

The username and password are set at the time of Oracle VM Manager installation. The user role is that of admin.

The Home view is the first screen you see after logging into Oracle VM Manager.

Once logged in, you can import resources as well as create and add components such as storage repositories, server pools, Oracle VM Servers, and virtual machines.

As shown in the server pools tab of the management pane below, no server pools are present. Home view also includes the Unassigned Virtual Machines folder in the navigation pane.


3.   Click Server Pools in the navigation pane to view the server pool name in the management pane. If the management pool says, "No Server pools found", use New Server pool to create one.

4.   Select the Hardware view in the Views pane. Add Oracle VM Servers, networking, and external storage as resources in the hardware view.

Note   The VM Manager's user interface displays context-sensitive information, relevant to the selection in the navigator and management panes.

Discovering Oracle VM Servers

The discovery process will add all the servers to the **Unassigned Servers** resource pool.
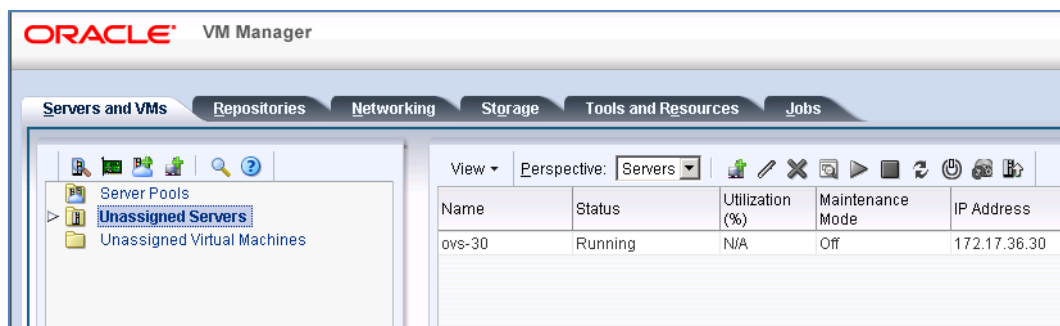
To discover servers in VM Manager, follow these steps:

1. Click the Servers and VMs tab and select **Unassigned Servers**.

2. Click **Discover Servers** from the menu.

    The Discover Servers dialogue box opens for entering server information in VM Manager. Enter the IP Address of the servers individually or as a range of IP addresses to list the servers in the network system.

3. Enter Oracle VM Agent Port number and Oracle VM Agent Password to connect the servers with the VM Manager. All available servers are populated.

> **Note** Servers remain unassigned until added to a server pool. Oracle VM Agent Password is set during the Oracle VM Server installation.

Oracle VM Manager uses this password to manage and monitor Oracle VM Server and the guests created and running within it. This is the password to use when discovering Oracle VM Servers in Oracle VM Manager.

Screen 5: Message in Jobs View - Discovery of Servers Complete

∨ Jobs		
Description	Status	M
Discover Server 172.17.36.30	Completed	

Registering Fibre Channel-based Storage in Oracle VM Manager

As seen in the following figure, the **Storage** tab has storage elements logically divided into File Servers and Storage Arrays. The fileservers refer to file-based storage whereas Storage Arrays are block-based storage or raw disks. The **Storage Array** tab in the management pane shows a list of Storage Arrays of type iSCSI and Fibre Channel (FC). The idea is to create a new storage array instead of using the Unmanaged FC Storage Array.

To **register** the storage array and **Add Admin Server**, follow these steps:

1. Click the **Storage** tab and select **SAN Servers**.

2. Right-click SAN Servers to select and then select **Discover SAN Server** from the menu.

3. In the Discover SAN Server window, enter **Name** and **Description** for the storage array to that you are registering with VM Manager. Names may contain a maximum of 32 characters (alphanumeric characters, '!', '#', '$', '%', '&', ''', '+', '-', '.', '=', '@', '^', '_', '{', '}', '~', '(', ')', '[', ']').

4.   Select **Storage Type** from the drop down box as *Fibre Channel Storage Server or iSCSI*.

5.   Select **Storage Plug-In** as Hitachi Storage Adapter.

6.   Enter Plug-in Private Data.

          NON HUVM RAID Storage:

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7. The Hitachi adapter uses the Plugin Private Data parameter to pass the

- **HORCM ID**. **HORCM ID** is the RAID Manager instance used with the command device to communicate with storage devices on an Oracle VM server. (for stype=vbox this is not needed)

- **stype** is the SAN storage type and should be set to "vsp" All of them are key=value pairs.

- **id is the SAN Storage number**

- **ag** is the Access Group name which will be used for Clone lun mapping (before clone can be created , secondary lun should be mapped to some access group, so in order to do that activity user need to provide access group)

Example: id=10072, **stype** = vsp, **hrcmid**=19, ag=CL4-A_HOSTGROUP1

HUVM RAID Storage to manage RESOURCE GROUP:

a. **stype** is the SAN storage type and should be set to "vsp" All of them are key=value pairs.

b. **id is the SAN Storage number**

c. **ag** is the Access Group name which will be used for Clone lun mapping (before clone can be created , secondary lun should be mapped to some access group, so in order to do that activity user need to provide access group) access group contains "<port name>_<hostgroup or iscsi target name>

d. **pstorages** is very specific for stype=vbox, pstorage is of type list, which can contain information of physical storage devices, each entry of the physical storage should contain, storage id, horcmid, IP address of the storage , all separated by ":", and each storage entry should be separated by ",".

e. All of them are key=value pairs.

Example: stype=vbox, ag=CL1-A_HITACHI-OVM-AUTOGEN, pstorages=[10076:20:172.17.47.58]

8. Make sure that you enable Host Group security for all the ports that you want to use for Access Group creation or multipathing.

9. Enter Administrative Information; Admin Host IP address, Admin Username, and Admin Password.

10. The Hitachi adapter uses the Admin Host parameter to pass the storage management IP address in case physical storage and storage ID incase of resource group (vbox)

11. If the storage subsystem does not user authentication enabled, enter a dummy username and password in the authentication field and Click **Next** to navigate to the **Add Admin Server** screen.

12. Admin servers are allowed to execute Oracle VM agent transactions on behalf of the Oracle VM Manager.

13. Select one or many server(s) from the list of **Available Servers** and click arrow button to add the selected server to the list of **Selected Servers**.

14. The selected Oracle VM server acts as the admin server for managing FC disk operations. This is a required step when using the network file system in a clustered server pool.
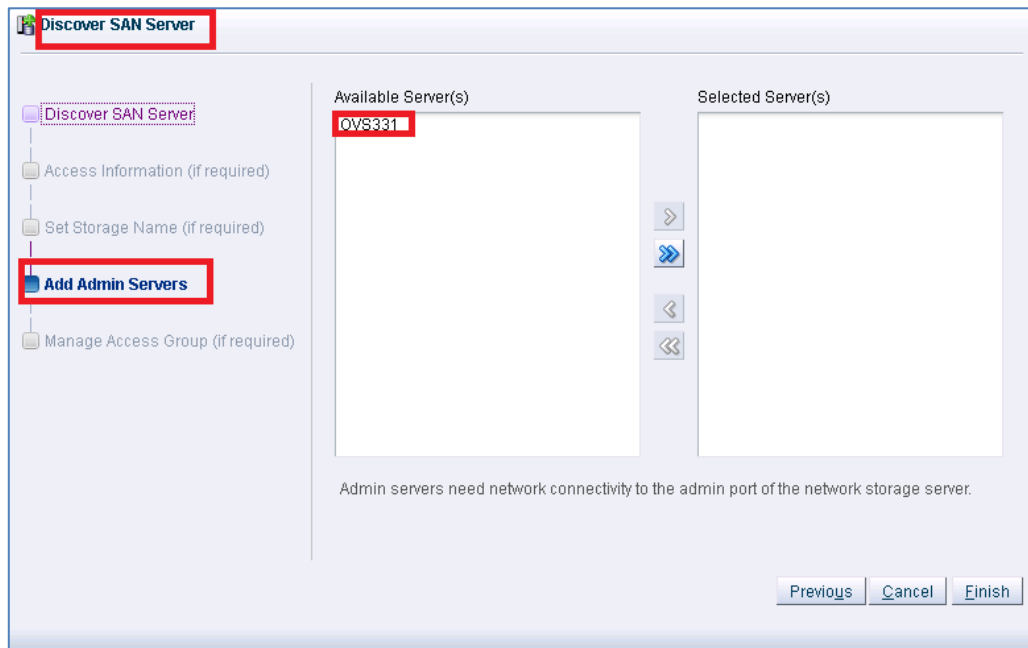
15. Click **Finish** when done. You must configure the access groups in the Oracle VM Manager and refresh the storage subsystem to be able to view the FC LUNs.

The Oracle VM Servers (initiators) and the storage arrays (targets) now connect over the VM Manager. The VM Manager communicates with the Oracle Server machines and presents the LUNs to the server clients via the access groups in VM Manager.

Storage Configuration Information						
Field	**sub field**	**AMS**	**HUS**	**VSP/VSP G1000/VSP Gx00**	**VBOX (Resource Group)**	**Description**
Name		✔	✔	✔	✔	Any name for the storage to identify
Description		optional	optional	optional	optional	
StorageType		✔	✔	✔	✔	ISCSI Storage Server or FibreChannel
Storage Plug-in		✔	✔	✔	✔	Hitachi Storage Adapter
Plugin Private Data	**id**	✔	✔	✔	✘	storage server id
	stype	ams	hus	vsp	vbox	storage type
	hrcmid	✘	✘	✔	✘	CCI instance number of the storage running on the server
	ag	✔	✔	✔	✔	existing hostgroup/iscsi target name which will be used while creating clone, secondary lun will be mapped to this access group before cloning (mandatory field) access group should contain "portname"_"host group/iscsis targer name"
	pstorages	✘	✘	✘	✔	[<primary storage id>:<CCI instance number of the storage running on the server>:<primary storage IP address>]

Storage Configuration Information						
Field	**sub field**	**AMS**	**HUS**	**VSP/VSP G1000/VSP Gx00**	**VBOX (Resource Group)**	**Description**
	Ip2	✓	✓	✘	✘	AMS/HUS Management control ip address 2
admin host		Management ip	Management ip	Management ip	resource group storage id	For AMS/HUS it should be controller managerment IP 1 address , for VSP series it should be management IP, for HUVM resource group it should be resource group storage id
admin username		✓	✓	✓	✓	SVP username. For resource group, storage credentials of resource group and physical storage should be same
admin password		✓	✓	✓	✓	SVP password

Register iSCSI-based Storage in Oracle VM Manager

As seen in the following screen, the Storage tab in the hardware view has storage elements logically divided into File Servers and Storage Arrays. The file servers refer to files based storage whereas Storage Arrays are block-based storage or raw disks. The Storage Array tab in the management pane shows a list of Storage Arrays of type iSCSI and Fibre Channel (FC). The idea is to create a new storage array instead of using the Unmanaged iSCSI Storage Array.
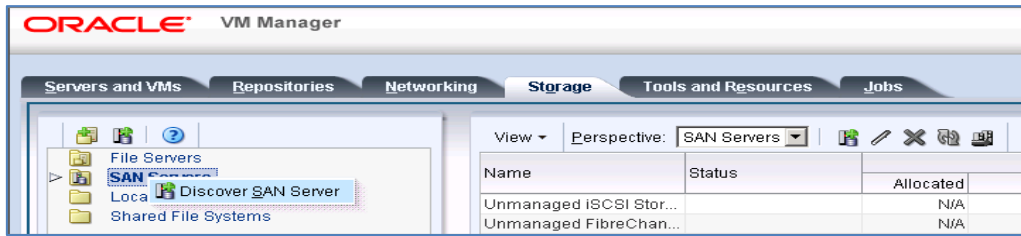
To **register** the storage array and **Add Admin Server**, follow these steps:

1. Click **Storage** tab and select **SAN Servers**.

2. Right-click SAN Servers to select and then click **Discover SAN Server** from the menu.

3. Enter Name and Description for the storage array to be registered with VM Manager. Name may contain a maximum of 32 characters (alphanumeric characters, '!', '#', '$', '%', '&', ''', '+', '-', '.', '=', '@', '^', '_', '{', '}', '~', '(', ')', '[', ']').

4. Select **Storage Type** from the drop down box as iSCSI.

5. Select Storage Plug-In as Hitachi Storage Adapter.

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Enter Plug-in Private Data. The Hitachi adapter uses the Plugin Private Data parameter to pass the controller IP2 and storage type. Controller ip2 connects to the storage device on Oracle VM server. stype is a SAN storage type that can be "ams" or "hus." All of them are key=value pairs.

Example for HUS: id=89787, stype = hus, ip2=172.17.46.61, ag=CL4-A_HOSTGROUP1

Example for AMS: id=10028, stype = ams, ip2=172.17.46.67, ag=CL4-A_HOSTGROUP1

Example for VSP-G1000: id=40566, stype = vsp, hrcmid=12, ag=CL4-A_HOSTGROUP1

Example for VSP-Gx00: id=40789, stype = vsp, hrcmid=18, ag=CL4-A_HOSTGROUP1

6. Make sure that Host Group security is on for all the ports that you want to use for Access Group creation or multipathing.

7. Enter Administrative Information; Admin Host IP address, Admin Username, and Admin Password. The Hitachi adapter uses Admin Host parameter to pass the storage number information.

8. If the storage subsystem does not have user authentication enabled, enter a dummy username and password in the authentication field. Click **Next** to navigate to the Add Admin Server screen. Admin servers are the servers that are allowed to execute Oracle VM agent transactions on behalf of the Oracle VM Manager.

9. Select one or more access hosts (storage server iSCSI port IP address and port number, username) to connect.
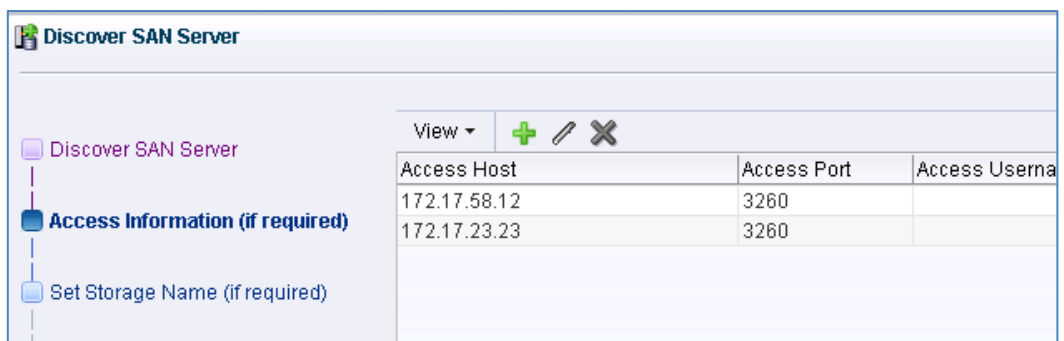
10. Select one or many server(s) from the list of **Available Servers** and click the arrow button to add the selected server to the list of **Selected Servers**.

10. Select one or many server(s)

The selected Oracle VM server acts as the admin server for managing FC disk operations. This is a required step when using the network file system in a clustered server pool.
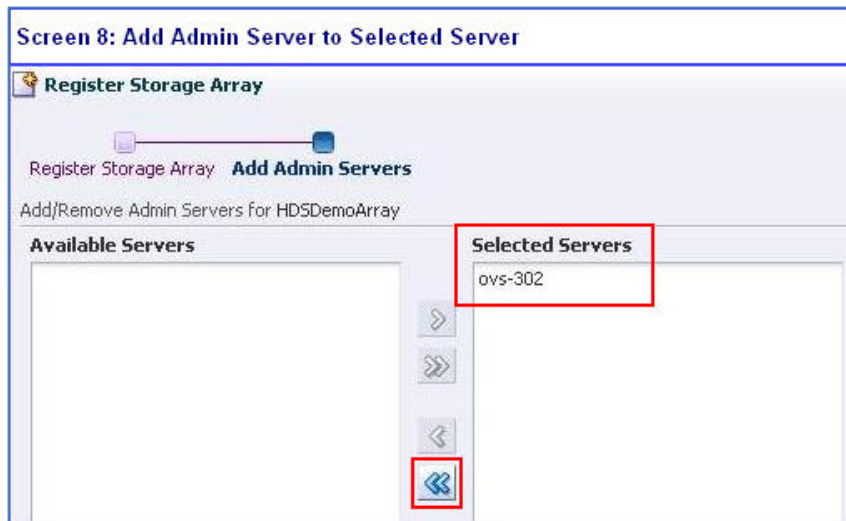
11. Click Finish when done. You must configure the access groups in the Oracle VM Manager and refresh the storage subsystem to be able to view the FC LUNs.

The Oracle VM Servers (initiators) and the Storage Arrays (targets) are now connected over the VM Manager. The VM Manager communicates with the Oracle Server machines and presents the LUNs to the server clients via the access groups in VM Manager.

Delete Oracle VM Servers in Oracle VM Manager

Oracle VM Servers that no longer have access to storage subsystems and are not functional are removed from the virtual machines, and Oracle VM Manager achieves this.

To delete the Oracle VM Server, follow these steps:

1. Click the **Storage** tab.

2. Select the Oracle VM Server to be removed and right-click to select **Delete** from menu.

3. Click **OK** to confirm deletion.
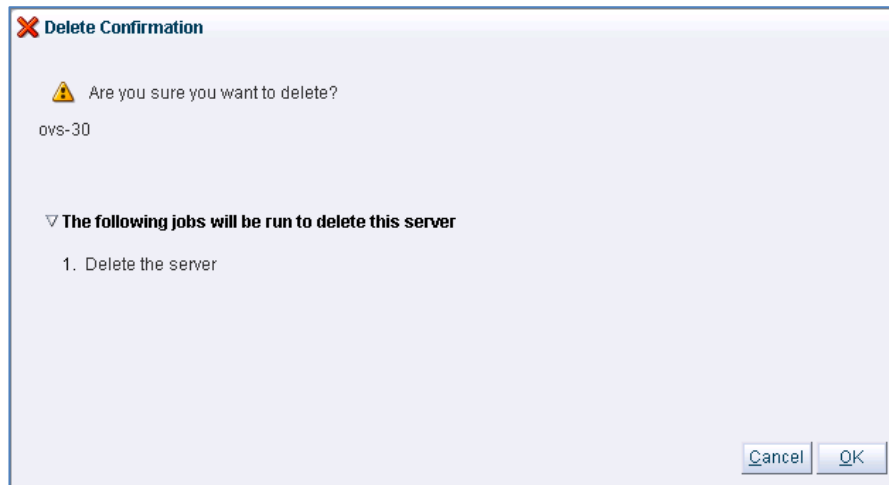
Managing Hitachi Storage

The Hitachi storage subsystem works seamlessly with the Oracle Virtual Servers in a virtualized environment. By virtualizing the hardware and allocating parts of it based on the real needs of users and applications, the available computing power, storage space, and network bandwidth can be much more effective. We can add more storage and present them to your server pools as your need for storage increases. Reduce the amount of storage again if the higher storage requirements are temporary.

The Hitachi Adapter manages the Hitachi storage subsystem on virtualized machines using the Oracle VM.

The chapter gives a detailed understanding on the adapter methods to discover, provision and replication of Logical Units(LUNs) on the Hitachi storage subsystems.

- Configure Storage Subsystems
- Register Hitachi Storage Subsystems
- Delete a Storage Array
- View Information in Oracle VM Manager
- Manage Access Groups
- Lifecycle of a Logical Unit (LUN)
- Clone Management

Configure Storage Subsystems

Whatever the Oracle VM Server configuration in your environment is, Oracle VM always requires a location to store environment resources that are essential to the creation and management of virtual machines.

These resources include VM templates and assemblies, ISO files (virtual DVD images), VM configuration files and VM virtual disks. The location of such a group of resources is a storage repository.

You can configure storage repositories on an NFS file system or on a physical disk (LUN) of a storage array. However, for storage repositories on physical disk, like the Hitachi Storage arrays, the servers with access to it must be members of a clustered server pool. For un-clustered server pools, only file server storage is available.

The storage element that is most tangible and visible to all users of Oracle VM is the virtual machine disk. A VM disk is either a disk image file in a storage repository or a raw physical disk. If a physical disk (LUN) is used, it attaches directly to the VM in the same way it would to a physical machine. The availability of VM disks in a storage location with shared access from all server pool Oracle VM Servers is essential for VM high availability.

Oracle VM Manager communicates with all storage through a set of Hitachi Adapter named Hitachi Storage Adapter for Oracle VM. This plug-in does not run from the Oracle VM Manager but rather lives on some or all of the Oracle VM servers. You can see these plug-in files in the local file system of an Oracle VM Server in the **/opt/storage-connect/directory**.

In the user interface of Oracle VM Manager, select Hitachi Storage Adapter when creating and configuring storage elements, LUNs, for use in your environment.

Register Hitachi Storage Subsystems

Configure storage on centralized external subsystems so that Oracle VM Manager can assign it to Oracle VM Servers. This means that external storage should be ready; if Fibre Channel is the interface for server pool storage systems, then LUNs must be present on the storage subsystems and be presented to Oracle VM Servers.

Register Hitachi SAN Storage Subsystems

To register the storage array, follow these steps:

1.   To add the Hitachi Adapter, click the **Storage** tab.

2.   Right-click **SAN Servers**, and then click **Discover SAN Server** from the menu.

3. Enter the name and description. Select storage Type as **iSCSI Storage Server/Fibre Channel** based on your setup.

4. Click the down arrow to add Storage Plug-in and select Hitachi Storage Adapter.

5. Enter SAN Storage Type, Horcm ID, and other desired terms in Plugin Private Data.

6. Make sure that the following are true:

7. SAN Storage Type (**stype**) should be **ams** (for AMS) or **hus** (for HUS) or **vsp** (for VSP, HUS-VM, VSP-G1000, VSP-Gx00)

8. Horcm ID is the instance name you have used while starting RAID Manager for this storage device. Check the RAID Manager Configuration section.

9. HG security is active for all the ports that you want to use for multipathing.

10. WWN is available for all the ports that you want to use for multipathing.

11. Enter the Storage Serial number or Controller IP in the **Admin Host** field along with storage username and password used to connect with the SAN storage.

The Adapter can now connect to the storage server and create the virtualized environment comprising logical access groups and logical units from Fibre Channel types of storage arrays registered with VM Manager.

Edit Storage Array

To rename a storage array, follow these steps:

1. Right-click the storage array and select **Edit Storage Array**.

2. Rename the Array to a suitable name and click **OK**.
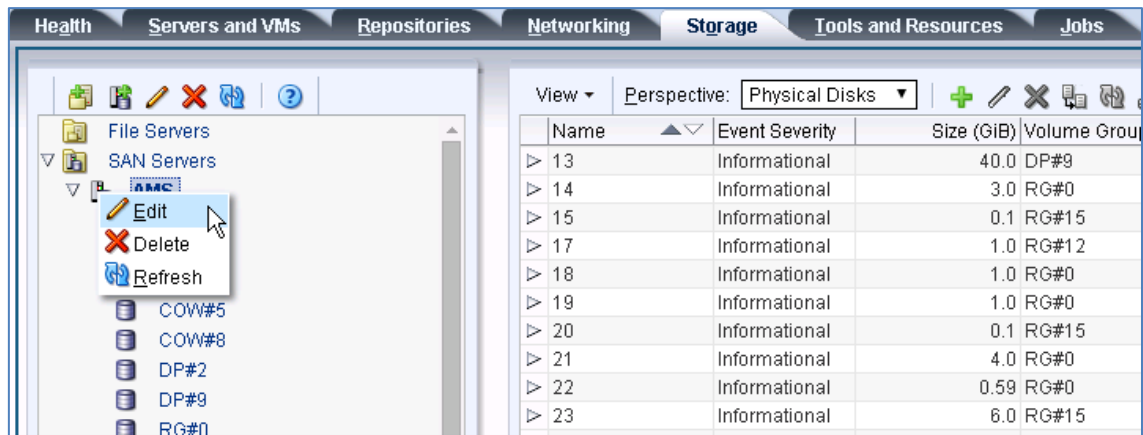
Add/Remove Admin Server

The admin server for a storage array can be added or removed even after you register it in the VM Manager.

Adding or Removing an Admin Server

1. Right-click the selected storage array and click **Edit Admin Server** from the menu.

2. Click one or more servers from available servers and click arrow button to move them to selected servers to add the servers.

3. Click one or more servers from selected servers and click an arrow button to move them to available servers to remove the servers.

4. Click **Finish** once done.

Delete a Storage Array

A storage array, when empty, can be removed from the VM Manager.

To delete a storage array, follow these steps:

1. Select the storage array name from the navigation tree of the storage tab of the Hardware view.

2. Right-click the storage array, and then click **Delete** to remove the storage from the VM Manager.

3. Click **OK** to confirm the deletion of the storage array.

See the following figure.
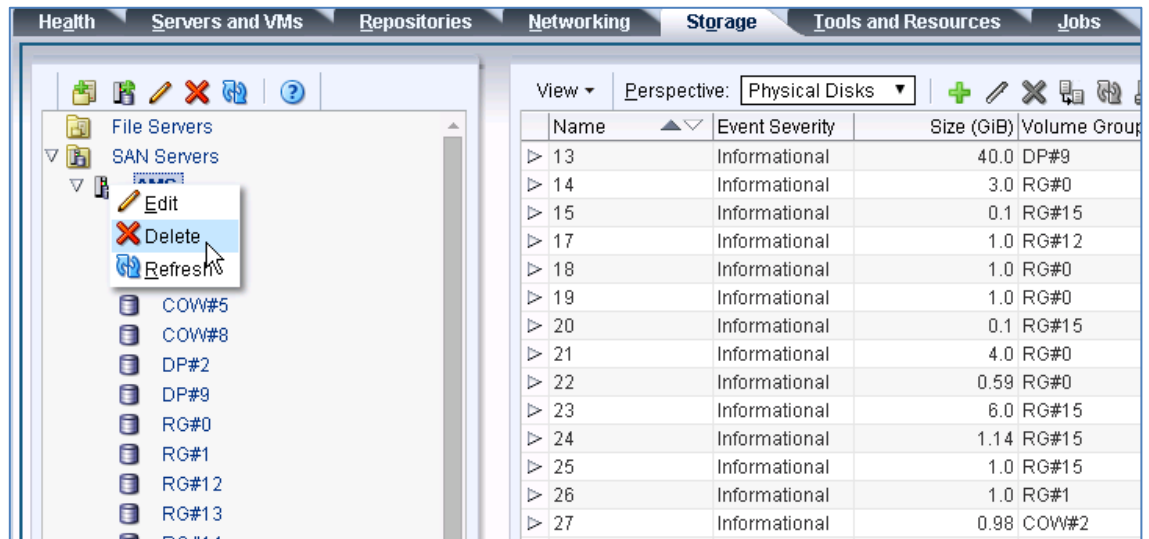
View Information in Oracle VM Manager

All the information related to the registered SAN server can be obtained by selecting the registered SAN server on the **Storage** tab and selecting the **info** perspective.

The following figure displays the action status in the **Jobs** Pane. It gives a message to the user every time there is an action taken from the Oracle VM Manager for every user action such as Discover Servers and Register storage array.
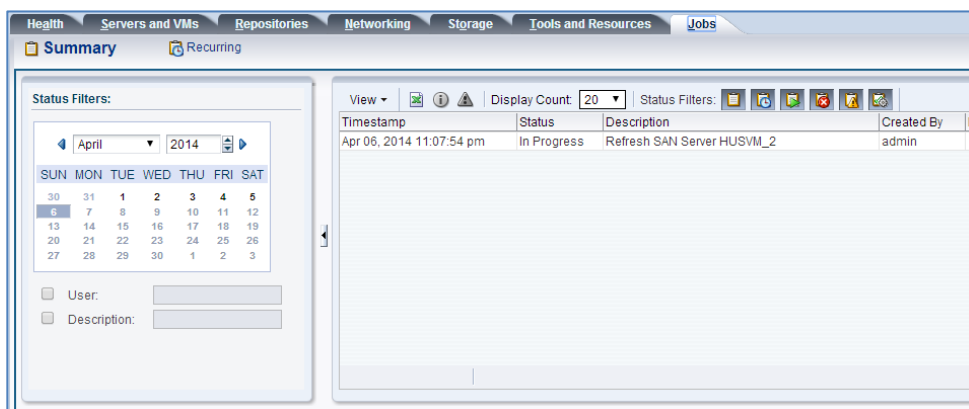
Refresh a Storage Array

This command on the storage array automatically searches for all the LUNs and list them. Refresh operation is available only for the storage array. Refresh will populate the LUNs from all the volume groups.
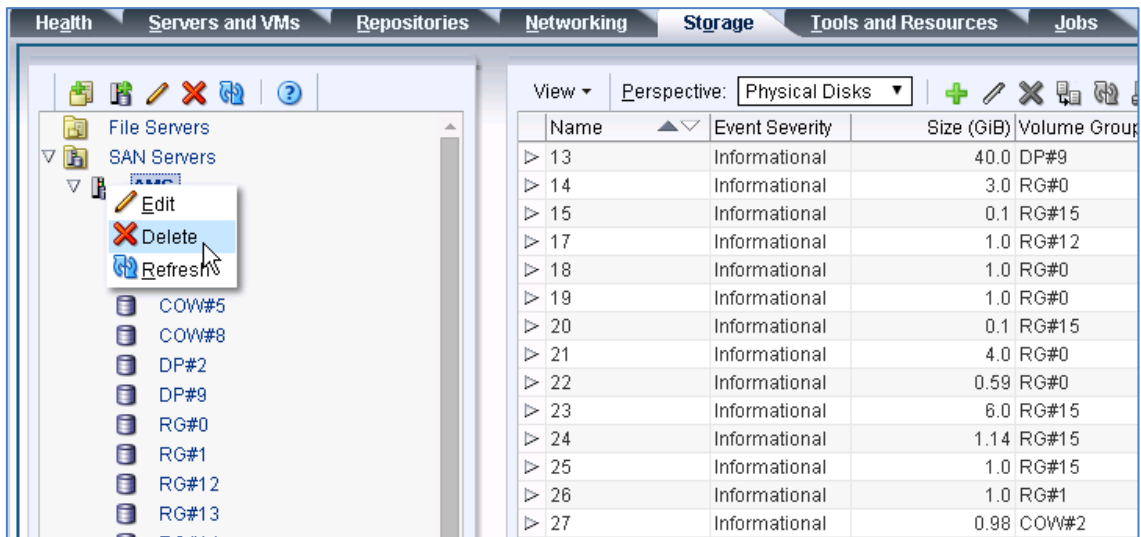
To refresh a registered storage array, follow these steps:

1. Click the **Storage** tab and select the registered storage server example **TestVSP**).

2. Right-click the storage array to select, and click **Refresh Storage Array** from the menu. The message in the **Jobs** pane shows the operation status In Progress and description.

Managing Hitachi Storage

Hitachi Storage Adapter for Oracle VM User's Guide
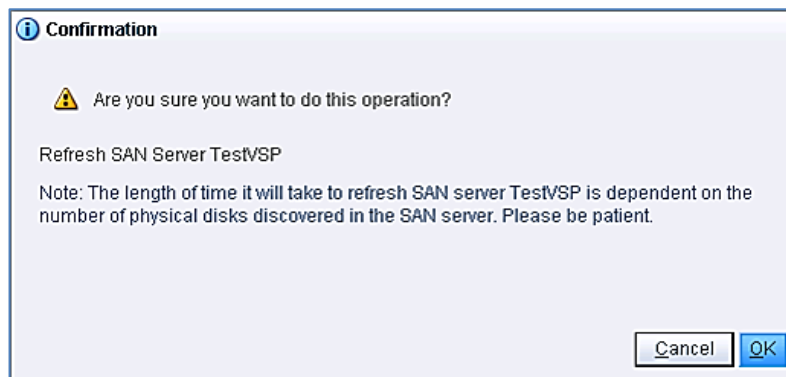
LUN extracted from PG volume group when allocated a size reduces the free size from the total size of that volume group. In Hitachi Dynamic pools, the size allocated to a LUN does not reduce the free size of the volume group, because the free size changes dynamically only when there is consumption of that storage space.

The following screen shows the populated LUNs of volume group types from the storage array.

View Storage Server Information

The storage server is registered in the VM Manager and its details are displayed in the navigation and management panes of the VM Manager.

To view the registered storage server details, follow these steps:

1. Click the arrow button to expand the navigation tree object Storage Array *<<Storage instance name>>* Access Groups.

2. Click Access groups to expand them to view the list of available groups. Volume groups do not display the LUNs. Only a Refresh operation on the storage array populates the Volume groups.
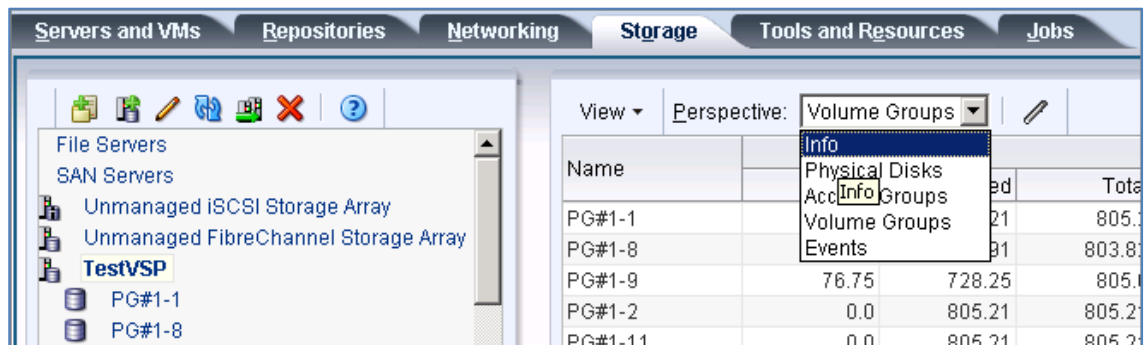
3. Click the storage array name, <storage instance name>, in the management pane to view its details under the **Info** tab of the management pane.

4. View the storage array, volume group, and LUN configuration information by selecting the respective **Software** tab of Hardware View and viewing their configuration in the **Info** tab of the management pane.

View Volume Group Information

Volume group information shows the name, description of volume group, free size, and Total size in GB, as shown in the screen below.

Name	Size (GiB)			Description
	Free	Used	Total	
PG#1-1	107.98	697.21	805.2	
PG#1-8	271.91	531.91	803.82	
PG#1-9	76.75	728.25	805.0	
PG#1-2	0.0	805.21	805.21	
PG#1-11	0.0	805.21	805.21	
PG#1-12	764.57	40.62	805.2	
PG#1-13	5.1	800.1	805.2	
PG#1-14	25.21	780.0	805.21	
PG#1-15	0.0	805.21	805.21	
PG#1-3	0.0	805.21	805.21	
PG#1-4	0.01	550.19	550.2	
PG#1-5	10.19	794.86	805.05	
PG#1-6	7.89	797.3	805.19	
PG#1-7	5.01	800.2	805.21	
PG#2-1	799.74	5.46	805.2	

Oracle virtualization techniques, when applied to Hitachi storage arrays, extract LUNs from the following types of volume groups
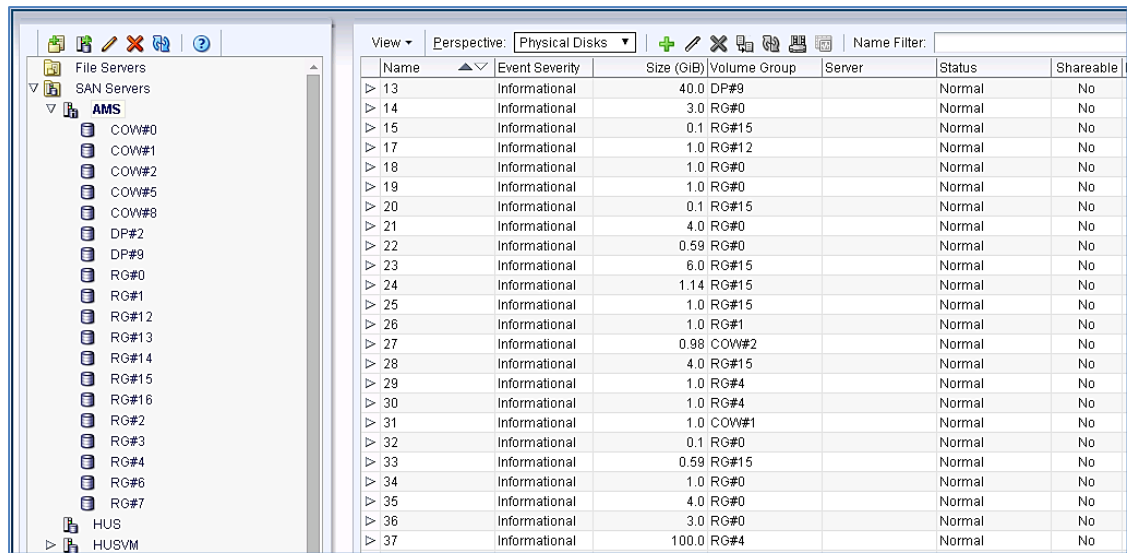
For AMS/HUS/VSP/ HUS VM/VSP G1000/VSP Gx00 Fx00:

- **Dynamic pool groups** – these are flexi-provisioned groups as per their utilization. Naming convention followed is <*DP#number*>.

- **Dynamic tearing Active Flash– these are flexi-provisioned groups as per their utilization. Naming convention followed is** <RT#number>**.**

- **PG groups** – these are static and have a predefined capacity for data load. Naming convention followed is <*PG#number*>.
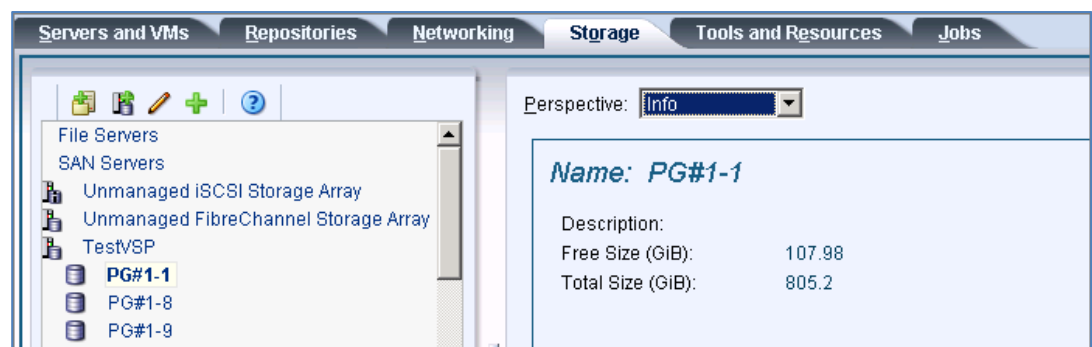
- **Dynamic tearing groups** – these are flexi-provisioned groups as per their utilization. Naming convention followed is <*DT#number*>.

⊡ **COW Pool** – These are Copy on Write Image Pools used for snapshot and cloning. Naming convention followed is <***COW#number***>.

View LUN Information

1. To view LUN information, perform the following steps:

2. Select the registered SAN server(for example, hm800)and select the "perspective" as physical disk from right pane. Select a particular LUN and expand the LUN information by clicking on the arrow before "LUN name."

   Note that all the logical unit numbers are shown in decimals. The following figure shows the LUN # 219 information before presenting it to an access group.

The following figure shows the LUN #219 information after presenting it to an access group.
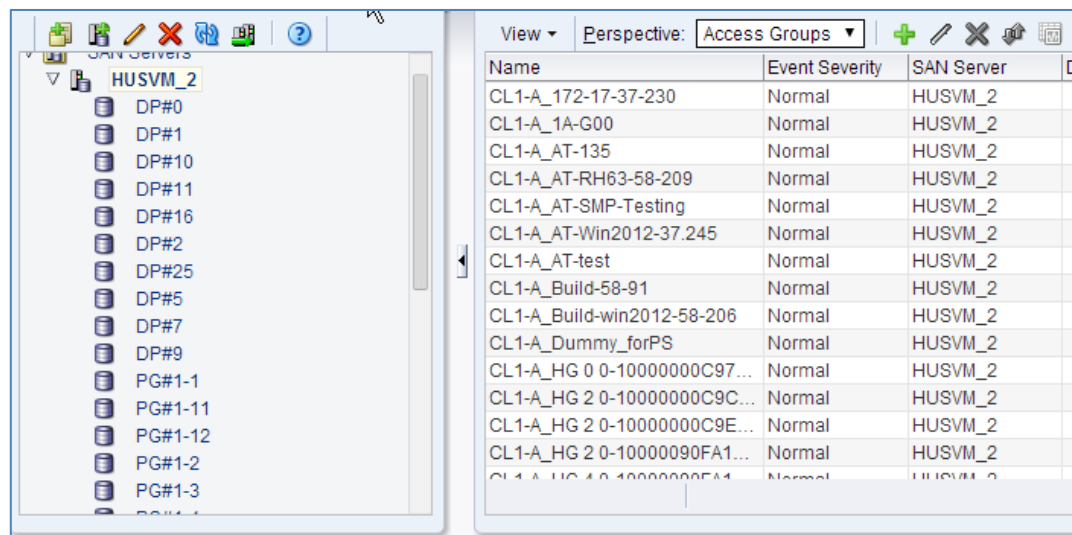
View Access Group Information

To view a list of LUNs visible to the Oracle VM Servers over an Access Group, select the **Access Groups** perspective in the right pane, then select a particular access group under consideration. Click the **Edit** button, All the LUNs presented to the server will be available on the **Physical Disks** tab.

Each access group name starts with the port number followed by an underscore (_) and host group name. All those Volume groups associated with the selected access group are listed along with the corresponding LUN details such as name, size, and description.

Note	If you are unable to find a physical disk (LUN), refresh the storage array for that LUN. The VM Manager populates the LUN list with all the LUNs.

Manage Access Groups

An access group is a logical entity used to limit the server that can interact with a specific LUN. Every access group has a list of access entries that a specific LUN can use. Access entries are a list of HBA port WWNs for FC SAN on a server and iSCSI Initiator in case of SCSI storage. They connect the LUNs (physical FC disks) to the FC storage initiators (servers) in the VM Manager. Once you create the access groups, you can rename and delete them.

In addition, the most important function is that of Add and Remove physical disks or LUNs—what we call Present and Unpresent LUNs on the Oracle VM servers.

Notes	To support FC multipathing, create an access group on each storage port and add WWN.
	Create Access Group: When you create a new access group, you should provide the name in the same order.
	For example, you might specify "CL1-A_Hostgroup1" where CL1-A is the port number of the storage array that will be used to present LUN and "Hostgroup1" is the host group name.
	Note: For HUVM RESOURCE GROUP management, Create Access Group is not supported for this release.
	Add and Remove WWN to the Access Group: This adds or removes WWN to or from all the targets created in the previous step.
	Note: For HUVM RESOURCE GROUP management, we currently do not support this operation.
	Present and Unpresent Physical Disks: This adds/removes physical disks to/from all the Access Groups (targets) created in above steps.
	Delete Access Group: This deletes the Access groups (targets) on all the ports mentioned by the Register Storage Array screen.

Create an Access Group

To create an Access Group for LUNs to be visible to servers, follow these steps:

1. Select the registered SAN server under consideration , then select Perspective as "Access Groups" in right pane.
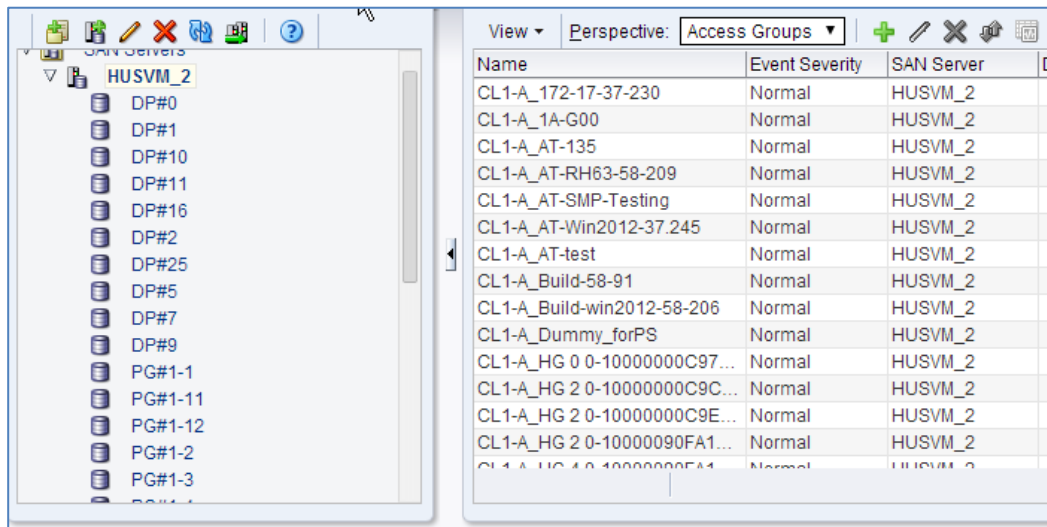
2. Click on the **Create** ➕ button.

3. Enter the Name and Description of the Access group.
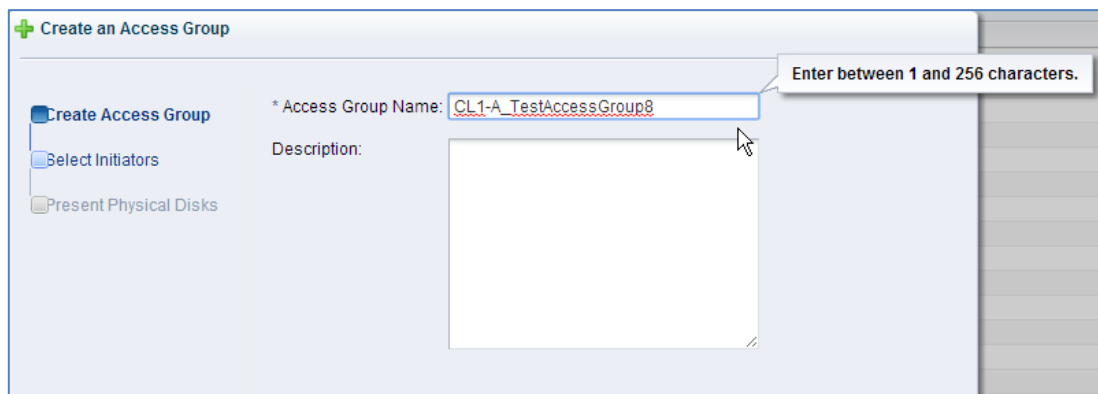
Naming an Access Group

An Access Group name should always starts with port name separated by ":" and then the host group name.

For example:

> **<portname>_<host group name>**

> Example: **CL3-A_Hostrgoup_test_1**

This adds the host group in the specified storage, in order to map the host group to RESOURCE GROUP please use RAID Manager command

Note	Creation of access groups on Virtual storage is not supported in this release.

A window appears and shows the list of available storage initiators. Follow these steps:

1. Select the access entry (HBA port WWNs) from the list of available storage initiators and move them to the selected storage initiators.

2. Click **OK** to save the Access group.

3. Add a storage initiator to the new access group.

The screen below shows the access group for a storage array with the list of available physical disks.
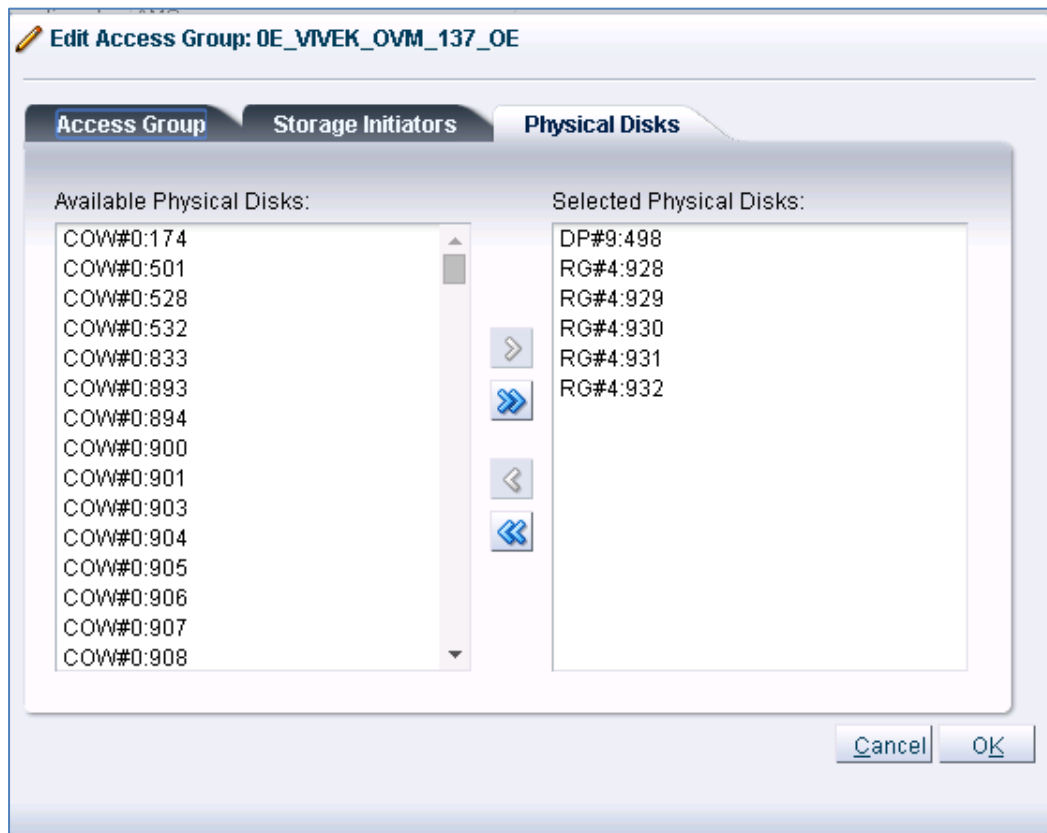
The following screenshot shows the physical disks selected to be presented to the server through access groups.
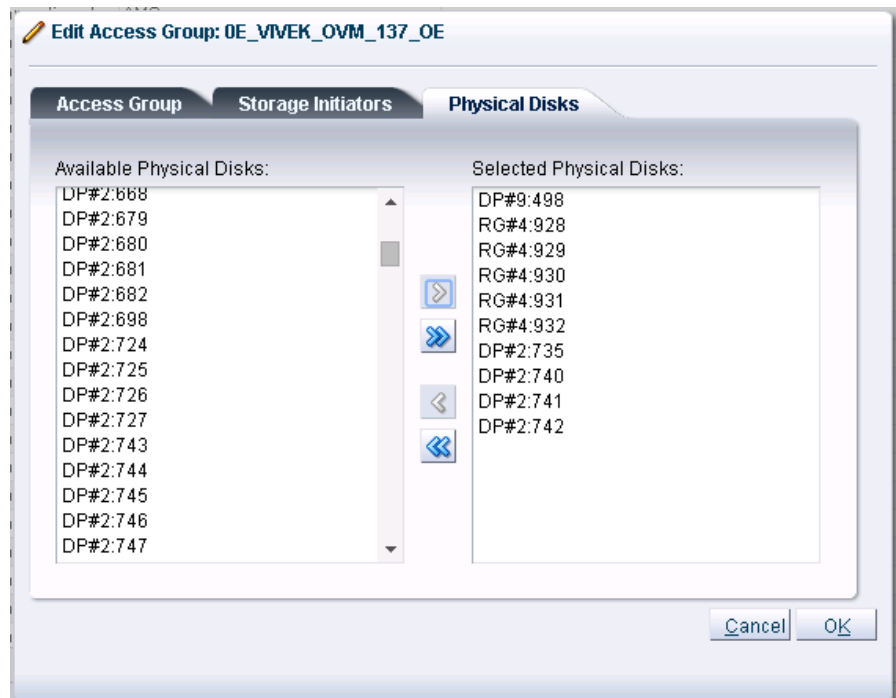
Edit Access Groups

Once you create an access group, you can edit it.

To edit an access group, follow these steps:

1. Right-click the selected access group and select edit access group.

2. To change the storage initiator for a LUN, move the storage initiators from available to selected and back to available as per its usage and click **OK** when done.
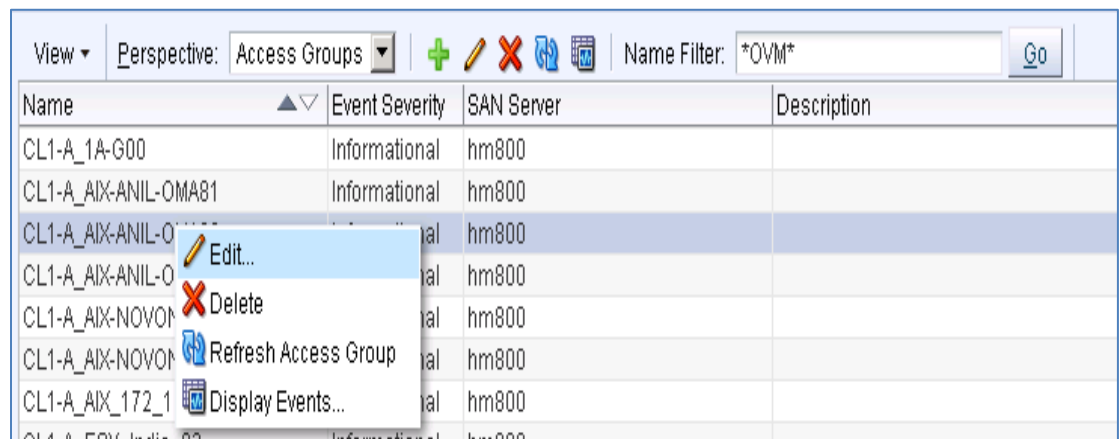
3. As shown in the following screenshot, you can modify the list of selected storage initiators.
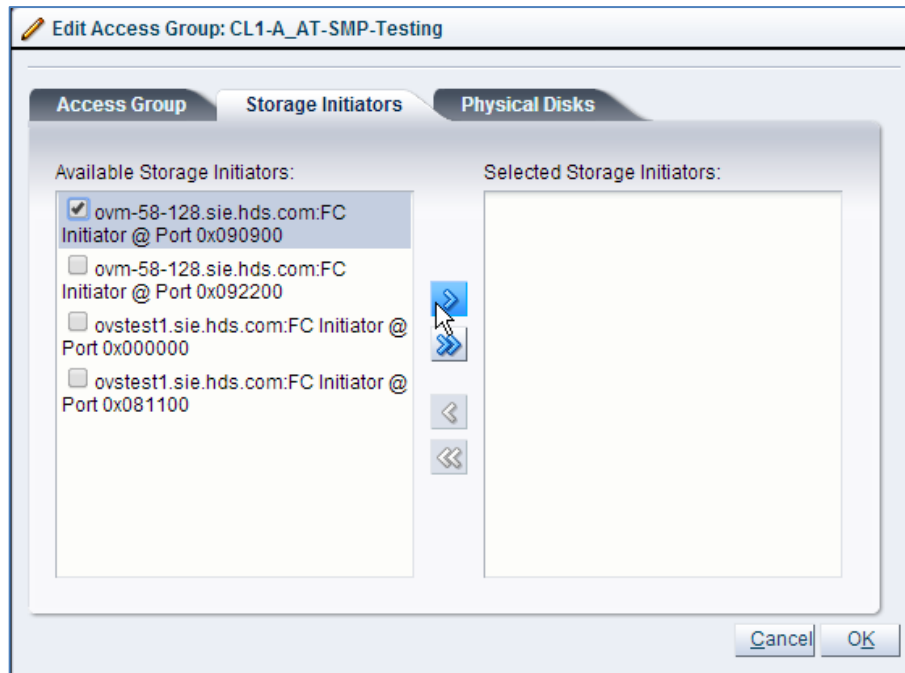
4. Select the storage initiator from the available list.
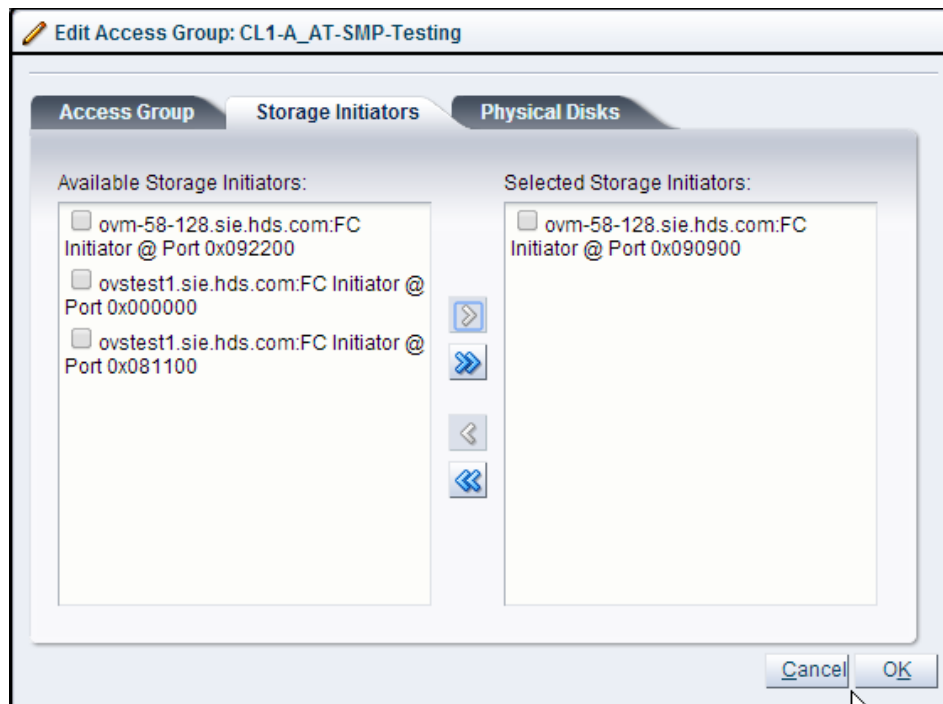
5. You can also add/remove LUNs from the physical disks tab.
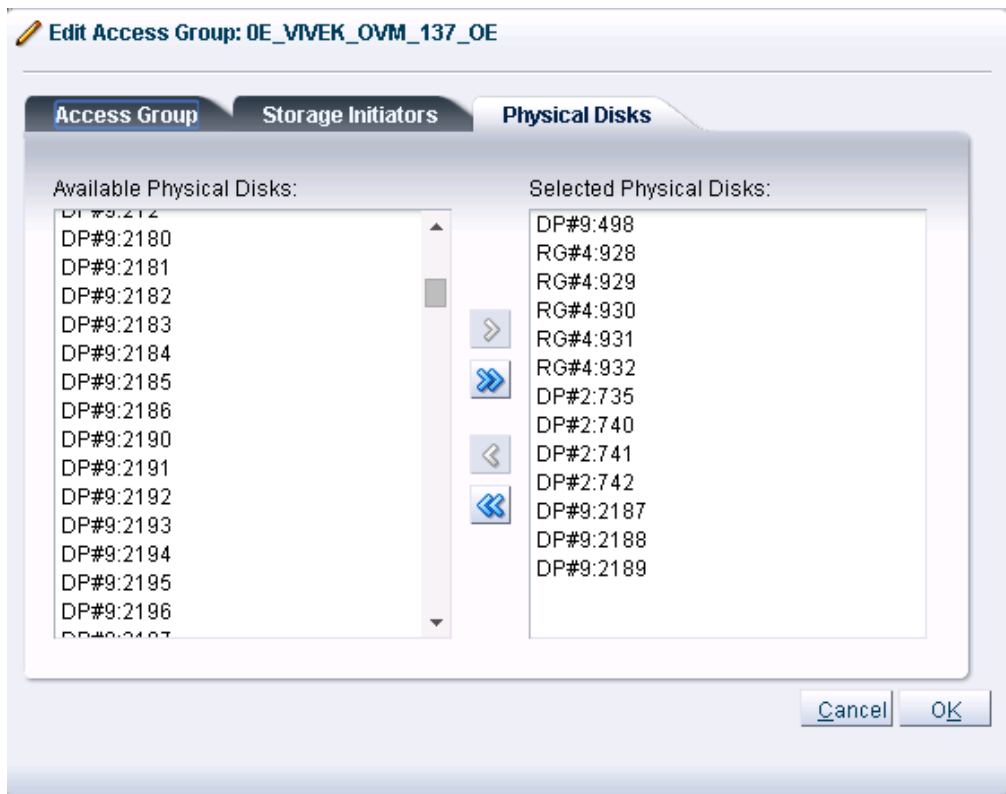
6. Once the physical disks are selected, click **OK** to present the disks to the server under consideration.

Delete Access Groups

To delete an Access group, follow these steps:

1. Edit the selected Access group and unpresent all the LUNs from the access group.

2. Right-click the selected Access group and select **Edit** to move the selected storage initiator to the available storage initiator.

3. Right-click access group and click **Delete** from the menu to remove the Access group from the storage server.
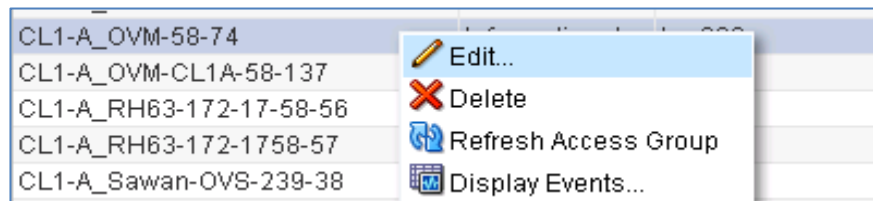
4. Click **OK** to confirm deletion of the access group.

> For HUVMRESOURCE GROUP management, we do not support deleting Access Groups.

Present and Unpresent Physical Disks

Once created, you can present LUNs to a server by editing the access group. To present one or more LUNs, follow these steps:

1. Select an access group, right-click, and select Edit.
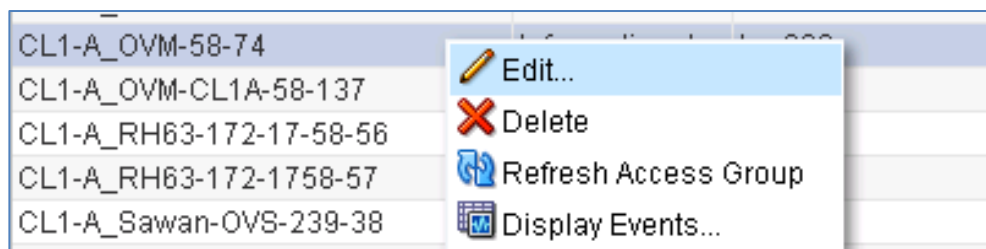
2. Select the LUNs from list of available physical disks to be presented to the server.

The LUNs must be presented to an access group before they can be visible to the storage initiator, as shown in the following figure.
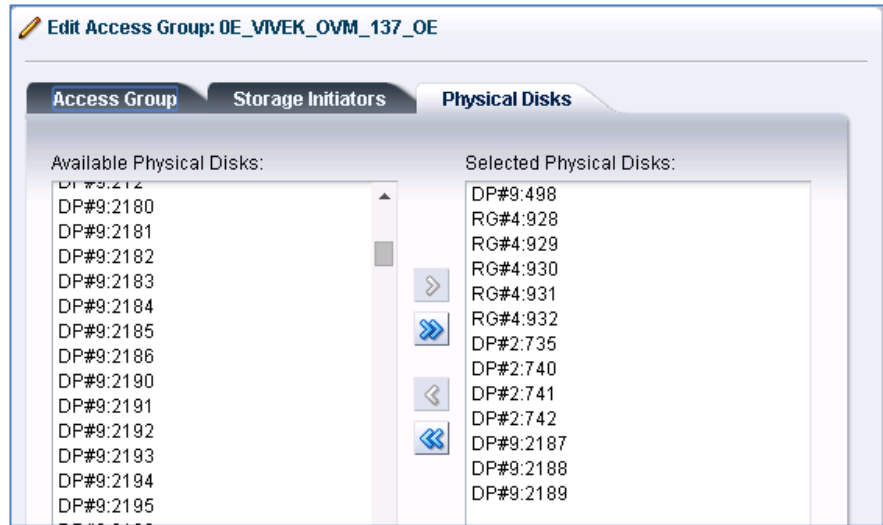
3. Once selected, click the **arrow** button to move them to the Selected Physical Disks box for presenting.

4. Click **OK** to present the selected LUNs.
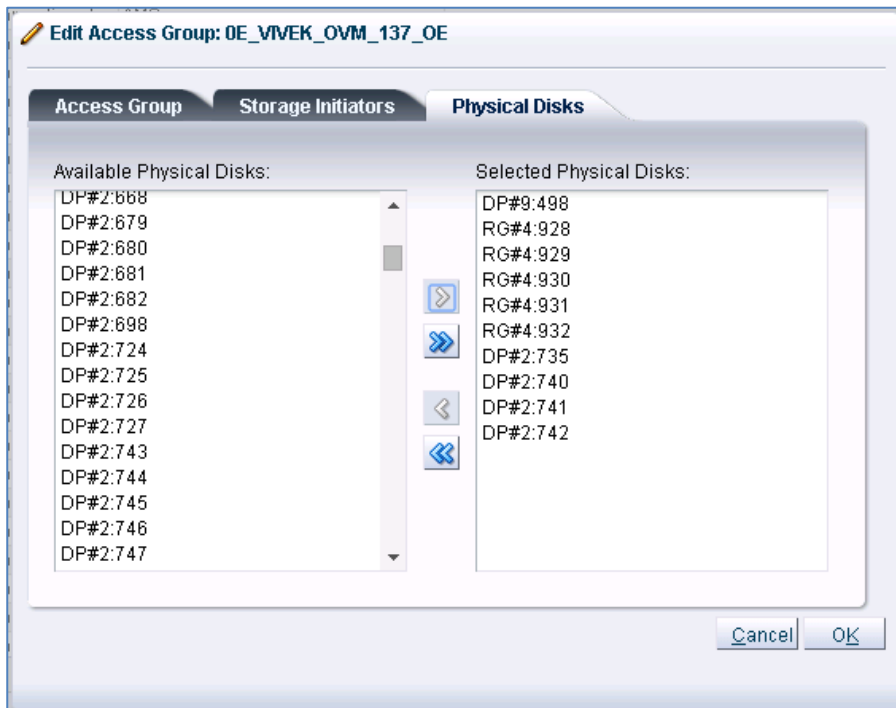
To unpresent LUNs

1.   Right-click the selected Access group and select **Edit** from the menu.

2.   The following window appears showing the access group information.
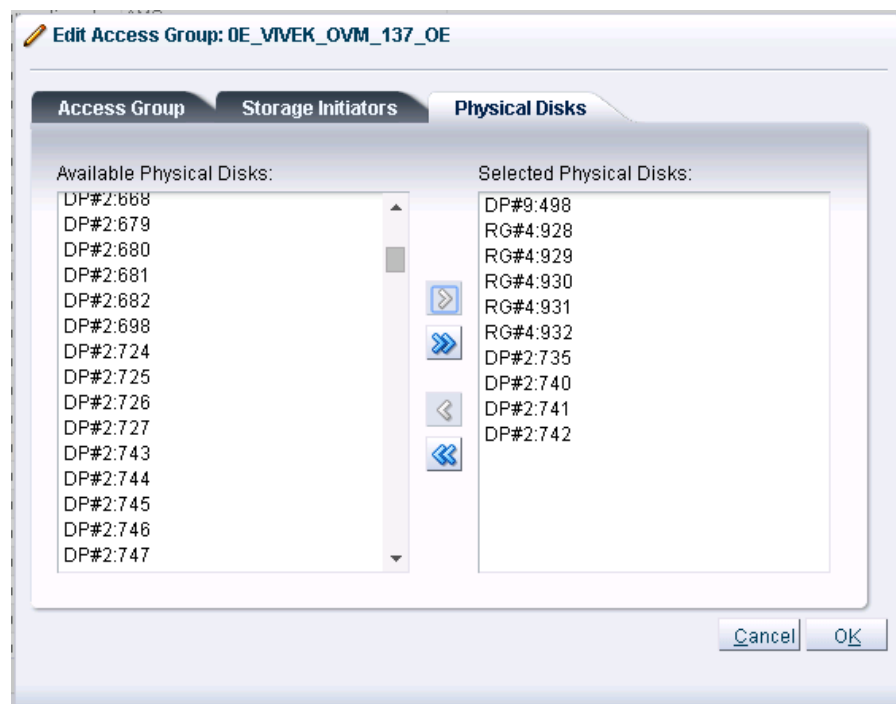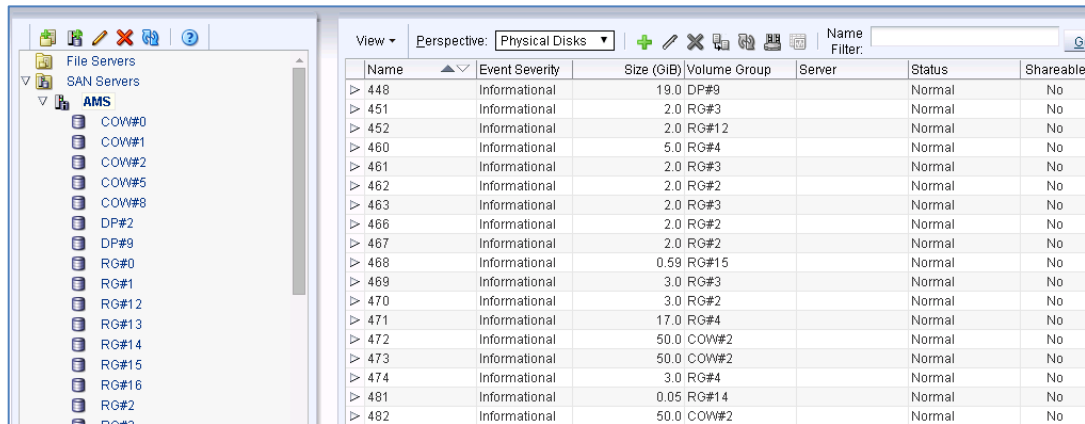
3.   To unpresent LUNs, select the Physical disks pane, then select one or more LUNs from the **Selected Physical Disks** box and click **arrow** button to move them to the **Available Physical Disks** box.

4.   Click **OK** to unpresent the moved LUNs.

Lifecycle of a Logical Unit (LUN)

The following pages describe a storage element or logical unit, beginning with creating a LUN, then managing a LUN, and ending with deleting a LUN.

Create a LUN

A LUN is a logical unit allocated from a Parity group or from DP storage pool of SAN Storage type of volume group.

To create a physical disk (LUN)

1.   Either select the Physical Disk from drop down menu, or select the volume group where you want to create Logical Unit. Click on the "+" icon on top right hand corner. to create a LUN.

2.   Enter the LUN number in **name** field, along with a description and the size in gigabytes.

> HUVM requires a virtual LUN number in the resource group. Plan to map LUNs from physical storage to resource groups.

3.   Click **OK** to create the LUN.

The Volume Group name for Parity group and DP Groups are given in the format <*PG#number*> and <*DP#number*> respectively.

The LUN219 created from DP #13. Its information is shown in the following screen.

Name	Event Severity	Size (GiB)	Volume Group	Server	Status ▲▽	Shareable	Description
▽ 219	Informational	932.0	DP#13		Normal	No	

Name:	219	Reserved by Server(s):
User Friendly Name:	219	Storage Targets:
SAN Server:	hm800	Server Pool:
Thin Provision:	Yes	Repository:
Type:	LUN	VM(s):

ID: 0004fb0000180000f7fe9d21ecf607cd
Page83 ID: 360060e8012272000050402720000000db
Access Groups:
Extra Information:

The LUN153 created from PG#1-2, and its information appears in the Info tab of the management pane.

Name	Event Severity	Size (GiB)	Volume Group	Server	Status ▲▽	Shareable	Description
▽ 153	Informational	50.0	PG#1-2		Normal	No	

Name:	153	Reserved by Server(s):
User Friendly Name:	153	Storage Targets:
SAN Server:	hm800	Server Pool:
Thin Provision:	Yes	Repository:
Type:	LUN	VM(s):

ID: 0004fb000018000008a96030af4126dc
Page83 ID: 360060e8012272000504027200000000099
Access Groups:
Extra Information:

Hitachi Storage Adapter for Oracle VM User's Guide

To create an LU on an HUVM Resource Group

You must create the virtual LU and map it to a physical LU. Follow the steps below.

1. Delete the default virtual LDEV ID.

Example

Raidcom get ldev ldev_id<physical ldev number which is not used>-login <username><password> -I15(assume the LDEV is 34542)

Raidcom unmap resource -ldev_id 34542-virtual_ldev_id 34542 login <username><password> -I15

2. Reserve an LDEV ID in the resource group.

Example

Raidcom add resource -ldev_id 34542 -resource_name AT-R800-10075 -login <username><password> -I15

After this step you should see the LDEV created in Resource Group (refresh the RESOURCE GROUP).

3. Virtualize the target volume.

Example

Raidcom map resource –ldev_id 34542 –virtual_ldev_id 86:EF -login <username><password> -I15

Present a New LUN

To present a new LUN to an Access Group, follow these steps:

1. Right-click the access group to which you want to present the new LUN and select Edit to Present/Unpresent Physical Disks from the menu.

2. Select DP#13:LUN219 from the Available Physical Disks box and click the arrow button to move it to the Selected Physical Disks box.

3. Click OK to save the LUN allocation.
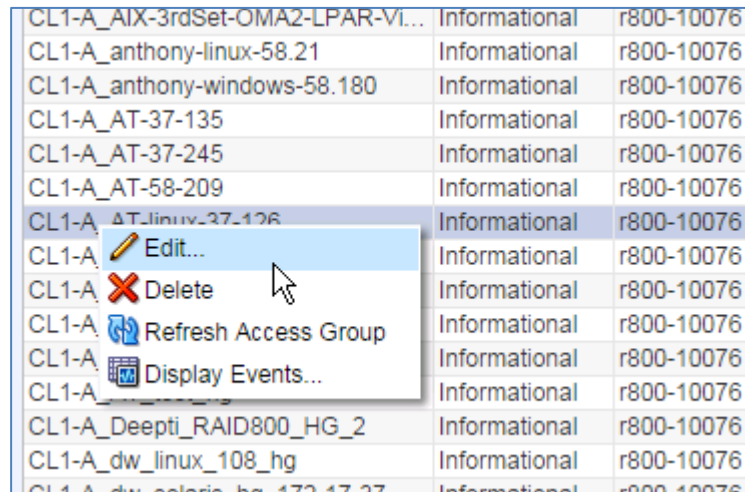
4. The LUN219 is presented to the Oracle VM Server 331 Server, as seen in the screen below.

Resize LUNs

To resize a LUN follow these steps:

1. Right-click on the LUN from physical Disk perspective tab.

2. Select **Edit**.

3. Change the New Size(GIB): to new value , value should be higher than the old one

4. Click **OK** to save the LUN allocation.
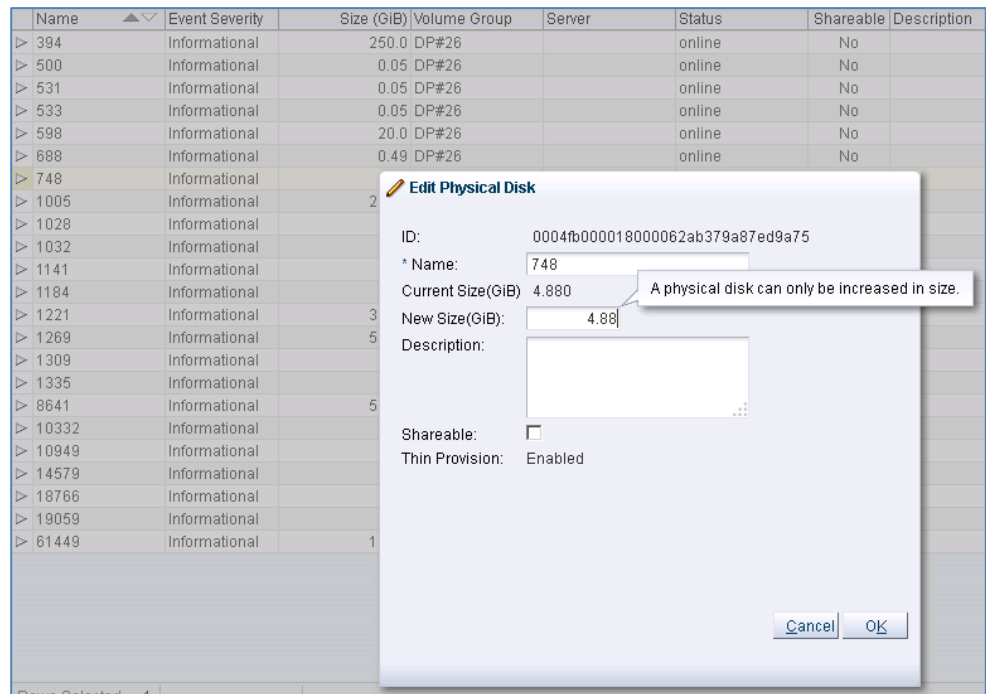
Once the operation complete lun size should show new size

NOTE: only HDP pool logical unit size can be expanded

Delete LUNs

First, unmap the LUN from the server. Second, remove the LUN from the access group. Third, delete the LUN from the storage system.

To Delete a LUN

To delete a LUN, unpresent it from the access group (see the Unpresent steps below)and then follow these steps:

1.   In the storage tab , select the LUN that you want to delete.

2.   Right-click the LUN and select Delete from the menu to delete the LUN from the storage subsystem.
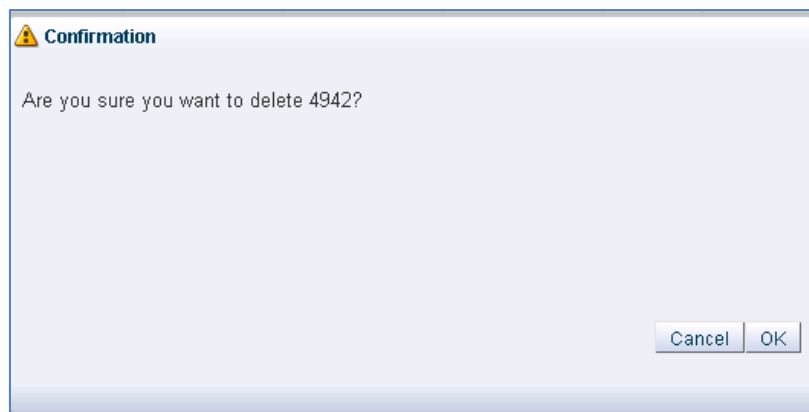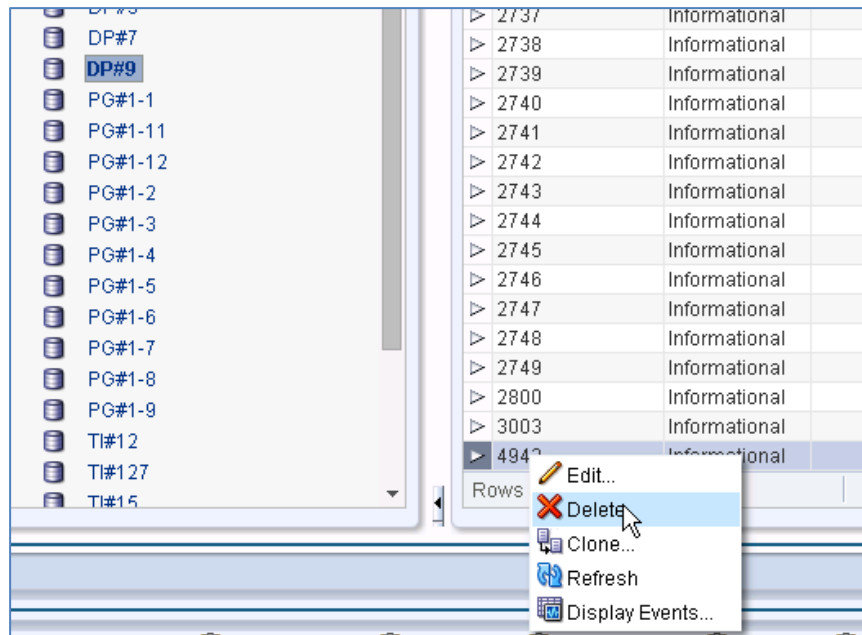
3. Click **OK** to confirm deletion. A LUN cannot be deleted if still in an access group. Unpresent the LUN from the access group before deleting, or VM Manager displays the message below.

To Unpresent a LUN

To unpresent a LUN from an access group:

1.   Right-click the access group and select edit from the menu.

2.   To unpresent the LUN, select the LUN219 from the **Selected Physical Disks** box and move to **Available Physical Disks** box with the arrow button.

   The following screenshot shows the LUN 219 info without the Access group name.

Name	Event Severity	Size (GiB)	Volume Group	Server	Status ▲▽	Shareable	Description
▽ 219	Informational	932.0	DP#13		Normal	No	

Name:	219	Reserved by Server(s):	
User Friendly Name:	219	Storage Targets:	
SAN Server:	hm800	Server Pool:	
Thin Provision:	Yes	Repository:	
Type:	LUN	VM(s):	

ID:	0004fb0000180000f7fe9d21ecf607cd
Page83 ID:	360060e8012272000504027200000000db
Access Groups:	
Extra Information:	

Clone Management

Hitachi Storage adapter for Oracle VM allows administrators to use the Oracle VM Manager GUI to perform advanced storage functionality such as cloning a Storage LUN. The definition of "Clone" with respect to the Hitachi Storage Adapter for Oracle VM is referred to as "instant" clone, which in Hitachi Storage terminology translates to either a **Copy-on-Write (CoW) HTI** or **ShadowImage**. In this release of the adapter, all operations performed from the VM Manager using the Hitachi Adapter result in the creation of ShadowImage

Create a Clone

To create a clone we use Hitachi ShadowImage.

To clone a LUN, present the LUN to the access group and follow these steps:

1.   Right-click the LUN from the appropriate volume group and click Clone Physical Disk from the menu.
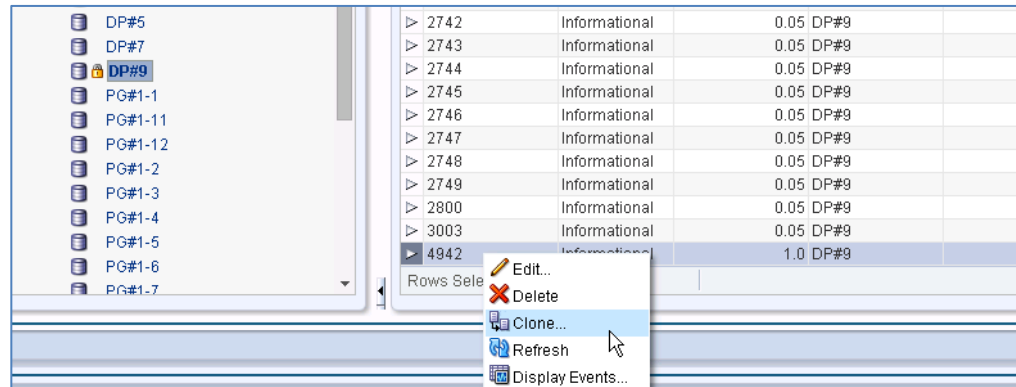
2. Click the down arrow to select the Clone Target Type. The target type is a Repository, a Physical Disk, or a Storage Array. Currently only Storage Array is supported.

3. Click the browse icon to select the storage array as the Clone Target.

4. Click OK to create a cloned LUN.

5. Note: Clone Type is set default to Thin Clone , we do not support Thin Clone we support Hitachi Shadow Image (Full Clone). Due to UI constraint we cannot change text box.

6. Note: Command device LUN, HTI LUN cannot be cloned
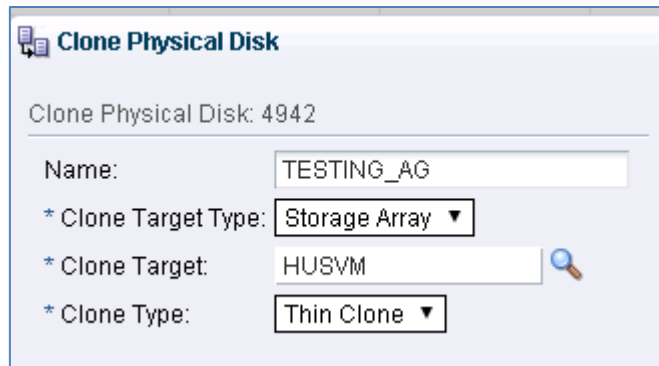
The following are the results when a new clone is created.

7. Get Port Number and Host group information from private Plugin text box from UI key is "ag" User is expected that hosgroup/iscsi target mentioned in private plugin text box is already created.

8. Presents the secondary volume LUN to above provided hostgroup/iscsi target host group.

9. Creates a replication pair between the primary volume and the secondary volume.

10. Remove the replication pair between the primary volume and secondary volume

11. After above operation, Primary and secondary volumes will be independent entity

   Oracle VM automatically adds this newly-created secondary volume to the primary LUN host group and rescans all the disks on the server.
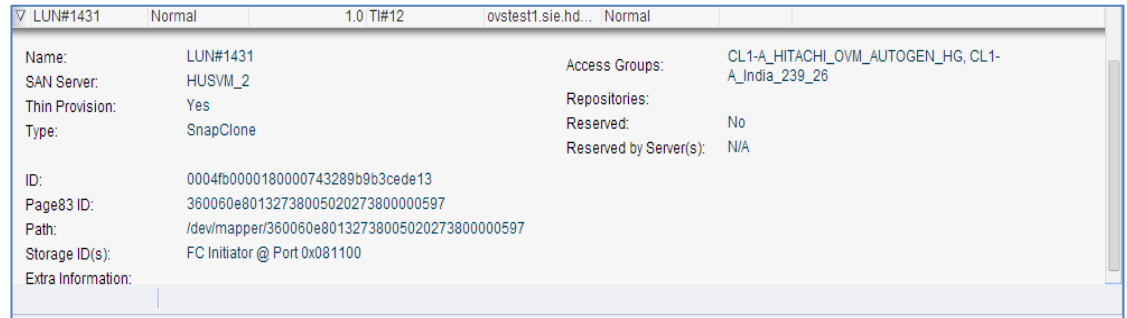
Delete Clones

To delete a clone, unpresent the LUN from the access group and follow these steps:

1. Right-click the LUN to select it from the appropriate volume group.

2. From the menu, click **Delete**.
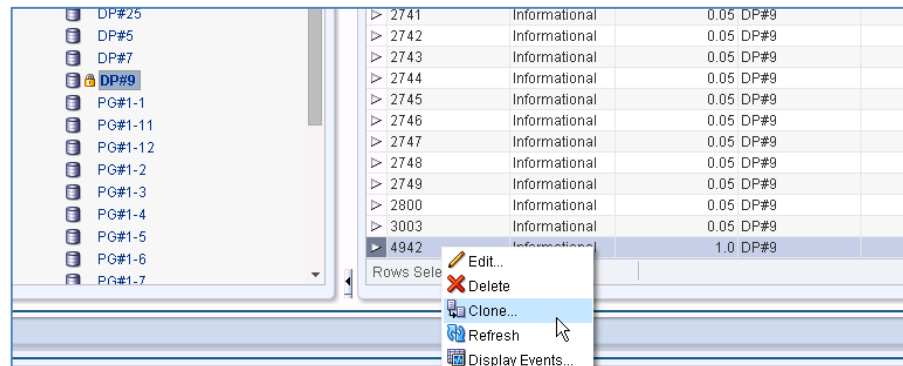
   To delete a clone, perform the following operation:

3. Unpresent the LUN from all the host groups where it is presented.

   The following are the results of deleting a clone:

4. The LUN is deleted.

Logging

This chapter includes the following sections:

Log Files

Log files are created in the log sub-folder

The Oracle VM agent manages the above location log.

/var/log/

When you delete the log folder, the application creates a new log folder.

The log files are created with Unicode encoding, which allows multi-byte strings to be stored in the log files. For example, when you enter a Japanese username and password in a user input screen, the data username is logged with the correct Japanese character encoding.

Log File Location

Hitachi Storage Adapter for Oracle VM

/var/log/HiOVM.log

Table 6-1 Log Output of Each Module

#	Log File Name	Description	Other output
1	HiOVM.log	Adapter log	
3	ovs-agent.log	Oracle agent log	Oracle VM Manager UI

Specifying Logging Levels in the Configuration File

The configuration file **log4cplus.properties** is at:

/opt/storage-connect/plugin/hitachi/storage/lib directory.

The **log4cplus.properties** file also contains more information about logging levels. By default, the log is set to TRACE, STDOUT, TRACE_LOG.

Supported log levels are:

- LOG : Report everything of priority INFO or higher to HiOVM.log
- DEBUG_LOG : Report everything of priority DEBUG or higher to HiOVM.log
- TRACE_LOG: Report everything of priority TRACE or higher to HiOVM.log

Log Generation and Rotation

Hitachi Storage Adapter for Oracle VM log files are created when the hiStorApp process starts. The log file generation and rotation of the adapter log files have the following features:

- Allow multiple processes to log to the same log file.
- User-specified, size-based log rotation.
- Rotate the current or active log file by incrementing the log file name, by appending consecutive numbers, starting from zero up to a user-specified limit, or a system default.
- Log file names are HiOVM.log, HiOVM.log.1, HiOVM.log.2, and so on.

The active log file name is **HiOVM.log**.

Log Configuration Values

The log configuration values are written in the **log4cplus.properties** file.

MaxFileSizeconfig value

log4cplus.appender.LOG.MaxFileSize=1MB, this value can range from 1 to 100, indicating size to be 1MB to 100MB. If the values outside this range are provided, the default value of 10 is used.

Maximum number of backup files, config value [subheading]

log4cplus.appender.LOG.MaxBackupIndex=5, this value can range from 1 to 255. If values outside this range are provided, the default value of 5 is used.

Message Codes

0xE430000C

Message ID	E430000C
Message Text	0[%s] :%s:create storage device failed %d.
Explanation	Information only.
Recommended Action	No action required.

0xE430000D

Message ID	E430000D
Message Text	0[%s] :%s:validate storage device failed %d:%s.

Explanation	Information only.
Recommended Action	No action required.

0xE430000E

Message ID	E430000E
Message Text	0[%s] :%s:get unit information failed %d.
Explanation	Information only.
Recommended Action	No action required.

0xE430000F

Message ID	E430000F
Message Text	0[%s] :%s:getlun list failed %d.
Explanation	Information only.
Recommended Action	No action required.

0xE4300010

Message ID	E4300010
Message Text	0[%s] :%s:getlun info failed %d.
Explanation	Information only.
Recommended Action	No action required.

0xE4300011

Message ID	E4300011
Message Text	0[%s] :%s:createlun info failed %d.
Explanation	Information only.
Recommended Action	No action required.

0xE4300012

Message ID	E4300012
Message Text	0[%s] :%s:add to host group failed %d.
Explanation	Information only.
Recommended Action	No action required.

0xE4300013

Message ID	E4300013
Message Text	0[%s] :%s:create host group failed %d.
Explanation	Information only.
Recommended Action	No action required.

0xE4300014

Message ID	E4300014
Message Text	0[%s] :%s:rename host group failed %d.
Explanation	Information only.
Recommended Action	No action required.

0xE4300015

Message ID	E4300015
Message Text	0[%s] :%s:remove host group failed %d.
Explanation	Information only.
Recommended Action	No action required.

0xE4300016

Message ID	E4300016
Message Text	0[%s] :%s:present lun to host group failed %d.
Explanation	Information only.
Recommended Action	No action required.

0xE4300017

Message ID	E4300017
Message Text	0[%s] :%s:unpresent lun to host group failed %d.
Explanation	Information only.
Recommended Action	No action required.

0xE4300018

Message ID	E4300018
Message Text	0[%s] :%s:remove lun failed %d.

Explanation	Information only.
Recommended Action	No action required.

0xE4300019

Message ID	E4300019
Message Text	O[%s] :%s:get all info failed %d.
Explanation	Information only.
Recommended Action	No action required.

0xE430001A

Message ID	E430001A
Message Text	O[%s] :%s:get pool list failed %d.
Explanation	Information only.
Recommended Action	No action required.

0xE430001B

Message ID	E430001B
Message Text	O[%s] :%s:get host group list failed %d.
Explanation	Information only.
Recommended Action	No action required.

0xE430001C

Message ID	E430001C
Message Text	O[%s] :%s:create snapshot failed %d.
Explanation	Information only.
Recommended Action	No action required.

0xE430001D

Message ID	E430001D
Message Text	O[%s] :%s:remove snapshot failed %d.
Explanation	Information only.
Recommended Action	No action required.

0xE430001E

Message ID	E430001E
Message Text	0[%s] :%s:split snapshot failed %d.
Explanation	Information only.
Recommended Action	No action required.

0xE430001E

Message ID	E430001F
Message Text	0[%s] :%s:restore snapshot failed %d.
Explanation	Information only.
Recommended Action	No action required.

0xE4300020

Message ID	E4300020
Message Text	0[%s] :%s:get current snapshots failed %d.
Explanation	Information only.
Recommended Action	No action required.

0xE4300021

Message ID	E4300021
Message Text	0[%s] :%s:get vvol list failed %d.
Explanation	Information only.
Recommended Action	No action required.

0xE4300022

Message ID	E4300022
Message Text	0[%s] :%s:rename lun failed %d.
Explanation	Information only.
Recommended Action	No action required.

Troubleshooting

□ Errors and Known Issues

□ Troubleshooting Tips

Hitachi Storage Adapter for Oracle VM User's Guide

Troubleshooting Tips

Sometimes the Oracle VM Manager service needs to be restarted after the unregister SAN server operation. The unregistered array is not cleared up from the GUI. This is an OVM Manager issue.

Sometimes the physical device created through the adapter shows the status as "error reading LU status." Once the SAN server is refreshed, LUN status becomes "Normal."

If an iSCSI session is established, log in to iSCSI manually. Please refer to iSCSI documentation for login operations.

When the adapter creates an access group, its default authentication is set to CHAP, NONE. Change this according to your needs.

For iSCSI, storage systems allow multiple host names on same host IQN and port. This feature is as designed.

Once the SAN server is re-registered, custom clone names go away. The adapter does not support custom clone names. This is as designed; we use custom clone names only to provide LUN numbers for HUVM.

References and Terms

References

For more information, visit the web resources listed in the table below.

URLs for more Information	
Oracle Virtualization	http://www.oracle.com/virtualization
Oracle Templates	http://www.oracle.com/technetwork/server-storage/vm/templates-1-1937.html
Oracle VM	http://www.oracle.com/technetwork/server-storage/vm/overview/index.html

Acronyms and Abbreviations

Acronym/ Abbreviation	Definition
AMS	Adaptable Modular System
DAS	Direct Attached Storage
DP	Data Pool
FC(HBA WWN)	Fibre Channel Host Bus Adapter World Wide Name)
FCoE	Fibre Channel over Ethernet
HBA	Host Bus Adapter
HUS	Hitachi Unified Storage
IaaS	Infrastructure as a Service
iSCSI	Internet Small Computer System Interface

Acronym/ Abbreviation	Definition
LUN	Logical Units
OVS	Oracle Virtual Server
RAID	Redundant Array of Independent Disks
RG	RAID Group
RPM	RPM/Red Hat Package Manager
SAN	Storage Area Network
SP	Storage Pool
VM	Virtual Machine
WWN	World Wide Name

Glossary

This glossary defines the special terms used in this document. Click the desired letter below to display the glossary entries that start with that letter.

| [#](#) | [A](#) | [D](#) | [G](#) | [H](#) | [L](#) | [M](#) | [P](#) | [S](#) | [T](#) | [V](#) | [W](#) |

#

A

Access Group

Access groups limit the server that can interact with a specific LUN. In Hitachi terminology, an access group is typically known as a Hostgroup(HG). Oracle VM identifies an access group with a user-readable name. With every access group a list of access entries is associated. This would normally be a list of iSCSI initiators (for iSCSI storage type) and a list of HBA port WWNs (for FC SAN).

D

Domain

A domain is a configurable set of resources, including memory, virtual CPUs, network and disk devices, in which virtual machines run. A domain is granted virtual resources and can be started, stopped and restarted independently.

Domain (domU)

References and Terms

Hitachi Storage Adapter for Oracle VM User's Guide

Guest operating systems each have their own management domain called a "user domain", abbreviated to "domU". These domains are unprivileged domains with no direct access to the hardware or device drivers. Each domU is started by Oracle VM Server in dom0.

G

Guest Operating System

A guest is a virtualized operating system running within a domain. A guest operating system may be paravirtualized, full virtualized, or hardware virtualized. Multiple guests can run on the same Oracle VM Server.

H

Host Bus Adapters (HBAs)

Also called Fibre Channel interface cards, each HBA has a unique World Wide Name (WWN). An HBA connects a host system (computer) to other network and storage devices. The HBA usually assumes the role of SCSI initiator (host computer), in that it issues commands to other SCSI devices. A computer can contain more than one host adapter (HBA), which can greatly increase the number of SCSI devices available.

High Bandwidth Adapters (HBA)

Host Bus Adapters are also referred to as high-bandwidth adapters in case of Fibre Channel (FC) controllers.

L

Logical Units (LUs)

A device having a logical unit number (LUN), addressed by a Fibre Channel or iSCSI protocol.

M

Management Domains(Dom0)

The responsibility of hardware detection in an Oracle VM Server environment is passed to the management domain, referred to as domain zero (or dom0). dom0 is a LINUX kernel that provides access to much of the system hardware, creating, destroying, and controlling guest operating systems; and presenting those guests with a set of common virtual hardware.

P

Port

A port is software serving as a communication endpoint in a computer's host operating system. A port is associated with an IP address of the host

and the type of protocol for communication. A 16-digit number called the port number identifies a port for each address and protocol.

S

Storage Area Network (SAN)

SAN is a dedicated network that provides access to consolidated, block level data storage. The primary purpose of SANs is to make storage devices, such as disk arrays, accessible to servers so that the devices appear like locally attached devices to the operating system. A SAN typically has its own network of storage devices that are generally not accessible through the local area network by other devices. A SAN does not provide file abstraction, only block-level operations. However, file systems built on top of SANs do provide file-level access, and are known as SAN file-systems or shared disk file systems.

Storage Array

Any block-based storage device, be it Fibre Channel (SAN Storage), Ethernet (iSCSI Storage), or direct connect (SCSI/SAS/DAS) based.

SCSI Initiator and Target

In computer data storage, a SCSI initiator is the endpoint that initiates a SCSI session, that is, sends a SCSI command. The host computer or initiator usually does not provide any Logical Unit Numbers (LUNs).

A SCSI target is the endpoint that does not initiate but waits for initiators' commands and provides required input/output data transfers.

The data storage device or target provides to the host computer/initiators one or more LUNs, so that the read or write command is possible.

Storage Server (ss)

For every storage server managed by Storage Connect framework, Oracle VM maintains a record called ss_record. An ss_record is structurally a python dictionary and has fields such as "name", "uuid", "storage_server_id", "storage_type", "admin_user", admin_passwd", "status", "access_groups", "storage_description" and so on. This dictionary record is passed as an argument to most adapter APIs. For more details, please refer to "Oracle Storage Connect Plug-in General Development Guide".

Storage Element (se)

This term refers to any type of storage that the storage array supports, for example: LUNs, Snapshots, and Clones etc.

In the current release, the Hitachi Adapter supports only LUNs. The storage connect framework refers to a storage element using a dictionary record structure called se_record. se_record has fields such as "se_type", "ss_uuid", "name", "uuid", "state", "size", "status", "access_grp_names"

and so on. This dictionary record is passed as argument to many adapter APIs that operate at the individual storage element level. For more details, please refer to "Oracle Storage Connect Plug-in General Development Guide".

T

Thin Provision

A LUN is said to be thin provisioned as in DP Storage Pool or fully provisioned as in RAID Group. During LUN creation if the Thin provision flag is set to true then the volume group name is set as per the DP Storage pool number **DP#<DP SPNumber>** else the volume group name is set as per the RAID group as **PG#<PGNumber>**.

V

VBOX

Viritual storage or resource group or storage.

Virtual Machine

A virtual machine is a guest operating system and its associated application software.

Volume Group

This is a storage grouping construct from which LUNs can be carved out. With Hitachi Storage adapter, volume group can refer to a DP Storage Pool(DP) or a Parity Group (PG). The name of the volume group is of the form "DP#*<DynamicPoolNumber>*" when it refers to a storage pool. The name of the volume group is of the form "PG#*<ParityGroupNumber>*" when it refers to a Parity Group.

W

World Wide Name

A unique identifier that identifies particular Fibre Channel.

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