

# Global-Active Device and VMware vSphere Metro Storage Cluster Configuration on Hitachi Storage

## Implementation Guide

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## Feedback

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## Revision History

Revision	Changes	Date
v1.0	First Draft	08/18/2020
V1.1	Final PDF	8/27/20

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## Executive Summary

This document provides guidelines on how to configure VMware vSphere Metro Storage Cluster using Hitachi Storages.

## 1. Introduction:

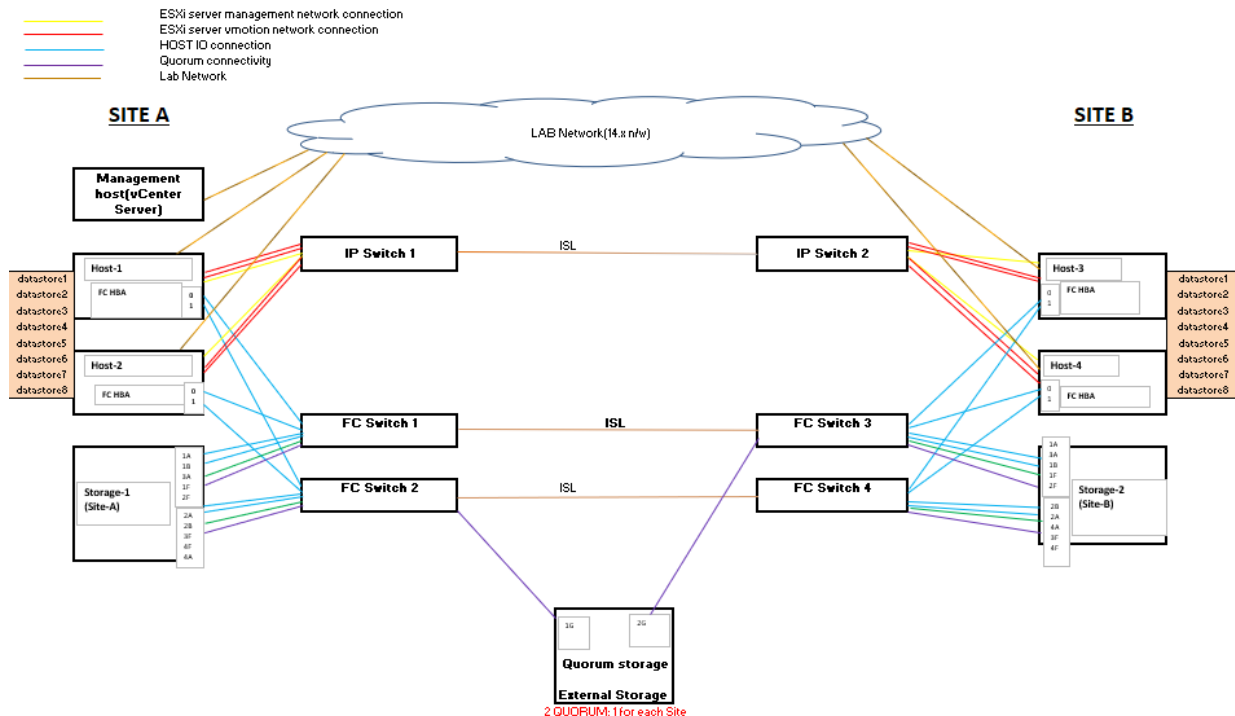
A VMware vSphere Metro Storage Cluster (vMSC) configuration is a specific storage configuration that combines replication with array-based clustering. These solutions are typically deployed in environments where the distance between data centers is limited, often metropolitan or campus environments.

### 1.1 Purpose:

This article provides step by step information for configuring/deploying a VMware metro storage cluster across 2 data centers using Hitachi Storage Array Platforms. It also includes various failure scenarios in used cases.

### 1.2 vMSC block diagram:

Figure 1: vMSC block diagram



### 1.3 Hardware requirement:

Hardware used for vMSC tests must be listed under VMware vCG. The following components create a VMware vSphere Metro Storage Cluster environment:

- 4 ESXi hosts, 2 in each site, having 4 port NIC card and 2 port FC HBA or CNA as per requirement. All ESXi hosts will be running 2 VMs each (at minimum).
- 2 \*IP switches for management network and vMotion connections between hosts/VMs.
- 4 \*FC switch or iSCSI switch as per requirement for SAN connectivity to the datacenter storage network.

- d. 2 \*GAD Quorum Disks i.e. iSCSI disk from virtual machine or separate FC/iSCSI storage system such as Hitachi VSP F/G or other supported 3rd-party storage.
- e. One management host i.e. vCenter server.

## 2. Global-Active Device (GAD) vMSC Configuration:

Configuration steps of vMSC with global-active device (GAD) can be divided in 5 areas. They are as follows:

### 2.1 Host configuration:

- vSphere 6.0U2, 6.5 or 6.7 ESXi host servers — The physical hosts on both data centers running the virtual machines and managed by vCenter Server.
- Host HBA/CNA connectivity to FC/iSCSI switches to be made as per block diagram for SAN connectivity to the datacenter storage network.
- 1 NIC port of 4 port NIC card of each host to be connected to free NIC port of another host on the same site for vMotion connectivity between hosts.
- 2 NIC ports of 4 port NIC card of each host to be connected to iSCSI switches of that site for management network connectivity.
- All the 4 hosts along with their VMs are part of a single vSphere Cluster under a VMware Datacenter.
- 2 VMs will reside in each host and RDM LUNs or vmfs volumes from datastore to be assigned to those VMs as per requirement.
- Host multipathing: All the four ESXi hosts must be configured with multipathing software, either with NMP (VMware Native Multipathing) or with HDLM (Hitachi Dynamic Link Manager) to load-balance I/O between all available preferred & non preferred paths.
- NMP/HDLM multipathing software integrates with GAD to provide load balancing, path optimization, path failover, and path fallback capabilities for vSphere hosts.
- When HDLM is chosen as multipathing software, first HDLM for VMware zip file is copied to the required server. Then after unzipping the file, 5 no. of vib files will be there under 5 different folders. All the vib files needs to be installed first to get HDLM installed on the server. Commands are as below:
  - `esxcli software vib install -v /<HDLM location>/vib20/hex-hdlm-dlnkmgr/*.vib`
  - `esxcli software vib install -v /<HDLM location>/vib20/psp-hdlm-exlbc/*.vib`
  - `esxcli software vib install -v /<HDLM location>/vib20/psp-hdlm-exlio/*.vib`
  - `esxcli software vib install -v /<HDLM location>/vib20/psp-hdlm-exrr/*.vib`
  - `esxcli software vib install -v /<HDLM location>/vib20/satp-hdlm/*.vib`

Now, to check whether Hitachi LUNs are managed by HDLM, run the following commands:

- `esxcli storage nmp device list`

Output for a LUN should be like below:

```
Device Display Name: HITACHI Fibre Channel Disk (naa.60060e8008753e000050753e00000133)
Storage Array Type: HTI_SATP_HDLM
Storage Array Type Device Config: {device config options }
Path Selection Policy: HTI_PSP_HDLM_EXLIO
Path Selection Policy Device Config:
Path Selection Policy Device Custom Config:
Working Paths: vmhba65:C0:T0:L0, vmhba64:C0:T0:L0
Is USB: false
```

- When NMP is chosen as multipathing software, ALUA rules must be set on ESXi hosts prior to version ESXi6.7 update 1 for Hitachi LUNs as below:
  - `esxcli storage nmp satp rule add -V HITACHI -M "OPEN-V" -P VMW_PSP_RR -s VMW_SATP_ALUA -c tpgs_on`
  - `esxcli storage core claimrule load`

For ESXi 6.7update1 and above hosts, ALUA rule is already enabled on OS and no additional command is required to enable/configure ALUA on hosts.

## 2.2 Switch configuration:

- 2 \* network switches are configured for LAN connectivity to the datacenter network from each host and VMs (ref. vMSC block diagram on 1.2).
- 4 \* FC switches are configured to connect ESXi hosts of both sites to the datacenter storage network(FC). For configuring metro cluster environment, FC switch 1 in site-1 needs to be in cascade with FC switch-3 in site-2, similarly FC switch 2 in site-1 with FC switch-4 in site-2.
- For iSCSI vMSC configuration, 4 iSCSI switches are needed, and they are configured similarly in a cascade switch connection.

## 2.3 Primary/ Secondary storage configuration:

- 2 \* Hitachi storages are configured one in each site and connected to FC/iSCSI switches of respective site as shown in block diagram.
- Each site storage will have 2 sets of LUNs, one set for primary volumes and another set for secondary volumes. All these LUNs will be made available to all the 4 hosts on both sites.
- Each site storage will have two pair of storage ports for MCU(initiator)-RCU(target) pair. These connections will act as the storage replication link between the primary-secondary storages (ref. vMSC block diagram).
- Site-1 storage primary volumes will be in GAD pair with secondary volumes of Site-2 storage. Similarly, Site-2 storage primary volumes will be in GAD pair with secondary volumes of Site-1 storage.
- For NMP-ALUA configurations, ALUA setting must be enabled on PVOLs of both the sites. Following is the command for enabling ALUA on Hitachi LUNs:
  - `raidcom modify ldev -ldev_id <ldev_id> -alua enable -fx -IH<horcm_instance>`



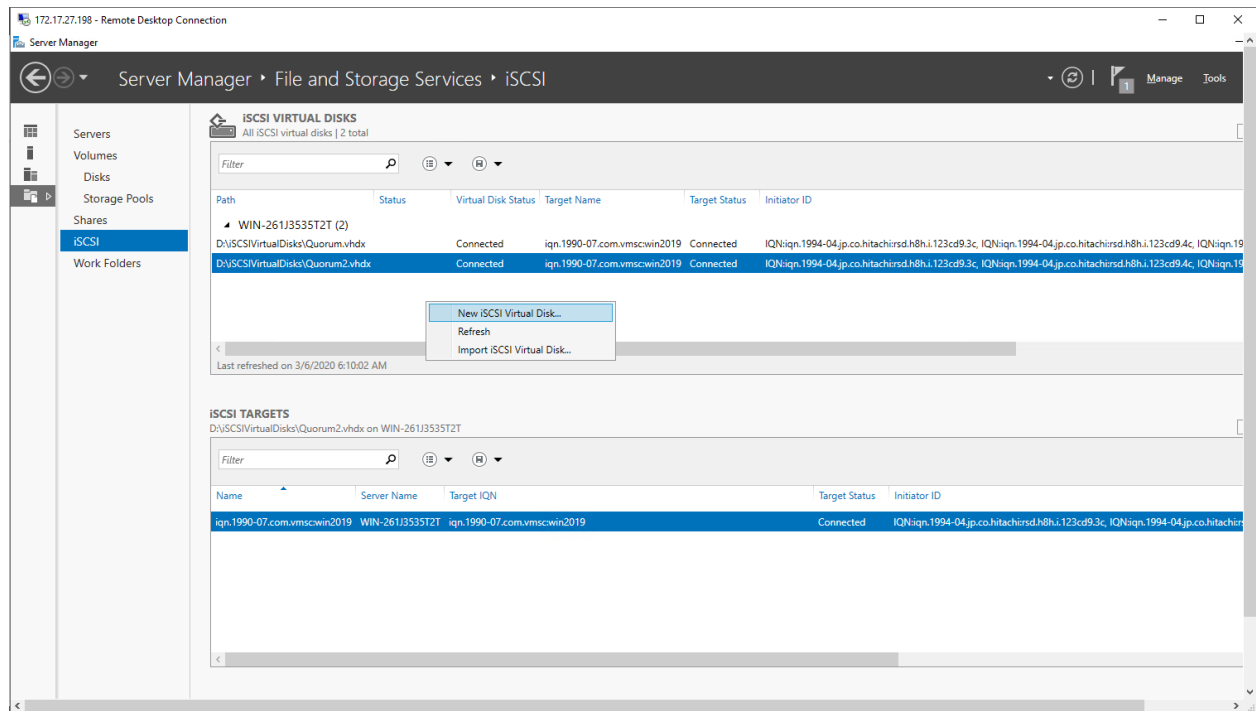
For example,

- raidcom modify ldev -ldev\_id 08:10 -alua enable -fx -IH4545
- Also, path optimization settings need to be done on primary and secondary storage hostgroups as mentioned below:
  - raidcom modify lun -port cl1-d HOSTGROUP -lun\_id all -asymmetric\_access\_state optimized -I10 (On PVOL host group)
  - raidcom modify lun -port cl1-d HOSTGROUP -lun\_id all -asymmetric\_access\_state non\_optimized -I10 (On SVOL host group)
- HMO78 needs to be set on Host group having SVOLs for all HDLM configurations. This option is not required for NMP-ALUA configurations.

## 2.4 Quorum storage configuration:

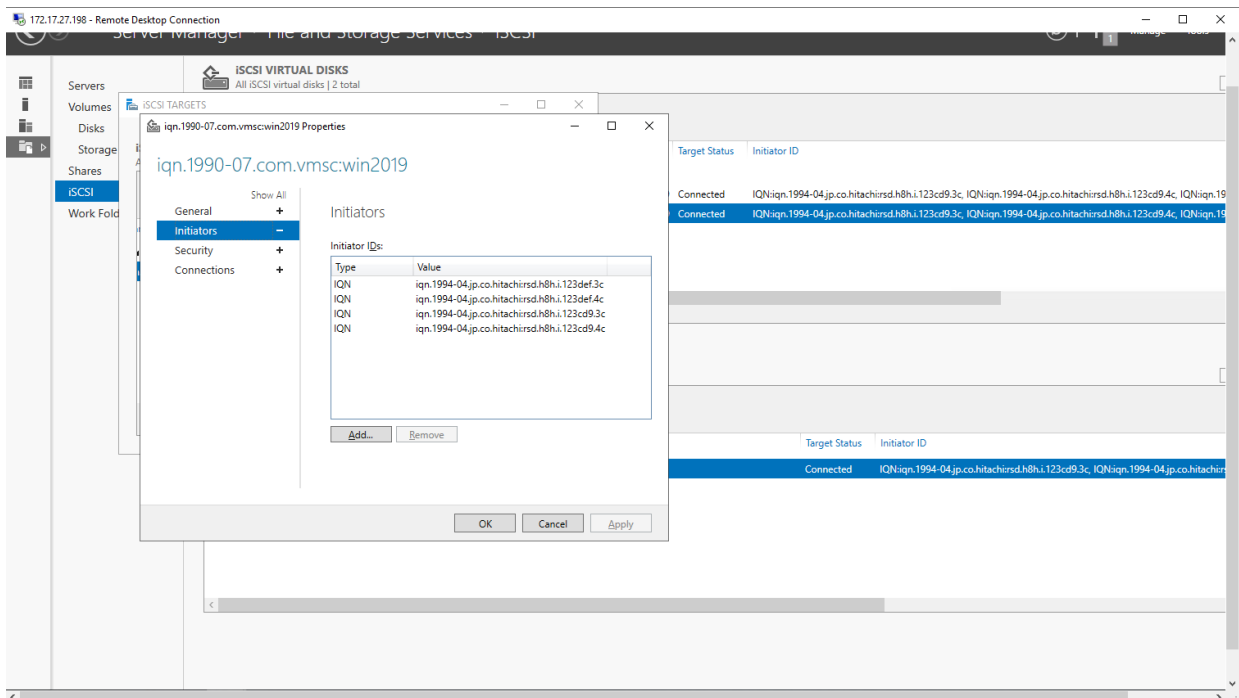
- 2 \*quorum disks are assigned for each site GAD pair set.
  - Quorum disk can be configured by either assigning an iSCSI disk from the local disk of server hosting a Microsoft Windows Server or separate storage system such as Hitachi VSP F/G or other supported 3rd-party storage
1. Steps to configure Windows Server local disk as iSCSI Quorum disk for VSP storage units Go to Server Manager -> File and Storage Services -> iSCSI -> New iSCSI Virtual Disk. Follow the steps to create iSCSI disks.

**Figure 2: Create iSCSI disks**



2. Under iSCSI Targets, Right click 'View all Targets' -> Properties -> Initiators. Add the IQN of the storage ports that will be used as External Ports for Quorum.

**Figure 3: Add External Ports for Quorum**



## 2.5 GAD configuration:

- 2 sets of GAD pair are configured in each site storage for vMSC environment.
- GAD pair can be created using storage GUI or from CCI.
- To create GAD pair from Raid Manager CCI server, steps are as follows:
  - On Primary storage:
    1. First, create DP pool for Primary volumes on site-1 storage. Repeat the same steps to create DP pool for Primary volumes on site-2 storage.
 

```
raidcom add dp_pool -pool_name <pool_name> -ldev_id <ldev_id> -l<Primary storage horcm instance>
```

Create LDEVs from this DP pool for Primary volumes in site-1 storage. Repeat the same steps to create Primary volumes on site-2 storage. Command to create each LDEV is as follows:

```
raidcom add ldev -pool <pool_id> -ldev_id <ldev_id> -capacity <pool_capacity> -l<primary_storage_horcm_instance>
```

Format the newly created LDEV:

```
raidcom initialize ldev -ldev_id <ldev_id> -operation fmt -l<primary_storage_horcm_instance >
```
    2. Create host group, set host mode options for Primary volumes host group in site-1 storage. Repeat these steps to create Primary volumes host group in site-2 storage as well.

Command to create host group:

```
raidcom add host_grp -port <host_group_id> -host_grp_name <host_group_name> -  
l<primary_storage_horcm_instance>
```

Command to set host mode and host mode options:

```
raidcom modify host_grp -port <host_group_id> -host_mode 21 -host_mode_opt 54 63 114 78 -  
l<primary_storage_horcm_instance>
```

Set Port topology and add HBA port wwns(for all 4 hosts) at Host Group:

```
raidcom modify port -port <port_id> -port_speed 0 -topology f_port -security_switch y -  
l<primary_storage_horcm_instance>  
raidcom add hba_wnn -port <host_group_id> -hba_wnn <HBA_WWN> -  
l<primary_storage_horcm_instance>
```

Assign LDEVs to host group:

```
raidcom add lun -port <host_group_id> -lun_id 0 -ldev_id <ldev_id> -  
l<primary_storage_horcm_instance>
```

■ On Secondary storage:

1. First, create resource group of primary storage(site-1) type on secondary storage (site-2) and assign respective secondary resources to it. Then repeat these steps to create resource group of primary storage(site-2) type on secondary storage (site-1) and assign respective secondary resources to it.

```
raidcom add resource -resource_name <resource_group_name> -virtual_type  
<primary_storage_serial_number> <storage_model_type> -  
lH<secondary_storage_horcm_instance>
```

Reserve the host group ID in the resource group of the storage system at the secondary site.

```
raidcom add resource -resource_name <resource_group_name> -port  
<secondary_hostgroup_ID> -IH<secondary_storage_horcm_instance>
```

Delete the virtual LDEV ID of the volumes from secondary storage which will be used for creating GAD pairs.

```
raidcom unmap resource -ldev_id <LDEV_ID> -virtual_ldev_id <virtual_LDEV_ID> -  
IH<secondary_storage_horcm_instance>
```

Reserve the LDEV ID's in the resource group.

```
raidcom add resource -resource_name <resource_group_name> -ldev_id <LDEV_ID> -  
I<secondary_storage_horcm_instance>
```

Setting the reservation attribute to the volume for the secondary volume of GAD pair.  
Set the reservation attribute for GAD to the LDEV ID's

```
raidcom map resource -ldev_id <LDEV_ID> -virtual_ldev_id reserve -  
IH<secondary_storage_horcm_instance>
```

For the LDEV ID to which the reservation attribute was set, ffff is displayed for VIR\_LDEV (virtual LDEV ID)

2. Create host group of GAD Secondary site Storage and set Host Mode Options:

```
raidcom add host_grp -port <Host_group_ID> -host_grp_name <host_group_name> -  
IH<secondary_storage_horcm_instance>
```

```
raidcom modify host_grp -port <Host_group_ID> -host_mode 21 -host_mode_opt 54 63 78 114  
-IH<secondary_storage_horcm_instance>
```

Set Port topology and add HBA port wwn of all the 4 hosts of both sites at Host Group

```
raidcom modify port -port <Port_ID> -port_speed 0 -topology f_port -security_switch y -  
IH<secondary_storage_horcm_instance>
```

```
raidcom add hba_wwn -port <Host_group_ID> -hba_wwn <HBA_WWN> -  
IH<secondary_storage_horcm_instance>
```

3. Create DP Pool and LDEVs for secondary volumes of Site-1 GAD pair. Repeat these steps for creating DP Pool and LDEVs for secondary volumes of Site-2 GAD pair.

```
raidcom add dp_pool -pool_name <Secondary_pool_name> -ldev_id  
<Pool_volume_LDEV_ID> -I<secondary_storage_horcm_instance>
```

Create secondary volumes with the same capacity as the primary volumes.

```
raidcom add ldev -pool <pool_id> -ldev_id <LDEV_ID> -capacity <LDEV_size> -  
IH<secondary_storage_horcm_instance>
```

Adding an LU path to the secondary volume.

```
raidcom add lun -port <Host_grp_ID> -lun_id 0 -ldev_id <LDEV_ID> -  
IH<secondary_storage_horcm_instance>
```

#### ■ GAD Pair Creation:

Use the below command in site-1 storage to create site-1 GAD Pair. Repeat this step to create site-2 GAD pair on Site-2 storage.

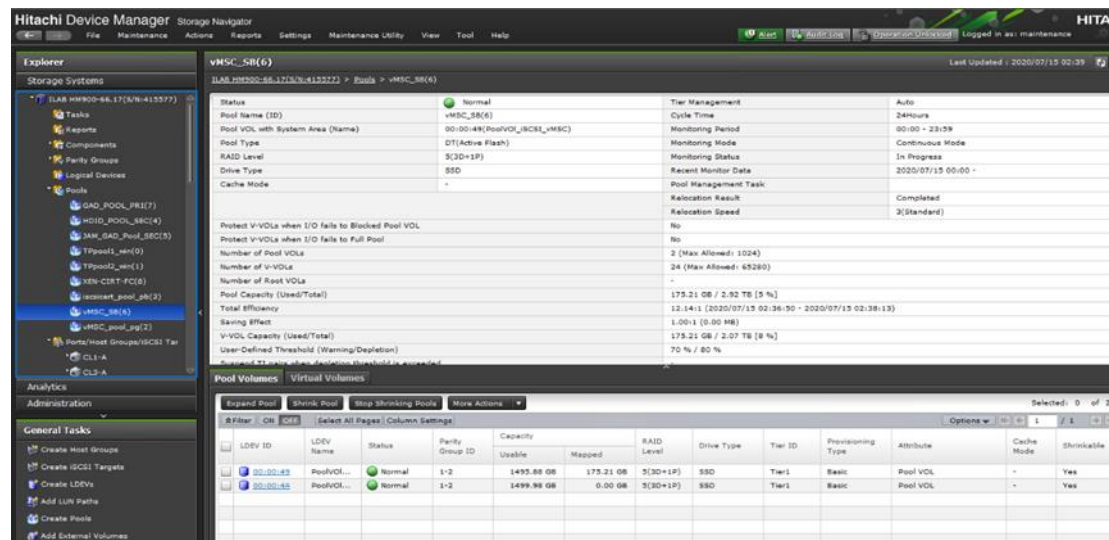
```
paircreate -g <GAD_PAIR_Name> -f never -vl -jq 7 -IH<primary_storage_horcm_instance>
```

o To create GAD pair from SVP, steps are as follows:

#### ■ On Primary storage:

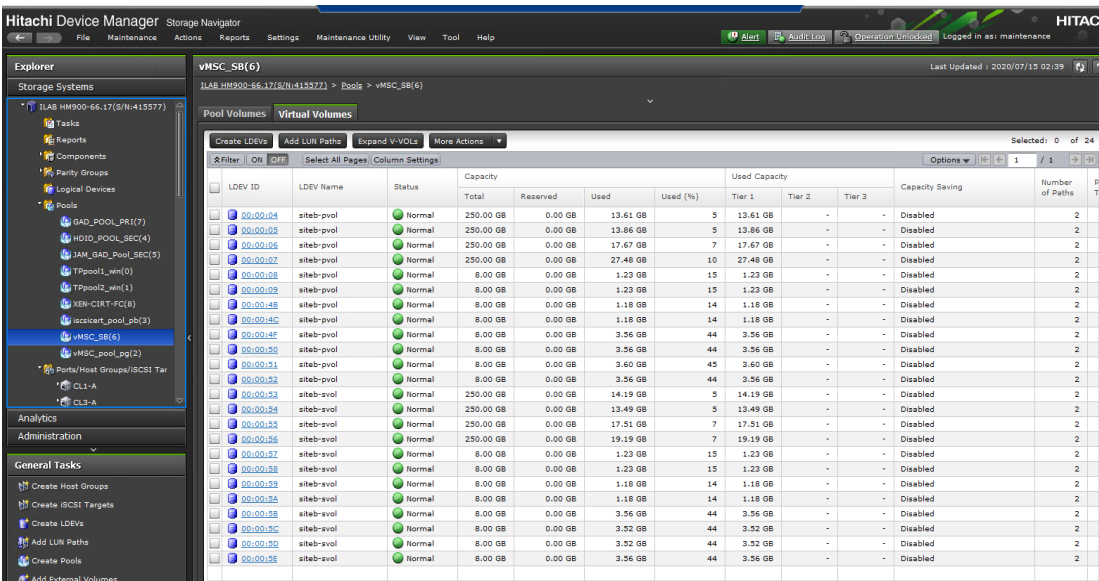
1. First, create DP pool for Primary volumes on site-1 storage. Repeat the same steps to create DP pool for Primary volumes on site-2 storage.

Figure 4: Create DP Pools



Create LDEVs from this DP pool for Primary volumes in site-1 storage. Repeat the same steps to create Primary volumes on site-2 storage. Command to create each LDEV is as follows:

Figure 5: Create LDEVs



2. Create host group, set host mode options for Primary volumes host group in site-1 storage. Repeat these steps to create Primary volumes host group in site-2 storage as well.

**Figure 6: Create Host Groups**

The screenshot shows the Hitachi Device Manager interface. The left sidebar contains the 'Explorer' menu with 'Storage Systems' expanded. The main area displays the configuration for '1D-G02 (02)'. The 'Hosts' tab is active, showing a table of hosts:

Port ID	HBA iSCSI Name	Host Name	iSCSI Target Alias	iSCSI Target Name
CL1-D	iqn.1990-07.com.emulex:00-00-c9-da-c7-ff	81	1D-G02 (02)	iqn.1994-0...
CL1-D	iqn.1990-07.com.emulex:00-90-fa-1a-d9-e9	74-0	1D-G02 (02)	iqn.1994-0...
CL1-D	iqn.1998-01.com.vmware:steehost2-154b9676	78	1D-G02 (02)	iqn.1994-0...
CL1-D	iqn.1998-01.com.vmware:steehost2-103277bd	82	1D-G02 (02)	iqn.1994-0...

Set host mode and host mode options:

**Figure 7: Set Host Mode Options**

The screenshot shows the 'Host Mode Options' tab selected. The table displays the following options:

Mode No.	Option Description	Status
54	(VAA) Support Option for the EXTENDED COPY command	Enabled
63	(VAA) Support option for vStorage APIs based on T10 standards	Enabled
114	The automatic asynchronous reclamation on ESXi6.5 or later	Enabled
0	Reserved	Disabled
1	Reserved	Disabled
2	VERITAS Database Edition/Advanced Cluster	Disabled
3	Reserved	Disabled
4	Reserved	Disabled
5	Reserved	Disabled

Assign LDEVs to host group:

**Figure 8: Assign LDEVs**

The screenshot shows the Hitachi Device Manager Storage Navigator interface. The main window displays the configuration for 'ID-G02 (02)'. The 'LUNs' tab is selected, showing a table of LDEVs assigned to the host group. The table includes columns for Port ID, LUN ID, LDEV ID, LDEV Name, Pool Name (ID), Capacity, and Used Capacity. The LDEVs are assigned to the 'CL1-D' host group.

Port ID	LUN ID	LDEV ID	LDEV Name	Pool Name (ID)	Capacity	Used Capacity
CL1-D	0	00-00-04	siteb-pvol	vMSC_S8(6)	250.00 GB	13.61 GB
CL1-D	1	00-00-03	siteb-pvol	vMSC_S8(6)	250.00 GB	13.86 GB
CL1-D	2	00-00-05	siteb-pvol	vMSC_S8(6)	250.00 GB	17.67 GB
CL1-D	3	00-00-07	siteb-pvol	vMSC_S8(6)	250.00 GB	27.48 GB
CL1-D	4	00-00-08	siteb-pvol	vMSC_S8(6)	8.00 GB	1.23 GB
CL1-D	5	00-00-08	siteb-pvol	vMSC_S8(6)	8.00 GB	1.23 GB
CL1-D	6	00-00-08	siteb-pvol	vMSC_S8(6)	8.00 GB	1.18 GB
CL1-D	7	00-00-4C	siteb-pvol	vMSC_S8(6)	8.00 GB	1.18 GB
CL1-D	8	00-00-4E	siteb-pvol	vMSC_S8(6)	8.00 GB	3.56 GB
CL1-D	9	00-00-50	siteb-pvol	vMSC_S8(6)	8.00 GB	3.56 GB
CL1-D	10	00-00-51	siteb-pvol	vMSC_S8(6)	8.00 GB	3.60 GB
CL1-D	11	00-00-52	siteb-pvol	vMSC_S8(6)	8.00 GB	3.56 GB

■ On Secondary storage:

1. First, create resource group of primary storage(site-1) type on secondary storage (site-2) and assign respective secondary resources to it. Then repeat these steps to create resource group of primary storage(site-2) type on secondary storage (site-1) and assign respective secondary resources to it.

Delete the virtual LDEV ID of the volumes from secondary storage which will be used for creating GAD pairs.



Figure 9: Delete Virtual LDEV ID

Edit Virtualization Management Settings

1.Edit Virtualization Management Settings > 2.Confirm

This wizard lets you edit virtual management settings of the selected LDEVs.  
Make the settings, and then Click Finish to confirm.

Virtual Management Settings:

Enable (Not Set) ▼

Initial Virtual LDEV ID:

LDKC : CU : DEV

Interval

▼

Virtual Configuration:

☐ Specify ☐ Not Set

Emulation Type:

▼

CVS Settings:

☐ Enable ☐ Disable

Number of Concatenated LDEVs:

(-)

SSID:

(-)

Setting the reservation attribute to the volume for the secondary volume of GAD pair.  
Set the reservation attribute for GAD to the LDEV ID's

Figure 10: Set Reservation Attribute

Assign GAD Reserves

1.Confirm

Enter a name for the task.  
Confirm the settings in the list and click Apply to add the task in the Tasks queue for execution.

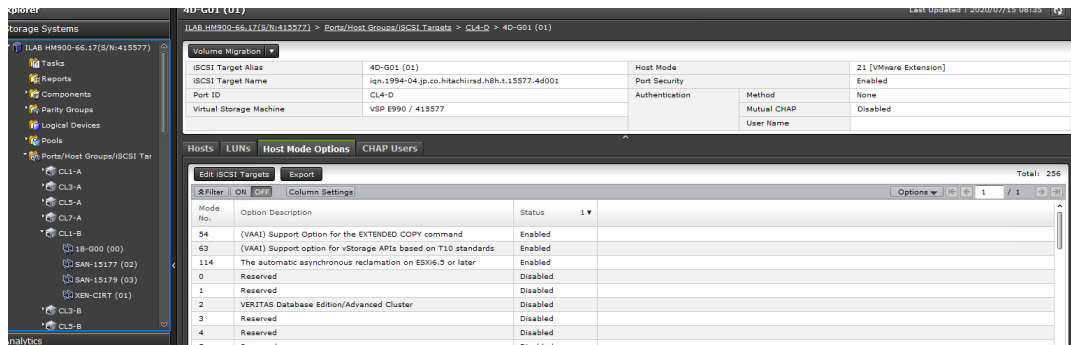
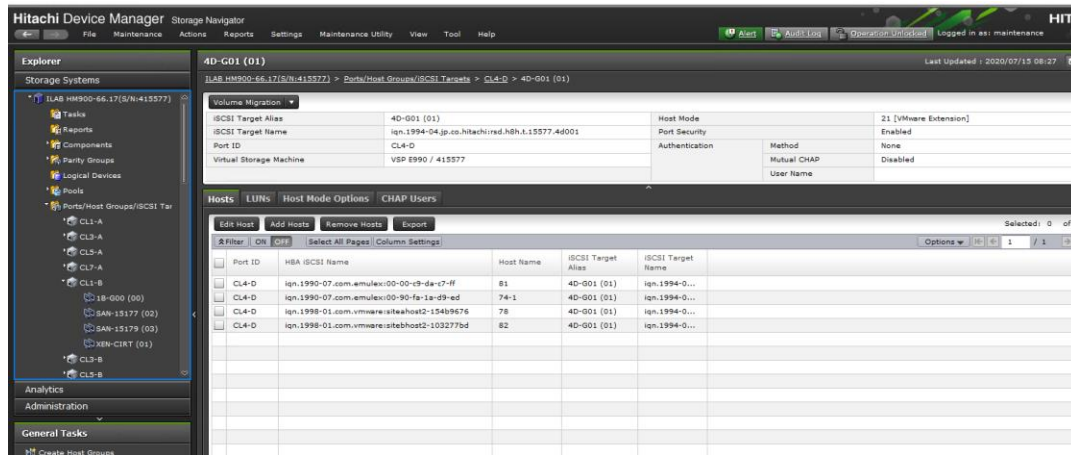
Task Name: 200715-AssignGADReserves (Max. 32 Characters)

Selected LDEVs

LDEV ID	Virtual Storage Machine	Capacity Saving	
00:00:17	VSP E990 / 415377	Disabled	

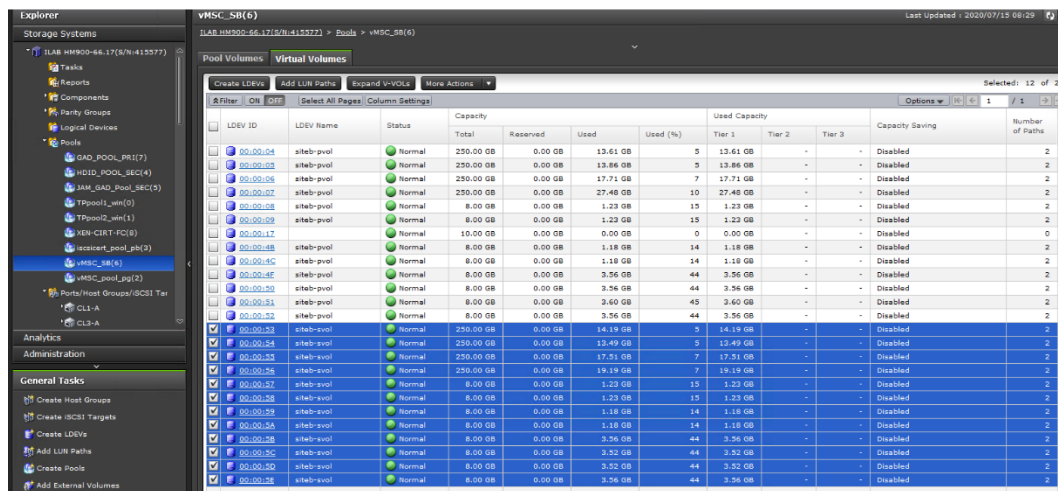
- 2. Create host group of GAD Secondary site Storage and set Host Mode Options

**Figure 11: Secondary Site Host Group and Host Mode Options**



3. Create DP Pool and LDEVs for secondary volumes of Site-1 GAD pair. Repeat these Steps for creating DP Pool and LDEVs for secondary volumes of Site-2 GAD pair. Create secondary volumes with the same capacity as the primary volumes.

**Figure 12: Create DP Pool and LDEVs**



Adding an LU path to the secondary volume.

Figure 13: Add LU Path

Storage Systems

Tasks

Reports

Components

Parity Groups

Logical Devices

Pools

Ports/Host Groups/SCSI Tar

CL1-A

CL3-A

CL2-A

CL1-B

CL18-000 (00)

CL5AN-15177 (02)

CL5AN-15178 (03)

CL5EN-CIAT (01)

CL3-B

CL5-B

Analytics

Administration

General Tasks

Create Host Groups

Create iSCSI Targets

4D-G01 (01)

ILAB-HM900-66.17/2/N(415377) > Ports/Host Groups/SCSI Targets > CL4-D > 4D-G01 (01)

Volume Migration

SCSI Target Alias

SCSI Target Name

Port ID

Virtual Storage Machine

4D-G01 (01)

lqn.1594-04.jp.co.hitachi.rsd.h8h.1.15377.4d001

CL4-D

VSP E990 / 415377

Host Mode

Port Security

Authentication

Method

Mutual CHAP

User Name

21 [iHare Extension]

Enabled

None

Disabled

Hosts

LUNS

Host Mode Options

CHAP Users

Add LU Paths

Copy LUN Paths

Edit Command Devices

More Actions

2 Filter

ON

OFF

Select All Pages

Column Settings

Options

Selected: 0 of 12

1

2

3

4

5

6

7

8

9

10

11

12

Port ID	LUN ID	LDEV ID	LDEV Name	Pool Name (ID)	Capacity	Reserved	Used	Used %	Used Capacity	Provisioning Type	Number of Paths	ALUA Mode
					Total				Tier 1			
CL4-D	0	00:00:33	steb-svol	VMSC_SB(6)	250.00 GB	0.00 GB	14.19 GB	5	14.19 GB	DP	2	Enabled
CL4-D	1	00:00:34	steb-svol	VMSC_SB(6)	250.00 GB	0.00 GB	13.49 GB	5	13.49 GB	DP	2	Enabled
CL4-D	2	00:00:35	steb-svol	VMSC_SB(6)	250.00 GB	0.00 GB	17.51 GB	7	17.51 GB	DP	2	Enabled
CL4-D	3	00:00:36	steb-svol	VMSC_SB(6)	250.00 GB	0.00 GB	19.19 GB	7	19.19 GB	DP	2	Enabled
CL4-D	4	00:00:37	steb-svol	VMSC_SB(6)	8.00 GB	0.00 GB	1.23 GB	15	1.23 GB	DP	2	Enabled
CL4-D	5	00:00:38	steb-svol	VMSC_SB(6)	8.00 GB	0.00 GB	1.23 GB	15	1.23 GB	DP	2	Enabled
CL4-D	6	00:00:39	steb-svol	VMSC_SB(6)	8.00 GB	0.00 GB	1.18 GB	14	1.18 GB	DP	2	Enabled
CL4-D	7	00:00:3A	steb-svol	VMSC_SB(6)	8.00 GB	0.00 GB	1.18 GB	14	1.18 GB	DP	2	Enabled
CL4-D	8	00:00:3B	steb-svol	VMSC_SB(6)	8.00 GB	0.00 GB	3.56 GB	44	3.56 GB	DP	2	Enabled
CL4-D	9	00:00:3C	steb-svol	VMSC_SB(6)	8.00 GB	0.00 GB	3.52 GB	44	3.52 GB	DP	2	Enabled
CL4-D	10	00:00:3D	steb-svol	VMSC_SB(6)	8.00 GB	0.00 GB	3.52 GB	44	3.52 GB	DP	2	Enabled
CL4-D	11	00:00:3E	steb-svol	VMSC_SB(6)	8.00 GB	0.00 GB	3.56 GB	44	3.56 GB	DP	2	Enabled

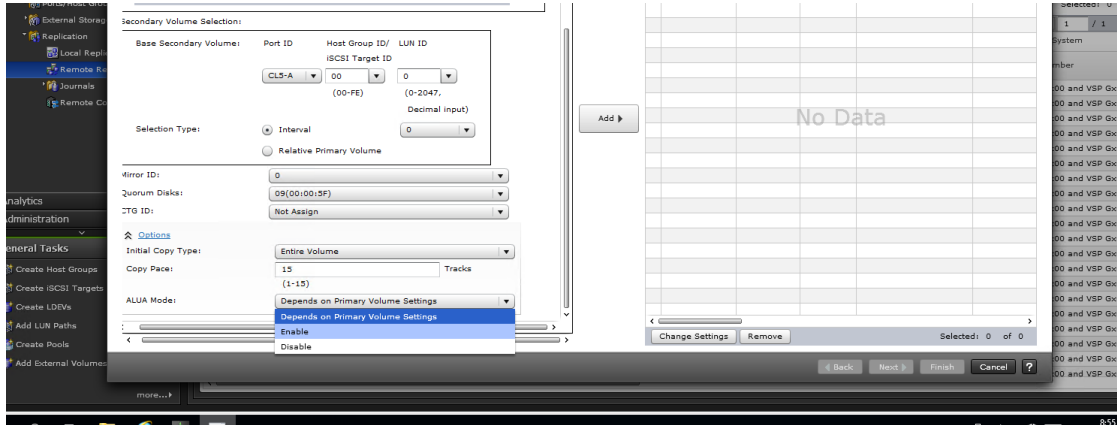
■ GAD Pair Creation:

Figure 14: GAD Pair Creation

Port ID	Host Group Name / SCSI Target Alias	LUN ID	LDEV ID
CL1-D	ID-G01 (01)	0	00:00:0A
CL1-D	ID-G01 (01)	1	00:00:0B
CL1-D	ID-G01 (01)	2	00:00:0C

For NMP-ALUA configuration, while creating ALUA pair ALUA mode must be enabled.

**Figure 15: Enable ALUA Mode**



### 3. Failure scenarios:

This section deals with the typical failure scenarios in a GAD vMSC environment and the results for each scenario

Remote connection failure for a particular site

GAD pair behaves differently for failing remote connections for each site.

#### Test simulation result of Storage TC ports failure (ALUA/NMP) for a particular Site (A or B):

1. Disabled Site A Storage TC ports:
  - Site A PVOLs win and Site B corresponding SVOLs block.
  - Site B PVOLs win and Site A corresponding SVOLs block.
2. Disabled Site B Storage TC ports:
  - Site A PVOLs block and Site B corresponding SVOLs win.
  - Site B PVOLs win and Site A corresponding SVOLs block.

#### Test simulation result of Storage TC ports failure (HDLM) for a particular Site (A or B):

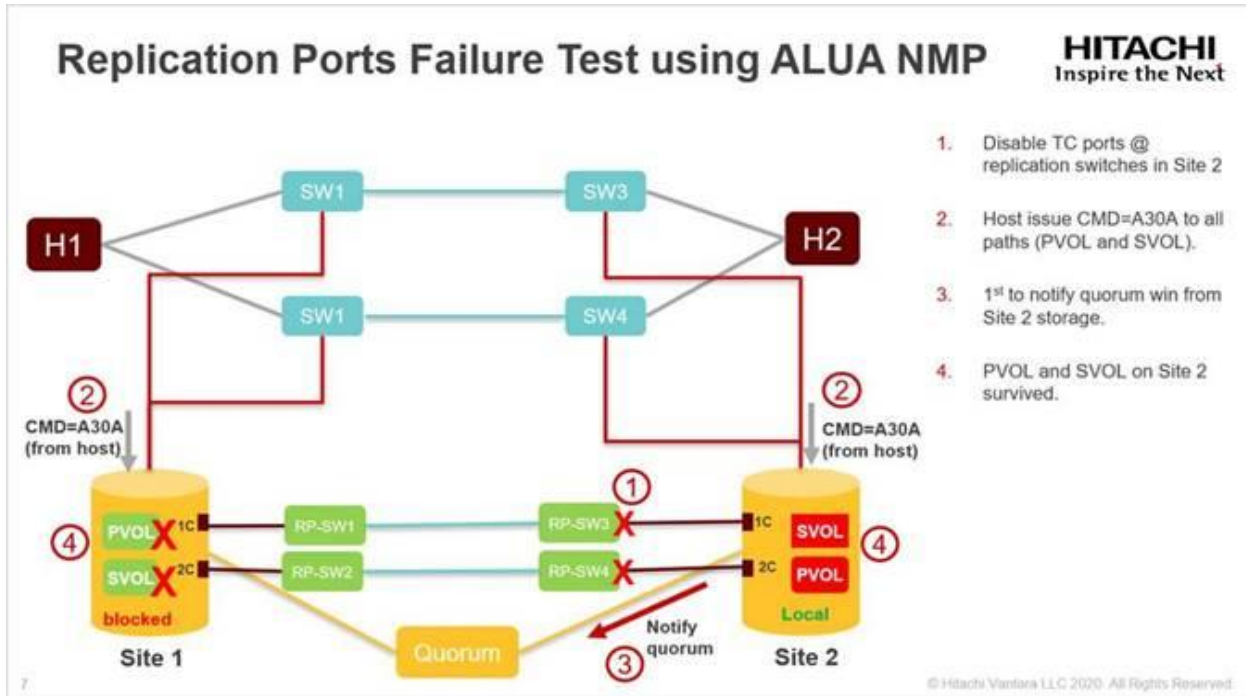
1. Disabled Site A Storage TC ports:
  - Site A PVOLs win and Site B corresponding SVOLs block.
  - Site B PVOLs win and Site A corresponding SVOLs block.
2. Disabled Site B Storage TC ports:
  - Site A PVOLs win and Site B corresponding SVOLs block.
  - Site B PVOLs win and Site A corresponding SVOLs block.

Note:

- For ESXi 6.7, the parameter for action\_OnRetryErrors is ON by default.
- For ESXi 6.7U3B, the same parameter is OFF by default.
- When using NMP/ALUA as multipath, set HMO78=OFF
- Ensure for NMP/ALUA, ALUA enabled per LUN / Dedicated Ports for PVOLs and SVOLs enabled with HG Optimized and Non-optimized Paths.

- vSphere GUI on all ESXi hosts showing LUN status: “Active (IO)” à PVOLs and “Active” à SVOLs.
- Zero IOPS observed on SVOLs Storage Ports and generated IO workload observed on PVOLs Storage Ports.
- For NMP/ALUA the host sends CMD=A30A to all the paths, and the storage that notifies Quorum first, survives.
- With HDLM, it was confirmed no ALUA RTPG A3h command send and therefore both PVOLs survived on both storages.

**Figure 16: Replication Ports Failure Test**



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