Deploy VMware Site Recovery Manager 5.8 with VMware vSphere 5.5 on the Hitachi Virtual Storage Platform Family Systems

Reference Architecture Guide

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Deploy VMware Site Recovery Manager 5.8 with VMware vSphere 5.5 on the Hitachi Virtual Storage Platform Family Systems

Reference Architecture Guide

This reference architecture guide describes a business continuity and disaster recovery solution to protect a VMware vSphere virtualized data center. The infrastructure is built on the Hitachi Virtual Storage Platform family systems and Hitachi Compute Blade 500. The operation depends on Hitachi TrueCopy® Heterogeneous Remote Replication bundle and Hitachi ShadowImage® Heterogeneous Replication.

The Virtual Storage Platform family of systems is an integral piece in building out a robust business continuity and disaster recovery solution. VMware vCenter Site Recovery Manager integrates tightly with the Virtual Storage Platform family using Hitachi Storage Replication Adapter. The advanced functionalities found in the Virtual Storage Platform family systems do the following by managing data replication across data centers:

- Fulfill the requirements of a virtual infrastructure
- Provide reliable protection

The Virtual Storage Platform family includes these models:

- Virtual Storage Platform G200
- Virtual Storage Platform G400
- Virtual Storage Platform G600
- Virtual Storage Platform G800
Virtualizing your data center with VMware vSphere provides several benefits to IT infrastructures, including the following:

- Reduce capital expenses through server consolidation.
- Reduce operating expenses through automation that allows the data center to run more efficiently.
- Protect critical applications running on a central infrastructure with features such as VMware High Availability, which reduces planned and unplanned downtime.

When you expand your data centers across multiple locations provides an opportunity to increase these layers of protection beyond a single data center.

VMware vCenter Site Recovery Manager is a business continuity and disaster recovery solution. It integrates vSphere infrastructures with array-based replication to either of the following:

- A traditional two-site design, with a protected site and recovery site
- A multi-site design, with multiple protected sites pointing to a single recovery site

The multi-site design ensures higher levels of recovery point objectives (RPO) and recovery time objectives (RTO) when compared to traditional backup and recovery solutions.

Using an automated recovery plan, a production data center site can failover to a disaster recovery site in an organized and validated manner.

Remote data replication is a key function in building out stable and reliable disaster recovery environments. Although data replication can be performed at the server level, perform this function more effectively within the storage infrastructure.

The intended use of the reference architecture guide is by IT administrators charged with the storage, deployment, or administration of VMware vSphere infrastructures on Hitachi Virtual Storage Platform family systems and Hitachi Compute Blade 500. It assumes familiarity with the following:

- Storage area network-based storage systems
- VMware vSphere
- Hitachi data replication technologies
- Common IT storage practices
Note — Testing of this configuration was in a lab environment. Many things affect production environments beyond prediction or duplication in a lab environment. Follow the recommended practice of conducting proof-of-concept testing for acceptable results in a non-production, isolated test environment that otherwise matches your production environment before your production implementation of this solution.
Solution Overview

This reference architecture describes a business continuity and disaster recovery solution to protect a VMware vSphere virtualized data center backed by hardware and software from Hitachi Data Systems to simulate two data centers. It uses the following components:

- **Hitachi Compute Blade 500** — Enterprise-class server platform, containing internal Fibre Channel and network switch modules, that provides dense compute resources and high I/O throughput

- **Hitachi Virtual Storage Platform Family Systems** — A high performance and highly scalable storage solution

- **Brocade 6510 Fibre Channel Switch** — Provides SAN connectivity to the storage network of the data center

- **VMware vSphere 5.5** — Virtualization technology providing the software infrastructure for the data center

- **VMware vCenter Site Recovery Manager 5.8** — Disaster recovery solution for protecting the vSphere virtual infrastructure

- **Hitachi Storage Replication Adapter 2.01.4** — Adapter for integrating Site Recovery Manager with the Virtual Storage Platform family systems

Figure 1 on page 5 is an overview of the VMware vSphere environment used in this reference architecture guide.
These are the operations performed by VMware vCenter Site Recovery Manager.

The operations below leverage the Hitachi Storage Replication Adapter in conjunction with either of the following storage-based replication technologies:

- Hitachi TrueCopy Synchronous Remote Replication bundle
- Hitachi Universal Replicator
The following replication examples use Hitachi TrueCopy.

- “Recovery,” starting on page 6
- “Reprotect,” starting on page 7
- “Recovery (Failback) and Reprotect,” starting on page 8
- “Test Recovery,” starting on page 9
- “Cleanup,” starting on page 11

**Recovery**

In a normal state, where replicating the primary site datastores to the recovery site, the ESXi host cannot mount the recovery site datastores, as they are in a read-only state. This means the replicated protected virtual machines cannot register to the recovery site ESXi host.

Because of this, VMware vCenter Site Recovery Manager creates and registers placeholder virtual machine files to reserve a place in the vCenter inventory of the recovery site for the protected virtual machines. For this environment, configure the management virtual machine datastore on the recovery site ESXi host to store the placeholder virtual machine files.

The recovery operation for Site Recovery Manager has two options:

- Planned migration
- Disaster recovery

Depending on the selected option, built-in verification steps run prior to executing the recovery process. At the storage replication level, three steps occur for both options:

- Recovery process initiates a replication split.
- Primary site volume (P-VOL) becomes read-only.
- Recovery site volume (S-VOL) becomes read/write.

Figure 2 on page 7 shows the pair state after a recovery process has run.
Reprotect

After performing a recovery, the recovery site ESXi host has write access to the replicated volume (S-VOL) and starts the virtual machines on the recovery site. This state does not protect the virtual machines.

Once the primary site is back up, the reprotect operation of Site Recovery Manager reverses the role of the two sites. The primary site protects the recovery site.

At the storage replication level, three steps occur:

- Recovery site volume converts to a primary volume (P-VOL).
- Primary site volume converts to secondary volume (S-VOL).
- TrueCopy replication initiates from recovery site to primary site.

Figure 3 shows the pair state after running a reprotect process.
Recovery (Failback) and Reprotect

When ready to resume normal operations, failback is required to migrate back the production workload to the primary site.

Essentially, the failback process works the same as another recovery operation, except it works in the reverse direction from the initial recovery process.

At the storage replication level, three steps occur:

- Recovery process initiates a replication split.
- Recovery site volume (P-VOL) becomes read-only.
- Primary site volume (S-VOL) becomes read/write.

Figure 4 shows the pair state after recovery (failback) process has run.

After successfully completing the failback, run reprotect to initiate storage replication again. This ensures protection of the virtual machines and returns the environment to its original state.

At the storage replication level, three steps occur:

- Primary site volume converts back to a primary volume (P-VOL).
- Recovery site volume converts back to secondary volume (S-VOL).
- TrueCopy replication initiates from primary site to recovery site.

Figure 5 on page 9 shows the pair state after running the final reprotect.
Figure 5

Test Recovery

Site Recovery Manager provides a feature to test recovery plans without disrupting ongoing operations at either site. This uses a locally replicated copy of the recovery site volume. Add this optional function to the existing configuration by creating another replication LUN on the storage system of the recovery site.

Hitachi ShadowImage Heterogeneous Replication bundle creates an in-system asynchronously replicated pair between the TrueCopy secondary volume (S-VOL) and the new LUN.

Figure 6 provides a diagram of the relationship between the TrueCopy and ShadowImage Heterogeneous Replication pairs.

Figure 6

Figure 6 shows the following:

- The TrueCopy secondary volume (S-VOL) becomes the ShadowImage primary volume (P-VOL).
- A Hitachi Open Remote Copy Manager instance (HORCM2) manages the ShadowImage secondary volume (S-VOL).
Both volumes are read-only. The ESXi host at the recovery site cannot access them.

When initiating the test recovery process, the replicated virtual machines attaches to one of the following:

- A non-production VMware vSphere virtual switch
- A private network specified in the recovery plan to avoid network conflicts with the protected virtual machines running on the primary site

At the storage replication level, two steps occur:

- Test recovery process initiates a replication split of the ShadowImage pair.
- Recovery site ShadowImage replicated volume (S-VOL) is made read/write.

Figure 7 shows the pair state after the test recovery process has run.

![SRM-initiated Test Recovery Diagram](image)

**Figure 7**

This configuration allows the ESXi host at the recovery site to power on the replicated virtual machines safely without disrupting the TrueCopy replication. This provides the administrator with a tangible method for testing and validating the disaster recovery process.

For more details around the configuration of the ShadowImage relationship, see "Configure the Hitachi ShadowImage Heterogeneous Replication Pair," starting on page 31.
**Cleanup**

After running a test recovery operation, the cleanup process returns the ESXi host on the recovery site to its original state. This powers off the replicated virtual machines and restores the placeholder virtual machines.

At the storage replication level, two steps occur:

- On the recovery site, Hitachi ShadowImage replicated volume (S-VOL) becomes read-only.
- Cleanup process resumes ShadowImage replication.

Figure 8 shows the pair state after the cleanup process has run.

*Figure 8*
Key Solution Components

The following are descriptions of the components used in this reference architecture.

Hitachi Virtual Storage Platform Family Systems

The Hitachi Virtual Storage Platform family systems are based on industry-leading enterprise storage technology. With flash-optimized performance, these systems provide advanced capabilities previously available only in high-end storage arrays. With the Virtual Storage Platform family, you can build a high performance, software-defined infrastructure to transform data into valuable information.

Hitachi Storage Virtualization Operating System provides storage virtualization, high availability, superior performance, and advanced data protection for all models in the Virtual Storage Platform family. This proven, mature software provides common features to consolidate assets, reclaim space, extend life, and reduce migration effort. New management software improves ease of use to save time and reduce complexity. The infrastructure of Storage Virtualization Operating System creates a management framework for improved IT response to business demands.

Hitachi Compute Blade 500

Hitachi Compute Blade 500 combines the high-end features with the high compute density and adaptable architecture you need to lower costs and protect investment. Safely mix a wide variety of application workloads on a highly reliable, scalable, and flexible platform. Add server management and system monitoring at no cost with Hitachi Compute Systems Manager, which can seamlessly integrate with Hitachi Command Suite in IT environments using Hitachi storage.

The Hitachi Compute Blade 500 chassis contains internal Fibre Channel and network switches for the high availability requirements of Hitachi Unified Compute Platform Select for VMware vSphere.

Hitachi TrueCopy Heterogeneous Remote Replication Bundle

For synchronous replication up to 190 miles (300 km), Hitachi TrueCopy Remote Replication bundle provides a no-data-loss, rapid restart solution. Real-time copies are the same as the originals. This reduces recovery time to minutes.

Synchronous replication provides very fast recovery time (low RTO) and good data currency (low RPO) between Hitachi Data Systems storage systems.
Hitachi Universal Replicator

Hitachi Universal Replicator is an advanced technology for asynchronously replicating data hosted on Hitachi Virtual Storage Platform family systems. Virtual Storage Platform manages the process of replicating the changes to the secondary site.

Universal Replicator software uses disk-based journaling and an optimized replication engine to reduce resource consumption and costs while increasing performance and operational resilience. The strengths of Hitachi Universal Replicator software are two key technical innovations: performance optimized, disk based journaling and a pull-style replication engine.

There is a potential for some data lag between remote and primary sites, particularly at longer distances. The recovery point objective is managed with the configuration of the data communication lines. When I/O activity at the primary site exceeds the capacity of the communication channel, the data is staged and moved to the secondary site in the same order as it was written at the primary site.

Hitachi ShadowImage Heterogeneous Replication

Hitachi ShadowImage Heterogeneous Replication is a storage-based solution that creates RAID-protected duplicate volumes within the Hitachi Virtual Storage Platform family systems. Primary volumes (P-VOLs) contain the original data. Up to nine secondary volumes (S-VOLs) can be created as copies.

On the Hitachi Virtual Storage Platform family systems, ShadowImage Heterogeneous Replication is used to implement clones, a full copy of the primary data. The clone is available to be used by secondary applications. The unique value of working with a clone is that any operation on the clone has no effect on the primary data.

VMware vSphere

VMware vSphere is a virtualization platform that provides a datacenter infrastructure. It features vSphere Distributed Resource Scheduler (DRS), High Availability, and Fault Tolerance.

VMware vSphere has the following components:

- **ESXi** — A hypervisor that loads directly on a physical server. It partitions one physical machine into many virtual machines that share hardware resources.

- **vCenter Server** — Management of the vSphere environment through a single user interface. With vCenter, there are features available such as vMotion, Storage vMotion, Storage Distributed Resource Scheduler, High Availability, and Fault Tolerance.
VMware vCenter Site Recovery Manager

**VMware vCenter Site Recovery Manager** is a disaster recovery solution that helps to reduce planned and unplanned downtime of a VMware vSphere infrastructure. It enables automated site recovery and migration processes. This can leverage the built-in vSphere Replication for hypervisor-based replication to cover a wide range of required recovery time and data currency.

This reference architecture focuses on using Site Recovery Manager with storage-based replication technologies such as Hitachi TrueCopy Heterogeneous Remote Replication bundle and Hitachi Universal Replicator. This use provides a centralized management of recovery plans. Tight integration between storage systems, VMware vCenter, VMware vCenter Site Recovery Manager, and Hitachi Storage Replication Adapter ensure a coordinated recovery for large, business critical environments.
Solution Design

This reference architecture is for a virtualized data center protected by VMware Site Recovery Manager. It uses the hardware and software components described in Key Solution Components to build the following infrastructures:

- Compute
- Storage area network
- Storage infrastructure

The architecture uses a synchronous and asynchronous storage replication model in a VMware vCenter Site Recovery Manager environment to illustrate support for different recovery point objective requirements.

Compute Infrastructure

This describes the compute infrastructure used in this reference architecture.

- Hardware components
  - Hitachi Compute Blade 500
  - VMware vSphere 5.5
- Disaster recovery and replication control components
  - VMware vCenter Site Recovery Manager 5.8
  - Hitachi Storage Replication Adapter 2.01
  - Command control interface
Hitachi Compute Blade 500

A Hitachi Compute Blade 500 chassis with two server blades hosted the VMware vSphere 5.5 infrastructure. Table 1 shows the hardware configuration.

Table 1. Hitachi Compute Blade 500 Configuration

<table>
<thead>
<tr>
<th>Hardware</th>
<th>Detail Description</th>
<th>Version</th>
<th>Quantity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hitachi Compute Blade 500 Chassis</td>
<td>▪ 8-blade chassis</td>
<td>SVP: A0165-E-8205</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>▪ 2 Brocade 5460 Fibre Channel switch modules, each with 6 × 8 Gb/sec uplink ports</td>
<td>5460: FOS v7.0.2c</td>
<td></td>
</tr>
<tr>
<td></td>
<td>▪ 2 Brocade VDX 6746 Ethernet switch modules, each with 8 × 10 Gb/sec uplink ports</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>▪ 2 management modules</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>▪ 6 cooling fan modules</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>▪ 4 power supply modules</td>
<td></td>
<td></td>
</tr>
<tr>
<td>520H B2 server blade</td>
<td>▪ Half blade</td>
<td>BMC/EFI: 01-59</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>▪ 2 × 12-core Intel Xeon E5-2697 v2 processor, 2.70 GHz</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>▪ 192 GB RAM</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>▪ 16 × 16 DIMMs</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Install VMware ESXi 5.5 on each server blade. This is the basis for simulating a primary and recovery virtualized data center site.

VMware vSphere 5.5

This reference architecture contains the entire primary and recovery sites in VMware vSphere 5.5 infrastructures with the following components:

- Virtual infrastructure management
- Disaster recovery management
- Storage array replication management
- Protected/recovery virtual machine environment
Create three resource pools in both vSphere infrastructures to separate the virtual machines by functionality and type of protection:

- Management
- Sync protected
- Async protected

The management resource pool contains three virtual machines for the following functions:

- **Infrastructure Management** — Use a Microsoft® Windows Server® 2012 R2 virtual machine running VMware vCenter Server 5.5 for overall management of the virtualized infrastructure.

- **Database** — Use a Microsoft Windows Server 2012 R2 virtual machine running Microsoft SQL Server® 2012 SP1. This serves database instances for VMware vCenter Server 5.5 and Site Recovery Manager 5.8.

- **Disaster Recovery Management** — Use a Microsoft Windows Server 2012 R2 virtual machine running VMware Site Recovery Manager, Hitachi Storage Replication Adapter, and command control interface. This handles the replication communication between the virtual and storage infrastructure, as well as site-to-site communications between Site Recovery Manager instances to facilitate an integrated disaster recovery process.

The sync protected and async protected resource pools on the primary site consisted of several virtual machines running on their respective storage-replicated VMFS primary volumes or P-VOLs. The sync protected and async protected resource pools on the recovery site contained placeholder virtual machines created by Site Recovery Manager for mirroring the protected virtual machines of the primary site.

**Disaster Recovery and replication Control Components**

Handle the virtual infrastructure disaster recovery and storage replication control using the software components installed on a virtual machine listed in Table 2.

<table>
<thead>
<tr>
<th>Application</th>
<th>Version</th>
</tr>
</thead>
<tbody>
<tr>
<td>VMware Site Recovery Manager</td>
<td>5.8 Build 2056894</td>
</tr>
<tr>
<td>Hitachi Storage Replication Adapter</td>
<td>02.01.04</td>
</tr>
<tr>
<td>Command control interface</td>
<td>01-33-03/01</td>
</tr>
</tbody>
</table>
Installing VMware Site Recovery Manager is a prerequisite to installing Hitachi Storage Replication Adapter. This is necessary so that Site Recovery Manager can register the installed Storage Replication Adapter. After installing the Site Recovery Manager Server instance, Site Recovery Manager -in appears in VMware vSphere Web Client. Use this on the protected and recovery sites to configure and manage Site Recovery Manager.

Rescan Storage Replication Adapter from the SRAs at Monitor tab in the Sites object of Site Recovery Manager. Use this to verify the installed Hitachi adapter version and supported array models.

Use command control interface to perform storage system operations by issuing commands to the Hitachi Virtual Storage Platform family system. The two command control interface components reside on the following:

- **Storage system** — Command devices and Hitachi TrueCopy or Hitachi Universal Replicator volumes (P-VOLs and S-VOLS)
- **Server** — Hitachi Open Remote Copy Manager (HORCM), configuration definition files (for example, horcm0.conf), and command control interface commands

Create command device logical volumes on the local and remote storage systems. Present these logical volumes as physical raw device mappings (RDM) to their respective Site Recovery Manager virtual machine.

Figure 9 on page 19 shows the overall architecture of the disaster recovery and replication control components in a VMware vSphere environment.
SAN Infrastructure

This describes the SAN infrastructure used in this reference architecture.

Server to Storage SAN Design

Each server blade at the local and remote site uses dual-port Fibre Channel mezzanine cards. They connect internally to the internal Fibre Channel switch modules located in the Hitachi Compute Blade 500 chassis.

Connect two inter-switch links from the internal Fibre Channel switch module to two Brocade 6510 switches, one link per switch for redundancy. Set the multipathing policy to round robin in VMware ESXi 5.5.
Figure 10 shows the storage network, configured identically for each site.

**Figure 10**

**Storage to Storage SAN Design**

To facilitate the copying of data between storage systems, configure storage replication links between the local site Hitachi Virtual Storage Platform family system and the remote site Virtual Storage Platform family system. Each storage system uses a total of two universal ports for the replication links. Prior to the Hitachi Virtual Storage Platform family system, each storage system used a total of two Initiator ports and two RCU target ports.

A storage replication link consists of universal ports on the primary storage system connected to a remote control unit universal port defined on the recovery storage system. It represents a two-way remote copy connection from the primary data volume (P-VOL) on the primary storage system to the secondary data volume (S-VOL) on the recovery storage system.

This enables reversing the direction of replication from the recovery site to the primary site for reprotect using VMware Site Recovery Manager. Two additional replication links connect through two Brocade 6510 switches. This totals two paths to provide maximum hardware redundancy, following best practice.
Figure 11 shows the storage system site-to-site configuration.

**Figure 11**

**Storage Infrastructure**

The storage infrastructure used in this reference architecture consists of the following:

- "Storage Design," starting on page 21
- "Defining Volume Pair Relationship," starting on page 23
- "Storage Replication," starting on page 26

**Storage Design**

For your implementation of this reference architecture, use Hitachi Dynamic Provisioning, a part of Hitachi Storage Virtualization System, on the Hitachi Virtual Storage Platform family systems. It simplifies storage management with the following:

- Over provisioning
- Wide striping
- On-line expansion of dynamic provisioning pools

This solution uses a dynamic provisioning pool comprised of a single RAID group with eight 900 GB 10k RPM SAS drives in a RAID-6 (6D+2P) configuration for each storage system. Using a RAID-6 configuration lowers the risk of data loss or pool failure, which is a primary concern for virtual machines protected in a VMware Site Recovery Manager environment.
Figure 12 shows the configuration for the dynamic provisioning pool on each storage system.

**Figure 12**

Provision five VMFS LUNs in your implementation of this environment:

- Datastore for storing management virtual machines (non-replicated)
- Datastore for storing the operating system (C:) virtual disks of synchronous replication-protected virtual machines
- Datastore for storing the data (D:) virtual disks of synchronous replication-protected virtual machines
- Datastore for storing the operating system (C:) virtual disks of asynchronous replication-protected virtual machines
- Datastore for storing the data (D:) virtual disks of asynchronous replication-protected virtual machines
The Hitachi Virtual Storage Platform family systems configuration on the recovery site is identical to the primary site configuration. The recovery LUNs on the recovery site are identical in size to their respective protected LUNs, as required for maintaining the P-VOL and S-VOL relationship.

Provision a 46 MB LUN, the smallest LUN that can be created, on both sites. Convert these LUNs to a command device. A command device is a dedicated logical volume on the storage system that functions as the interface to the storage system from a host. In this solution, command control interface sends replication commands to the command device for execution on the storage system.

Create LUNS on both systems for storing journal data required for Hitachi Universal Replicator volume pairs. The LUNs must be assigned with journal group IDs in order to be used as a journal volume by Hitachi Universal Replicator.

**Defining Volume Pair Relationship**

A key aspect of this reference architecture using VMware Site Recovery Manager 5.8 on the Hitachi Virtual Storage Platform family system is defining the volume pair relationship for replication between storage systems. Define and manage storage replication relationships through the Hitachi Storage Navigator graphical user interface or a host running Hitachi Open Remote Copy Manager (HORCM).

Hitachi Open Remote Copy Manager is a component of command control interface. It manages replication using a command-line interface. For this solution, command control interface enables Hitachi Storage Replication Adapter to issue Open Remote Copy Manager commands for managing, monitoring, and controlling the replication process initiated by VMware Site Recovery Manager.

Each Open Remote Copy Manager instance installed at the primary and recovery site contains a configuration definition file (horcmmx.conf). This file defines the devices in copy pairs. Define the configuration file before starting the Open Remote Copy Manager daemon.
Figure 13 shows a sample horcm0.conf file. This file is normally for the primary system.

```
#FileName: horcm0.conf
#******************************************************************************
HORCM_MON
#ip_address  service  poll(10ms) timeout(10ms)
172.17.171.233  horcm0  1000  3000
#******************************************************************************
HORCM_CMD
#dev_name  dev_name  dev_name
\:\CMD=400003
#******************************************************************************
HORCM_LDEV
#dev_group  dev_name  Serial#  CU:LDEV(LDEV#)  MU#
VM01_TC  VM01_C  400003  00:08
VM01_TC  VM01_D  400003  00:09
VM02_UD  VM02_C  400003  00:0C
VM02_UD  VM02_D  400003  00:0D
#******************************************************************************
HORCM_INST
#dev_group  ip_address  service
VM01_TC  172.17.171.234  horcm1
VM02_UD  172.17.171.234  horcm1
```

Figure 14 shows a sample horcm1.conf file. This file is normally for the recovery site.

```
#FileName: horcm0.conf
#******************************************************************************
HORCM_MON
#ip_address  service  poll(10ms) timeout(10ms)
172.17.171.233  horcm0  1000  3000
#******************************************************************************
HORCM_CMD
#dev_name  dev_name  dev_name
\:\CMD=400003
#******************************************************************************
HORCM_LDEV
#dev_group  dev_name  Serial#  CU:LDEV(LDEV#)  MU#
VM01_TC  VM01_C  400003  00:08
VM01_TC  VM01_D  400003  00:09
VM02_UD  VM02_C  400003  00:0C
VM02_UD  VM02_D  400003  00:0D
#******************************************************************************
HORCM_INST
#dev_group  ip_address  service
VM01_TC  172.17.171.234  horcm1
VM02_UD  172.17.171.234  horcm1
```
Figure 13 and Figure 14 show logical devices or LUNs associated to device group VM01_TC and device group VM02_UR.

In the VM01_TC pair, the following is true:

- **horcm0** instance manages P-VOLs defined as LUN 00:08 and LUN 00:09 on a Hitachi Virtual Storage Platform system registered with serial number 400003.
- **horcm1** instance manages S-VOLs defined as LUN 00:23 and LUN 00:24 on a Hitachi Virtual Storage Platform system registered with serial number 411111.

For the VM02_UR pair, the following is true:

- **horcm0** instance manages P-VOLs defined as LUN 00:0C and LUN 00:0D on a Hitachi Virtual Storage Platform system registered with serial number 400003.
- **horcm1** instance manages S-VOLs defined as LUN 00:2F and LUN 00:30 on a Hitachi Virtual Storage Platform system registered with serial number 411111.

Following recommended practice labeling the Hitachi Open Remote Copy Manager configuration files as follows:

- On the primary site managing the P-VOL, label the configuration file with an even number (**horcm0.conf**).
- On the recovery site managing the S-VOL label the configuration file with an odd number (**horcm1.conf**).

Table 3 shows the pair configuration defined by the configuration files in Figure 13 and Figure 14.

<table>
<thead>
<tr>
<th>Device Group</th>
<th>VSP Serial Number</th>
<th>LUN</th>
<th>Volume Type</th>
</tr>
</thead>
<tbody>
<tr>
<td>VM01_TC</td>
<td>400003</td>
<td>00:08</td>
<td>P-VOL</td>
</tr>
<tr>
<td></td>
<td>411111</td>
<td>00:09</td>
<td>P-VOL</td>
</tr>
<tr>
<td>VM01_TC</td>
<td>400003</td>
<td>00:23</td>
<td>S-VOL</td>
</tr>
<tr>
<td></td>
<td>411111</td>
<td>00:24</td>
<td>S-VOL</td>
</tr>
<tr>
<td>VM02_UR</td>
<td>400003</td>
<td>00:0C</td>
<td>P-VOL</td>
</tr>
<tr>
<td></td>
<td>411111</td>
<td>00:2F</td>
<td>S-VOL</td>
</tr>
<tr>
<td>VM02_UR</td>
<td>400003</td>
<td>00:0D</td>
<td>P-VOL</td>
</tr>
<tr>
<td></td>
<td>411111</td>
<td>00:30</td>
<td>S-VOL</td>
</tr>
</tbody>
</table>
Figure 15 shows verifying the pair relationship by running the `pairdisplay` command from the `horcm0` instance. Initially, the volumes are in simplex (SMPL) mode. The volumes are not paired and synchronized until running the `paircreate` command.

```bash
C:\HORCM\etc\pairdisplay.exe -g VM01_TC -iH0 -fCx
Group   PairVol(L/R) (Port#,TID, LU), Seq#, LDEV#, P/S, Status,Fence, %,P-LDEV# M
VM01_TC VM01_C(L) (CL3-C-3,30, 2) 400003 6 SMPL ------ ------ ------
VM01_TC VM01_C(R) (CL2-D-2,19, 2) 411111 23 SMPL ------ ------ ------
VM01_TC VM01_D(L) (CL3-C-3,30, 4) 400003 9 SMPL ------ ------ ------
VM01_TC VM01_D(R) (CL2-D-2,19, 4) 411111 24 SMPL ------ ------ ------

C:\HORCM\etc\pairdisplay.exe -g VM02_U -iH0 -fCx
Group   PairVol(L/R) (Port#,TID, LU), Seq#, LDEV#, P/S, Status,Fence, %,P-LDEV# M
VM02_U VM02_C(L) (CL3-C-3,30, 3) 400003 c. SMPL ------ ------ ------
VM02_U VM02_C(R) (CL2-D-2,19, 3) 411111 2f. SMPL ------ ------ ------
VM02_U VM02_D(L) (CL3-C-3,30, 6) 400003 d. SMPL ------ ------ ------
VM02_U VM02_D(R) (CL2-D-2,19, 5) 411111 30. SMPL ------ ------ ------
```

**Figure 15**

**Storage Replication**

After defining volume pair relationships and starting the Hitachi Open Remote Copy Manager daemon, initiate storage replication using Open Remote Copy Manager commands.

This reference architecture for a VMware Site Recovery Manager environment can use different storage replication technologies available with the Hitachi Virtual Storage Platform family. The type you use is addressed by different recovery point objective (RPO) requirements, as shown in Table 4.

<table>
<thead>
<tr>
<th>Requirement</th>
<th>Replication Type</th>
<th>Storage Replication Technology</th>
</tr>
</thead>
<tbody>
<tr>
<td>Low RPO</td>
<td>Synchronous remote replication</td>
<td>Hitachi TrueCopy Heterogeneous Remote Replication bundle</td>
</tr>
<tr>
<td>Flexible RPO</td>
<td>Asynchronous remote replication</td>
<td>Hitachi Universal Replicator</td>
</tr>
</tbody>
</table>

VMware Site Recovery Manager 5.0 has hypervisor-based replication called vSphere Replication. This complements storage-based replication by enabling disaster recovery protection for another tier of virtual machines that may not fall under the higher priority RPO requirements provided by a storage system. This replication method is outside of the scope of this reference architecture guide.
Low RPO — Synchronous Remote Replication

Synchronous (real-time) replication provides a high level of data consistency protection. It ensures that the remote data is identical to the local data.

The drawback to synchronous replication is its distance limitation. In synchronous replication, an input-output update operation from a virtual machine is not complete until confirming the completion at the primary site and recovery site. With increased distances, this can cause problems for latency-sensitive applications or virtual machines.

The practical distance for synchronous replication ranges from 20 miles (32 km) to 100 miles (161 km), depending on application or virtual machine tolerance. Synchronous replication up to 190 miles (300 km) requires using WAN-optimized controllers.

Initiate Hitachi TrueCopy Heterogeneous Remote Replication bundle from the horcm0 instance by typing the following at a command prompt in the C:\HORCM\etc directory:

```
paircreate.exe -g <grp> -vl -fg <fence> <CTGID> -IH0
```

Figure 16 shows the command and the output of a TrueCopy pair creation based on the Hitachi Open Remote Copy Manager configuration files in Figure 13 and Figure 14 on page 24.

```
C:\HORCM\etc>paircreate.exe -g VM01_TC -vl -fg never 0 -IH0

C:\HORCM\etc>pairdisplay.exe -g VM01_TC -IH0 -fcxe
Group  PairVol(L/R) (Port#,TID,LU), Seq#, LDEV#, P/IS, Status,Fence, %, P-LDEV# M CTG JID
VM01_TC VM01_C(L) (CL3-C-3.30, 2) 400003 8. P-VOL COPY NEVER , 36  23  - 0  -
VM01_TC VM01_C(R) (CL2-D-2.19, 2) 411111 23. S-VOL COPY NEVER ,----- 8  -  0  -
VM01_TC VM01_D(L) (CL3-C-3.30, 4) 400003 9. P-VOL COPY NEVER , 36  24  - 0  -
VM01_TC VM01_D(R) (CL2-D-2.19, 4) 411111 24. S-VOL COPY NEVER ,----- 9  -  0  -
```

**Figure 16**

The fence level setting specified during the paircreate operation is critical in defining the P-VOL behavior when interrupting a TrueCopy pair. Carefully consider various disaster recovery scenarios when setting the fence levels.

- **Data Fence Level**

  Setting the fence level to *Data* prevents the host from writing updates to the P-VOL during a replication failure. This keeps the S-VOL identical to the P-VOL, which can lower recovery time by assuring the currency of the data.

  However, when storage replication fails while the primary site still functions, TrueCopy disables write access to the VMFS volume from the primary site ESXi hosts. This disrupts the production virtual machines. Only use the *Data* setting for critical volumes where data consistency outweighs virtual machine uptime.
Never Fence Level

The example in Figure 9 on page 19 uses a fence level setting of Never. This supports input-output performance and virtual machine uptime over data recovery. The host has access and continues to update the P-VOL. However, the S-VOL may not be synchronized.

During a replication link failure, the primary site could still function. However, data consistency vulnerability exists on the recovery site until fixing replication.

The CTGID or consistency group ID ensures data consistency among multiple datastores assigned to Hitachi device groups. The datastores are maintained in a state of replication consistent with each other. For example, in Figure 16 on page 27 a CTGID of 0 is assigned. If replication is stopped on the pair VM01_C, replication also is stopped on VM01_D. Use consistency groups in virtual machine configurations where multiple virtual disks reside on different datastores.

Find further details on fence level and consistency group ID settings in Hitachi TrueCopy User Guide.

Flexible RPO — Asynchronous Remote Replication

Asynchronous replication provides a less favorable RPO than synchronous replication. However, it overcomes the distance limitations of synchronous replication.

Hitachi Universal Replicator uses disk journal volumes on the primary site and the storage system at the recovery site as a buffer mechanism. This eliminates the wait for the input-output response from the remote site. Providing data integrity with minimal host performance impact, this reduces the complexity and cost of replicating data.

Initiate Hitachi Universal Replicator asynchronous replication from the horcm0 instance by typing the following at a command prompt in the C:\HORCM\etc directory:

```
paircreate.exe -g <grp> -vl -f async -jp <journal id> -js <journal id> -IH0
```

Figure 17 shows the command and the output of a Universal Replicator pair creation based on the configuration files in Figure 13 and Figure 14 on page 24.
Engineering Validation

This describes the tests performed in the Hitachi Data Systems lab using VMware vCenter Site Recovery Manager 5.8.

Test Methodology

These were the steps followed to test the reference architecture:

1. Build the environment and have VMware vCenter Site Recovery Manager discover the replicated devices on both sites.

2. Create Site Recovery Manager Protection Groups for the protected virtual machines based on the replicated VMFS datastore where they resided.


4. Perform the following functions:
   - Recovery
   - Reprotect
   - Recovery (failback) and reprotect
   - Test Recovery
   - Cleanup

5. Use the `pairdisplay` command in command control interface to verify each function worked.

A test passes if each function works as intended in the reference architecture.

Separate testing used Hitachi TrueCopy Heterogeneous Remote Replication bundle and Hitachi Universal Replicator to validate this reference architecture.

Test Results

All functions described in worked as intended. Using the `pairdisplay` command in command control interface confirmed the replicated pair had the correct status for each function tested.

Each function performed with Site Recovery Manager yielded the same results from a storage replication perspective whether using Hitachi TrueCopy Heterogeneous Remote Replication bundle or Hitachi Universal Replicator for the procedure.
Conclusion

The Hitachi Virtual Storage Platform family storage systems provide multiple storage replication capabilities for different business needs. Hitachi Storage Replication Adapter allows VMware vCenter Site Recovery Manager to leverage these storage replication capabilities to protect virtualized vSphere data centers effectively.

This integrated and coordinated reference architecture provides IT administrators with multiple options to match the desired recovery point objective (RPO) and recovery time objective (RTO).
Configure the Hitachi ShadowImage Heterogeneous Replication Pair

The Hitachi ShadowImage Heterogeneous Replication pair definition used these Hitachi Open Remote Copy Manager configuration files.

Only specify mirror unit numbers (MU#) when defining ShadowImage pairs. Initiate ShadowImage local replication using the following command run from the horcm1 instance in C:\HORCM\etc>:

```
paircreate.exe -g <grp> -vl -IM1
```

Only initiate ShadowImage replication after establishing TrueCopy replication.

**horcm1.conf**

Figure 18 shows the contents of an updated horcm1.conf file. Following recommended practices, with the odd number (horcm1), this file is for the recovery site.

```
#FileName: horcm1.conf
#******************************************************************************
# For HORCM_MON
HORCM_MON
ip_address          service      poll(10ms) timeout(10ms)
172.17.171.234      horcm1      1000       3000
#******************************************************************************
# For HORCM_CMD
#dev_name          dev_name          dev_name
\CMD-411111
#******************************************************************************
# For HORCM_LDEV
#dev_group          dev_name          Serial#      CU LDEV(LDEV#)       MU#
VM01_TC            VM01_C          411111       00:23
VM01_TC            VM01_D          411111       00:24
VM02 UR            VM02_C          411111       00:2f
VM02 UR            VM02_D          411111       00:30
VM01 SI            VM01_C_SI       411111       00:23       0
VM01 SI            VM01_D_SI       411111       00:24       0

#******************************************************************************
# For HORCM_INST
#dev_group          ip_address          service
VM01_TC            172.17.171.233  horcm0
VM02 UR            172.17.171.233  horcm0
VM01_SI            172.17.171.234  horcm2
```

Figure 18
horcm2.conf

Figure 19 shows the contents of a horcm2.conf file. Following recommended practices, with the even number (horcm2), this file is for the primary site.

```plaintext
#FileName: horcm2.conf
#HorCM 2 MON
#ip_address  service  poll(10ms)  timeout(10ms)
172.17.171.234  horcm2  1000  3000
#HorCM CMD
#dev_name  dev_name  dev_name
\V\CMD-411111
#HorCM LDEV
#dev_group  dev_name  Serial#  CU:DEV(LDEV#)  MU#
VM01_SI  VM01_C_SI  411111  00:14
VM01_SI  VM01_D_SI  411111  00:15
#HorCM INST
#dev_group  ip_address  service
VM01_SI  172.17.171.234  horcm1
```

Figure 19
For More Information

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