Managing Virtual Machine Disaster Recovery

Data Protection Overview

The HX Data Platform disaster recovery feature allows you to protect virtual machines from a disaster by setting up replication of running VMs between a pair of network connected clusters. Protected virtual machines running on one cluster replicate to the other cluster in the pair, and vice versa. The two paired clusters typically are located at a distance from each other, with each cluster serving as the disaster recovery site for virtual machines running on the other cluster.

Once protection has been set up on a VM, HX Data Platform periodically takes a replication snapshot of the running VM on the local cluster and replicates (copies) the snapshot to the paired remote cluster. In the event of a disaster at the local cluster, you may use the most recently replicated snapshot of each protected VM to recover and run the VM at the remote cluster. Each cluster that serves as a disaster recovery site for another cluster, must be sized with adequate spare resources so that upon a disaster, it can run the newly recovered virtual machines in addition to its normal workload.

Note Only one snapshot retention is supported for backup workflows.

Each virtual machine can be individually protected by assigning it protection attributes, chief among which is the replication interval (schedule). The shorter the replication interval, the fresher the replicated snapshot data is likely to be, when it is time to recover the VM after a disaster. Replication intervals can range between 5 minutes and 24 hours.

Protection group is a group of VMs that have a common replication schedule and snapshot properties.

Setting up replication requires two existing clusters running HX Data Platform version 2.5 or higher. Both clusters must be on the same HX Data Platform version. This setup can be completed online.

First, each cluster is set up for replication networking. Use HX Connect to provide a set of IP addresses to be used by local cluster nodes to replicate to the remote cluster. HX Connect creates VLANs through UCS Manager, for dedicated replication network use.

Note When this option is chosen in HX Connect, UCSM is configured only when both UCS Manager and fabric interconnect are associated with the HyperFlex cluster. When UCSM and FI are not present, you must enter the VLAN ID, and not select UCSM configuration in HX Connect.

The two clusters, and their corresponding existing relevant datastores must be explicitly paired. The pairing setup can be completed using HX Connect from one of the two clusters. This requires administrative credentials of the other cluster.

Virtual machines can be protected (or have their existing protection attributes modified) by using HX Connect at the cluster where they are currently active.

HX Connect can be used to monitor the status of both incoming and outgoing replications at a cluster.

After a disaster, a protected VM can be recovered and run at the cluster that serves as the disaster recovery site for that VM.

Replication and Recovery Considerations

The following is a list of considerations when configuring virtual machine replication and performing disaster recovery of virtual machines.

- **Administrator—**All replication and recovery tasks, except monitoring, can only be performed with administrator privileges on the local cluster. For tasks involving a remote cluster, both the local and remote user must have administrator privileges and should be configured with the vCenter SSO on their respective clusters.
- **Minimum and Recommended Bandwidth—**For HX 4.0(2a) and forward, minimum bandwidth can be configured to be 10 Mb for smaller size deployments. The replication network link should also be reliable and have sustained minimum symmetric bandwidth same as configured in a HyperFlex DR network. This should not be shared with any other applications on Uplink or Downlink.
- **Maximum Latency—**Maximum latency supported is 75ms between two clusters.

  If you are scheduling to run multiple replication jobs at the same time, for example 32 as maximum supported by DR, and your bandwidth (50Mbs) is low and latency (75ms) high, it is possible that some jobs will error out until bandwidth becomes available. If this situation occurs, increase bandwidth or reduce the concurrency by staggering the replications.

  During this situation, unprotect operations can take longer than expected.
- **Network Loss—**When there is a packet loss in data transmission across two sites, protection and recovery operations will have unexpected results. The transmission should be reliable for these features to work as expected.
- **Storage Space—**Ensure that you have sufficient space on the remote cluster to support your replication schedule. The protected virtual machines are replicated (copied) to the remote cluster at every scheduled interval. Though storage capacity methods are applied (deduplication and compression), each replicated virtual machine will consume some storage space.

  Not having sufficient storage space on the remote cluster can cause the remote cluster to reach capacity usage maximums. If you see **Out of Space** errors, see Handling Out of Space Errors. Pause all replication schedules until you have appropriately adjusted the space available on the HX Cluster. Always ensure that your cluster capacity consumption is below the space utilization warning threshold.

- **Supported Clusters—**Replication is supported between the following HyperFlex clusters:
  - 1:1 replication between HX clusters running under fabric interconnects.
  - 1:1 replication between All Flash and Hybrid HX cluster running under fabric interconnects.
  - 1:1 replication between 3-Node and 4-Node HX Edge and another 3-Node and 4-Node HX Edge cluster.
  - 1:1 replication between All Flash 3-Node and 4-Node Edge and Hybrid 3-Node and 4-Node HX Edge clusters.
  - 1:1 replication between 3-Node and 4-Node HX Edge and an HX cluster running under fabric interconnects.

Note 1:1 replication with 2-Node HX Edge is not supported.

- **Rebooting Nodes—**Do not reboot any nodes in the HX Cluster during any restore, replication, or recovery operation.
- **Thin Provision—**Protected virtual machines are recovered with thin provisioned disks irrespective of how disks were specified in the originally protected virtual machine.
- **Protection Group Limitations**
  - The maximum number of VMs allowed in a protection group is 64.
  - Do not add VMs with ISOs or floppies to protection groups.

Protected Virtual Machine Scalability

- 1500 VMs across both clusters is supported. It can be 750 VMs per cluster in a bi-direction (that is replicating from both directions Site A to Site B and vice versa) or any split between the two clusters without exceeding the limit of 1500 VMs.
- The sum of VMs on all nodes should not exceed the maximum limit of 1500 VMs per cluster in single direction configuration and 750 VMs in a bi-direction configuration. The maximum limit of 1500 VMs is supported regardless of whether it is 4-node or 8-node cluster.

  For example, with 4-node clusters on both sides of DR, you can reach up to 800 VMs. However, with 8-node clusters on both sides, the replication and recovery of 1600 VMs is not supported.
- The maximum number of VMs allowed in a protection group is 64.
- Do not add VMs with ISOs or floppies to protection groups.
- A maximum of 100 protection groups are supported.

- **Non-HX Datastores—**If you have protected a VM with storage on a non-HX datastore, periodical replication will fail on this. You can either unprotect this VM or remove its non-HX storage.

  Do not move protected VMs from HX datastores to non-HX datastores. If a VM is moved to a non-HX datastore through storage vMotion, unprotect the VM, then reapply the protection.
- **Templates—**Templates are not supported for Disaster Recovery.

- **Protection and Recovery of Virtual Machines with Snapshots**
  - A VM with no Snapshots—When replication is enabled the entire content of the VM is replicated.
  - A VM with VMware Redolog snapshots—When replication is enabled the entire content including the snapshot data is replicated. When a VM with redolog snapshots is recovered, all previous snapshots are preserved.
  - A VM with Hyperflex Snapshots—When replication is enabled only the latest data is replicated, and the snapshot data is not replicated. When the VM is recovered, previous snapshots are not preserved.
- **Data Protection and Disaster Recovery (DR) snapshots** are stored on the same datastore as the protected VMs. Deleting these snapshots manually by an Admin, is not supported. Deleting the snapshot directories would compromise HX data protection and disaster recovery.

Caution As in any VMware environment, not restricted to HX on VMware, datastores can be accessed by the Admin via VCenter browser or by logging into the ESX host. Because of this, snapshot directory and contents are browse-able and accessible to Admins. VMware does not restrict operations on datastores by Admin. Please be aware of this to avoid deleting snapshots manually.

Other points for consideration include:

- **Location of the VMware Virtual Center**—If you delete a VM from VMware Virtual Center that is located on a "Other DRO" datastore pair, a recovery plan for this datastore pair fails during recovery. To avoid this failure, you must first unprotect the VM using the following command on one of the controller VMs:

  stcli dp vm delete --vmid <VM_ID>

- **Name of the VM**—If you rename a VM from the Virtual Center, Hyperflex recovers at the previous name folder but registers the VM with the new name on the recovery side. Following are some of the limitations to this situation:
  - VMware allows a VMDK located at any location to be attached to a VM. In such cases, Hyperflex recovers the VM inside the VM folder and not at a location mapped to the original location. Also, recovery can fail if the VMDK is explicitly referenced in the `virtualmachine name.vmx` file by its path. The data is recovered accurately but there could be problems with registering the VM to the Virtual Center. You can rectify this error by updating the `virtualmachine name.vmx` file name with the new path.
  - If a VM is renamed and a VMDK is added subsequently, the new VMDK is created at [sourceDs] newVm/newVm.vmdk. Hyperflex recovers this VMDK with the earlier name. In such cases, recovery can fail if the VMDK is explicitly referenced in the `virtualmachine name.vmx` file by its path. The data is recovered accurately but there could be problems with registering the VM to the Virtual Center. You can rectify this error by updating the `virtualmachine name.vmx` file with the new path.

Replication Network and Pairing Considerations

A replication network must be established between clusters that are expected to use replication for Data Protection. This Replication network is created to isolate inter-cluster replication traffic from other traffic within each cluster and site.

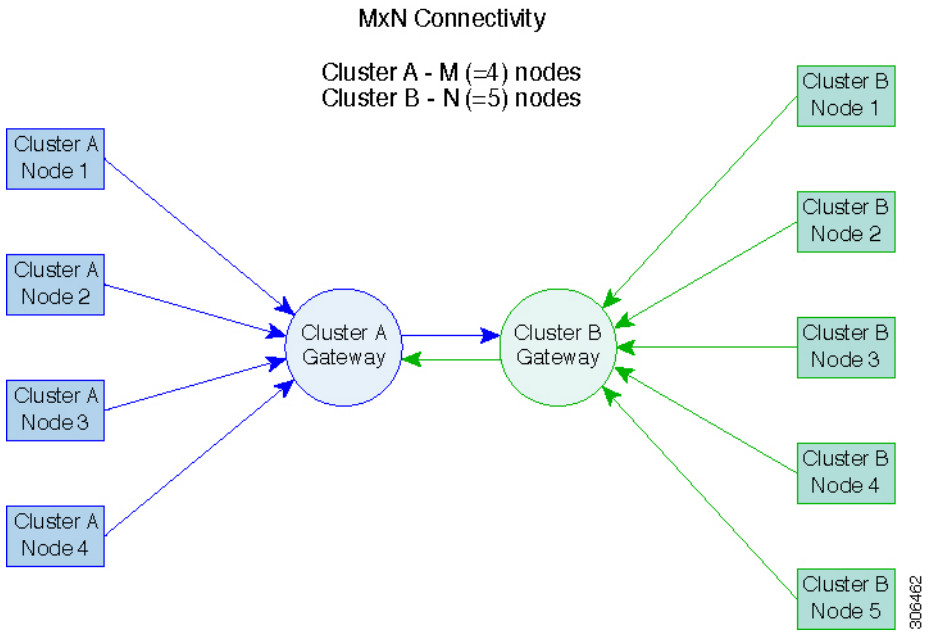
The following is a list of pre-validation checks necessary for pairing:

- Verify and ensure that peer credentials are working.
- Check the health of both clusters and proceed with pairing only when both the clusters are healthy.
- Verify and ensure that vCenter version is at least same or higher than ESXi version at each cluster.

The following is a list of considerations when configuring replication network and pairing:

- To support efficient replication, all M nodes of cluster A have to communicate with all N nodes of cluster B, as illustrated in the *M x N connectivity between clusters* figure.
- To enable replication traffic between clusters to cross the site-boundary and traverse the internet, each node on Cluster A should be able to communicate with each node on Cluster B across the site boundary and the internet.
- The replication traffic must be isolated from other traffic within the cluster and the data center.
- To create this isolated replication network for inter-cluster traffic, complete these steps:
  - Create a replication network on each cluster.
  - Pair clusters to associate the clusters and establish M x N connectivity between the clusters.
- IP addresses, Subnet, VLAN, and Gateway are associated with each replication network of each cluster. You must configure the corporate firewall and routers on both sites, to allow communication between the clusters and the sites on TCP ports *9338,3049,9098,4049,4059*.

M*N Connectivity Between Clusters



Data Protection Terms

Interval—Part of the replication schedule configuration, used to enforce how often the protected VMs replication snapshot must be taken and copied to the target cluster.

Local cluster—The cluster you are currently logged into through HX Connect, in a VM replication cluster pair. From the local cluster, you can configure replication protection for locally resident VMs. The VMs are then replicated to the paired remote cluster.

Migration—A routine system maintenance and management task where a recent replication snapshot copy of the VM becomes the working VM. The replication pair of source and target cluster do not change.

Primary cluster—An alternative name for the source cluster in VM disaster recovery.

Protected virtual machine—A VM that has replication configured. The protected VMs Reside on a datastore in the local cluster of a replication pair. They have a replication schedule configured either individually or through a protection group.

Protection group—A means to apply the same replication configuration on a group of VMs.

Recovery process—The manual process to recover protected VMs in the event the source cluster fails or a disaster occurs.

Recovery test—A maintenance task that ensures the recovery process is successful in the event of a disaster.

Remote cluster—One of a VM replication cluster pair. The remote cluster receives the replication snapshots from the Protected VMs in the local cluster.

Replication pair—Two clusters that together provide a remote cluster location for storing the replication snapshots of local cluster VMs.

Clusters in a replication pair can be both a remote or local cluster. Both clusters in a replication pair can have resident VMs. Each cluster is local to its resident VMs. Each cluster is remote to the VMs that reside on the paired local cluster.

Replication snapshot—Part of the replication protection mechanism. A type of snapshot taken of the protected VM, which is copied from the local cluster to the remote cluster.

Secondary cluster—An alternative name for the target cluster in VM disaster recovery.

Source cluster—One of a VM replication cluster pair. The source cluster is where the protected VMs reside.

Target cluster—One of a VM replication cluster pair. The target cluster receives the replication snapshots from the VMs of the source cluster. The target cluster is used to recover the VMs in the event of a disaster on the source cluster.

Best Practices for Data Protection and Disaster Recovery

As an administrator, you will need to design and deploy an effective data protection and disaster recovery strategy in your environment. The solution that you design and subsequently deploy must meet or exceed business requirements for both, Recovery Point Objectives (RPO) and Recovery Time Objectives (RTO) of the production VMs. Following are some of the points that you must consider while designing this strategy:

- The number of Service Level Agreements (SLA) necessary to comply with various categories of production workloads that may include mission critical, business critical, and important VMs.
- Detailed constructs of each SLA that may include RPO, RTO, the number or recovery points retained, requirements for offsite copies of data, and any requirements for storing backup copies on different media types. There may be additional requirements that include the ability to recover to a different environment such as a different location, different hypervisor or different private/public cloud.
- An ongoing testing strategy for each SLA which serves to prove that the solution meets the business requirements it was designed for.

Note that backups and backup copies must be stored external to the HyperFlex cluster being protected. For example, backups performed to protect VMs on a HyperFlex cluster should not be saved to a backup repository or a disk library that is hosted on the same HyperFlex cluster.

The built-in HyperFlex data protection capabilities are generalized into the following categories:

- **Data Replication Factor**—Refers to the number of redundant copies of data within a HyperFlex cluster. A data replication factor of 2 or 3 can be configured during data platform installation and cannot be changed. The data replication factor benefit is that it contributes to the number of cluster tolerated failures. See the section titled, HX Data Platform Cluster Tolerated Failures for additional information about the data replication factor.

  Note Data Replication Factor alone may not fulfill requirements for recovery in the highly unlikely event of a cluster failure, or an extended site outage. Also, the data replication factor does not facilitate point-in-time recovery, retention of multiple recovery points, or creation of point-in-time copies of data external to the cluster.

- **Data Platform Snapshots**—Operates on an individual VM basis and enables saving versions of a VM over time. A maximum of 31 snapshots can be retained.

Note Data Platform Snapshots alone may not fulfill requirements for recovery in the highly unlikely event of a cluster failure, or an extended site outage. Also, it does not facilitate the ability to create point-in-time copies of data external to the cluster. More importantly, unintentional deletion of a VM will also delete any data platform snapshots associated with the deleted VM.

- **Asynchronous Replication**—Also known as The HX Data Platform disaster recovery feature, it enables protection of virtual machines by replicating virtual machine snapshots between a pair of network connected HyperFlex clusters. Protected virtual machines running on one cluster replicate to the other cluster in the pair, and vice versa. The two paired clusters typically are located at a distance from each other, with each cluster serving as the disaster recovery site for virtual machines running on the other cluster.

Note Asynchronous Replication alone may not fulfill requirements for recovery when multiple point-in-time copies need to be retained on the remote cluster. Only the most recent snapshot replica for a given VM is retained on the remote cluster. Also, asynchronous replication does not facilitate the ability to create point-in-time copies of data external to either cluster.

We recommend that you first understand the unique business requirements of your environment and then deploy a comprehensive data protection and disaster recovery solution to meet those requirements.

Protecting Virtual Machines Overview

To protect a virtual machine, specify the following protection attributes:

- Replication interval, which is the frequency of replication.
- A start time (within the next 24 hours), which specifies the first-time replication is attempted for that virtual machine.
- Specify if the replication snapshot should be taken with the virtual machine quiesced or not.

Protection attributes can be created and assigned to protection groups. To assign the protection attributes to virtual machines, they can be added to a protection group.

For example, say you have three classes of protection: gold, silver, and bronze. Set up a protection group for each class, with replication intervals such as 5 or 15 minutes for gold, 4 hours for silver, and 24 hours for bronze. Most of your VMs could be protected by merely adding them to one of the three already created protection groups.

To protect virtual machines, you can choose from the following methods:

Note When you select multiple virtual machines, you must add them to a protection group.

- **Independently—**Select one virtual machine and configure. Set the replication schedule and the VMware quiesce option for the specific virtual machine. Changes to the replication settings will only affect the independently protected virtual machine. The virtual machine is not included in a protection group.
- **Existing protection group—**Select one or more virtual machines and add them to an existing protection group. The schedule and VMware quiesce option settings are applied to all the virtual machines in the protection group. When the protection group settings are changed, the changes are applied to all the virtual machines in the protection group.
- **New protection group—**Select two or more virtual machines and choose to create a new protection group. Define the protection group name, schedule, and VMware quiesce option settings. These settings are applied to all the virtual machines in the protection group. When the protection group settings are changed, the changes are applied to all the virtual machines in the protection group.

Data Protection Workflow

To protect VMs and their data using replication, perform the following steps:

- Configure two clusters and pair them to each other, to support the replication network activity.
- Assign replication schedule for the VMs to set the frequency (interval) for creating replication snapshots on the source cluster and copy them to the target cluster. Set replication schedule on individual VMs and on protection groups.

Replication Workflow

1. Install HX Data Platform, create two clusters.
2. Create at least one datastore on each cluster.
3. Log in to HX Connect.
4. Before creating the replication network, verify the IP addresses, subnet mask, VLAN, gateway, and IP range to be used for the replication network. After the replication network is created, validate connectivity within the cluster over this new replication network.
5. The default value of MTU is 1500. If your HyperFlex cluster uses OTV or other tunneling mechanisms, ensure that you choose an MTU which will work for inter-site or inter-cluster connectivity.
6. Configure cluster replication network on each cluster. The replication network information is unique to each cluster.

   Specify the subnet, gateway, range of IP addresses, bandwidth limit for dedicated use by the replication network. HX Data Platform configures a VLAN through UCS Manager for both clusters.
7. An intra-cluster network test is performed to validate connectivity between the nodes in the cluster, after the replication network is configured. If the intra-cluster network test fails, the replication network configuration is rolled back. Reconfigure the replication network after fixing the issue.
8. Before creating the replication pair, ensure that you have updated the corporate network to support this pairing.
9. Create a replication pair from one cluster to the other, connecting the two clusters. After the replication pair is created, a test of the inter-cluster pair network is performed to validate bidirectional connectivity between the clusters. Set the datastore mapping from both clusters.

10. Optionally, you can create protection groups.
    - Set the schedule. Each protection group must have one schedule.
    - Create multiple protection groups if you want to have various replication intervals (schedules) for different virtual machines. A virtual machine can only belong to one protection group.
11. Select virtual machines to protect, as individual virtual machines or virtual machines assigned to protection groups.
12. Set protection, do the following:
    a. Select one or more virtual machines. Click Protect.
    b. From the Protect Virtual Machine wizard, the options are:
        - Protect a single virtual machine through an existing protection group.
        - Protect a single virtual machine independently.

          Set the schedule.
        - Protect multiple virtual machines through an existing protection group.
        - Protect multiple virtual machines through a new protection group.

          Create new protection group and set schedule.

Configuring the Replication Network in HX Connect

Before a replication pair can be configured, the replication network has to be configured on both the local and remote cluster. Complete the configuration on the local cluster, then log in to the remote cluster and complete the configuration there.

Before you begin

Ensure that the following prerequisites are met, before configuring the replication network:

- A minimum of N + 1 IP addresses is required, where N is the number of converged nodes. An IP subnet spanning these new IP addresses, the gateway, and VLAN associated with this subnet is also required.
- To accommodate future cluster expansion, ensure that there are sufficient IP addresses in the subnet provided, for later use. Any new converged nodes in the expanded cluster would also need to be assigned IP addresses for replication. The subnet provided in the previous step should span the potentially new IP range as well.
- Additional IP-pool ranges can be added to the network later, however IP-pools already configured in the replication network cannot be modified.
- Make sure that the IP addresses to be used for the replication network are not already in use by other systems.
- Before creating the replication network, verify IP addresses, Subnet, VLAN, and Gateway to be used for the replication network.

Step 1 Log in to HX Connect as administrator.

Step 2 Select **Replication** > **Replication Configuration** > **Configure Network**.

Note You can only configure the replication network once. Once configured, you can edit the available IP addresses and the networking bandwidth.

Step 3 In the **Configure Replication Network** dialog box, under the **Configure Replication Network VLAN Configuration** tab, enter the network information.

UI Element	Essential Information
Select an existing VLAN radio button	Click this radio button to add an existing VLAN. If you manually configured a VLAN for use by the replication network through Cisco UCS Manager, enter that VLAN ID.
Create a new VLAN radio button	Click this radio button to create a new VLAN.
VLAN ID field	Click the up or down arrows to select a number for the VLAN ID or type a number in the field. This is separate from the HX Data Platform Management traffic network and Data traffic network. **Important** Be sure to use a different VLAN ID number for each HX Storage Cluster in the replication pair. Replication is between two HX Storage Clusters. Each HX Storage Cluster requires a VLAN dedicated to the replication network. For example, *3*. When a value is added, the default VLAN Name is updated to include the additional identifier. The VLAN ID value does not affect a manually entered VLAN name.
VLAN Name field	This field is automatically populated with a default VLAN name when the **Create a new VLAN** radio button is selected. The VLAN ID is concatenated to the name.
For Stretched Cluster, provide Cisco UCS Manager credentials for primary and secondary FIs (site A and site B).For normal cluster, provide Cisco UCS Manager credential for single FI.	
UCS Manager host IP or FQDN field	Enter Cisco UCS Manager FQDN or IP address. For example, *10.193.211.120*.
Username field	Enter administrative username for Cisco UCS Manager.
Password field	Enter administrative password for Cisco UCS Manager.

Step 4 Click **Next**.

Step 5 In the **IP & Bandwidth Configuration** tab, set the network parameters and the replication bandwidth.

UI Element	Essential Information

Subnet field	Enter the subnet for use by the replication network in network prefix notation. The subnet is separate from the HX Data Platform Management traffic network and Data traffic network.
	`Format example:`
	`x.x.x.x/<number of bits>`
	`1.1.1.1/20`

Gateway field	Enter the gateway IP address for use by the replication network. The gateway is separate from the HX Data Platform Management traffic network and Data traffic network. For example, *1.2.3.4*. **Note** The gateway IP address must be accessible even if the disaster recovery is being setup for a flat network.
IP Range field	Enter a range of IP addresses for use by the replication network. • The minimum number of IP addresses required is the number of nodes in your HX Storage Cluster plus one more. For example, if you have a 4 node HX Storage Cluster, enter a range of at least 5 IP addresses. • The **from** value must be lower than the **to** value. For example, *From 10.10.10.20 To 10.10.10.30*. • If you plan to add nodes to your cluster, include sufficient number of IP addresses to cover any additional nodes. You can add IP addresses at any time. **Note** The IP address range excludes compute-only nodes.
Add IP Range button	Click to add the range of IP addresses entered in **IP Range** `From` and `To` fields.

UI Element	Essential Information
Set Replication Bandwidth Limit check box	Enter the maximum network bandwidth that the replication network is allowed to consume for inbound and outbound traffic. Acceptable value is 33,000 Mbits/sec. The default value is `unlimited`, which sets the maximum network bandwidth to the total available to the network. The replication bandwidth is used to copy replication snapshots from this local HX Storage Cluster to the paired remote HX Storage Cluster. **Note** • At lower bandwidth (typically, lesser than 50 Mbits/sec), the replications of multiple VMs may exit without executing the replication process due to high data transfer rate. To overcome this issue, either increase the bandwidth or stagger VM replication schedule so that VMs do not replicate in the same window. • The bandwidth setting must be close to the link speed. The bandwidth setting for the clusters in the pair must be same. • The set bandwidth is applicable only for the incoming and outgoing traffic of the cluster to which the bandwidth is set to. For example, setting the bandwidth limit as 100Mb means that the 100Mb is set for incoming traffic and 100Mb is set for outgoing traffic. • The set bandwidth limit must not exceed the physical bandwidth. • The bandwidth configured must be same on both sites of the disaster recovery environment. • The allowed low bandwidth is 10Mb and the maximum latency supported with 10Mb is 75ms. If the initial replication of VMs fails due to lossy network or unstable HX clusters, the VM replication will be initiated again in the next schedule as a fresh replication job. In this case, you have to size the schedule accordingly to protect VMs.

UI Element	Essential Information
Set non-default MTU check box	Default MTU value is 1500. Select the check box to set a custom MTU size for the replication network. MTU can be set in the range 1024 to 1500. **Note** • Ensure to use the same MTU value on both sides of the cluster. • After configuring the cluster, if the MTU value needs to be changed, you must reconfigure the cluster. To reconfigure the replication network with a new MTU value, do the following: **a.** Delete the replication pair if it is already configured. **b.** In the Web CLI of HX Connect, execute the following command: `stcli drnetwork cleanup` **c.** After completion of the `drnetwork cleanup` task, configure the replication network.

Note When you use an existing VLAN for replication network, the replication network configuration fails. You must add the self-created replication VLAN to the management vNIC templates in Cisco UCS Manager.

Step 6 Click **Next**.

Step 7 In the **Test Configuration tab**, check the replication network configuration.

Step 8 Click **Configure**.

What to do next

- Be sure to configure the replication network on both HX Storage Clusters for the replication pair.
- After the replication network is created on the cluster, each converged node on the cluster would be configured with an IP address on the eth2 interface.
- Check for duplicate IP assignment using *'arp-scan'*.

```
For example if your replication subnet is 10.89.1.0/24:
$ sudo arp-scan 192.168.0.0/24 | cut -f1 | sort | uniq -d
```

If there is a duplicate IP assignment, it is necessary to remove the replication network assignments.

To reconfigure the replication network with proper IP assignment, do the following:

1. Delete the replication pair if it is already configured.
2. In the Web CLI of HX Connect, execute the following command:

   `stcli drnetwork cleanup`
3. After completion of the `drnetwork cleanup` task, configure the IP address in the replication network.

Test Local Replication Network

To perform an intra-cluster replication network test, do the following:

Step 1 Log in to HX Connect.
a) Enter the HX Storage Cluster management IP address in a browser. Navigate to *https://<storage-cluster-management-ip>*.
b) Enter the administrative username and password.
c) Click **Login**.

Step 2 In the Navigation pane, click **Replication**.

Step 3 From the **Actions** drop-down list, select **Test Local Replication Network**.

Step 4 Click **Run Test**.

Step 5 On the **Activity** page, you can view the progress of the *Test Replication Network* task.

Editing the Replication Network

When you expand a HX Cluster that has replication configured, ensure that you have sufficient IP addresses available for the replication network. The replication network requires dedicated IP addresses, one for every node in the cluster plus one more. For example, in a 3 node cluster, four IP addresses are required. If you are adding one more node to the cluster, five IP addresses are minimum. Edit the replication network to add IP addresses.

Step 1 Log in to HX Connect as administrator.

Step 2 In the Navigation pane, Select **Replication**.

Step 3 From the **Actions** drop-down list, select **Edit Replication Network**.

Step 4 In the **Edit Network Configuration** dialog box, you can edit the range of IPs to use and set the replication bandwidth limit for replication traffic. The replication network subnet and gateway are displayed for reference only and cannot be edited.

UI Element	Essential Information
Subnet field	The subnet that is configured for the replication network in network prefix notation. This value cannot be edited.
Gateway field	The gateway that is configured for the replication network. This is value cannot be edited.

UI Element	Essential Information
IP Range field	Enter a range of IP addresses for use by the replication network. • The minimum number of IP addresses required is the number of nodes in your HX Storage Cluster plus one more. For example, if you have a 4 node HX Storage Cluster, enter a range of at least 5 IP addresses. • The **from** value must be lower than the **to** value. For example, *From 10.10.10.20 To 10.10.10.30*. • If you plan to add nodes to your cluster, include sufficient number of IP addresses to cover any additional nodes. You can add IP addresses at any time. **Note** The IP address range excludes compute-only nodes.
Add IP Range field	Click to add the range of IP addresses that are entered in **IP Range** `From` and `To` fields.
Set replication bandwidth limit check box (Optional)	Enter the maximum network bandwidth that the replication network is allowed to consume for outbound traffic. Acceptable value is between 10 and 10,000. The default is `unlimited`, which sets the maximum network bandwidth to the total available to the network. The replication bandwidth is used to copy replication snapshots from this local HX Storage Cluster to the paired remote HX Storage Cluster.

Step 5 Click **Save Changes**.

The replication network is now updated. The added IP addresses are available for new nodes when they are added to the storage cluster. Replication traffic adjusts to any changes made to the bandwidth limit.

Replication Pair Overview

Creating a replication cluster pair is a pre-requisite for setting up VMs for replication. The replication network and at least one datastore must be configured prior to creating the replication pair.

By pairing cluster 1 with cluster 2, you are specifying that all VMs on cluster 1 that are explicitly set up for replication, can replicate to cluster 2, and that all VMs on cluster 2 that are explicitly set up for replication, can replicate to cluster 1.

By pairing a datastore A on cluster 1 with a datastore B on cluster 2, you are specifying that for any VM on cluster 1 that is set up for replication, if it has files in datastore A, those files will be replicated to datastore B on cluster 2. Similarly, for any VM on cluster 2 that is set up for replication, if it has files in datastore B, those files will be replicated to datastore A on cluster 1.

Pairing is strictly 1-to-1. A cluster can be paired with no more than one other cluster. A datastore on a paired cluster, can be paired with no more than one datastore on the other cluster.

Creating a Replication Pair

The replication pair defines the two halves of the protection network. The HX Storage Cluster you are logged into is the local cluster, the first half of the pair. Through this dialog, you identify another HX Storage Cluster, the second half of the pair, the remote cluster. To ensure the storage component, map the replication pair to datastores on each HX Storage Cluster. After the replication pair is configured, you can begin protecting virtual machines. See the **Virtual Machines** tab.

Important When pairing or mapping clusters at different versions, cluster pairing must be initiated on the 3.5 cluster and then the datastore mapping must be initiated from the 3.0 cluster.

- Cluster pairing must be initiated only from a 3.5 cluster to a 3.0 cluster.
- Datastore mapping must be initiated only from a 3.0 cluster to a 3.5 cluster.

Before you begin

- Create a datastore on both the local and the remote cluster.
- Configure the replication network.

Step 1 From HX Connect, log in to either the local or remote cluster as a user with administrator privileges. Select **Replication** > **Replication Pairs** > **Create Replication Pair**.

Step 2 Enter a **Name** for the replication pair and click **Next**.

Enter a name for the replication pairing between two HX Storage Clusters. This name is set for both the local and remote cluster. The name cannot be changed.

Step 3 Enter the **Remote Connection** identification and click **Pair**.

Once the Test Cluster Pair job is succesful, you can proceed to the next step. On the Activity page, you can view the progress of the Test Cluster Pair job.

UI Element	Essential Information
Management IP or FQDN field	Enter the IP address or fully qualified domain name (FQDN) for the management network on the remote HX Storage Cluster. For example: *10.10.10.10*.
User Name and **Password** fields	Enter vCenter single sign-on or cluster specific administrator credentials for the remote HX Storage Cluster.

HX Data Platform verifies the remote HX Storage Cluster and assigns the replication pair name.

Note Virtual machines to be protected must reside on one of the datastores in the replication pair.

Step 4 Set the **Datastore Mapping** from both clusters and click **Next**.

Note
- The virtual machines to be protected must on the datastores you select. Moving virtual machines from the configured datastores for the replication pair, also removes protection from the virtual machines.
- Moving virtual machine to another paired datastore is supported. If the VMs are moved to unpaired datastore, replication schedule fails.

UI Element	Essential Information
Local Datastore column	List of the configured datastores on this cluster, the local HX Storage Cluster. Map one local datastore to one remote datastore.
Remote Datastore column	Pair the datastores between the HX Storage Clusters. From the desired **Local Datastore** row, select a datastore from the **Remote Datastore** pull-down menu. This selects both the remote and local datastores in a single action.

Step 5 Review the Summary information and click **Map Datastores**.

UI Element	Essential Information
Datastore field	The selected datastore on this local HX Storage Cluster.
Target Datastore field	The datastore on the remote HX Storage Cluster where the replication snapshot is copied to.

Test Remote Replication Network

To test the pairing between clusters in a remote replication network, do the following:

Step 1 Log in to HX Connect.

a) Enter the HX Storage Cluster management IP address in a browser. Navigate to *https://<storage-cluster-management-ip>*.
b) Enter the administrative username and password.
c) Click **Login**.

Step 2 In the Navigation pane, click **Replication**.

Step 3 From the **Actions** drop-down list, select **Test Remote Replication Network**.

Field	Description
MTU Test Value	Default MTU value is 1500. MTU can be set in the range 1024 to 1500. **Note** • After configuring the cluster, if the MTU value needs to be changed, you must reconfigure the cluster. Please contact Cisco TAC. • Ensure to use the same MTU value on both sides of the cluster.

Step 4 Click **Run Test**.

Step 5 On the **Activity** page, you can view the progress of the *Replication Pair Network Check* task.

Editing a Replication Pair

Editing a replication pair is changing the datastores for the replication pair.

Step 1 Login to HX Connect as an administrator.

Step 2 Select **Replication** > **Replication Pairs** > **Edit**.

Step 3 Select the local or remote datastore and click **Finish**.

UI Element	Essential Information
Local Datastore column	List of the configured datastores on this cluster, the local HX Storage Cluster. Map one local datastore to one remote datastore.
Remote Datastore column	Pair the datastores between the HX Storage Clusters. **a.** To change the local datastore selection, remove the mapping to the current local datastore. From the pull-down menu in the **Remote Datastore** column, select **Do not map this datastore**. **b.** From the desired **Local Datastore** row, select a datastore from the **Remote Datastore** pull-down menu. This selects both the remote and local datastores in a single action.

Deleting a Replication Pair

Delete a replication pair on the local and remote clusters.

Select **Replication** > **Replication Pairs** > **Delete**.

Before you begin

On both the local and remote clusters, remove dependencies from the replication pair.

Log in to the local and the remote HX storage cluster and perform the following:

- Unprotect all virtual machines. Remove virtual machines from protection groups.
- Remove protection groups. If the protection group does not have a VM, deleting protection group is not required.

Step 1 Log in to HX Connect as an administrator.

Step 2 Unmap the datastores in the replication pair.

a) Select **Replication** > **Replication Pairs** > **Edit**.

After the test cluster pair job is successful, you can proceed to the next step. You can view the progress of the Test Cluster Pair job on the Activity page.

b) From the **Edit Replication Pair** dialog box, select **Do not map this datastore** from the **Remote Datastore** menu.

UI Element	Essential Information
Local Datastore column	List of the configured datastores on this cluster, the local HX Storage Cluster. Map one local datastore to one remote datastore.
Remote Datastore column	Pair the datastores between the HX Storage Clusters. **1.** To change the local datastore selection, remove the mapping to the current local datastore. From the pull-down menu in the **Remote Datastore** column, select **Do not map this datastore**. **2.** From the desired **Local Datastore** row, select a datastore from the **Remote Datastore** pull-down menu. This selects both the remote and local datastores in a single action.

c) Ensure all the possible remote datastores are set to **Do not map this datastore**.
d) Click **Finish**.

Step 3 Select **Replication** > **Replication Pairs** > **Delete**.

Step 4 Enter administrator credentials for the remote cluster and click **Delete**.

UI Element	Essential Information
User Name field	Enter the administrator user name for the remote HX Storage Cluster.
Password field	Enter the administrator password for the remote HX Storage Cluster.

Creating a Protection Group

A protection group is a group of VMs with the same replication scheme.

Create protection groups on a local cluster. Protection groups provide protection to the VMs where they are created. If protection groups have protected virtual machines that replicate to the remote cluster, these protection groups are listed in HX Connect.

Note You can only manage a protection group from its local cluster, the cluster where it is created.

Before you begin

Ensure that replication network and replication pair are configured.

Step 1 Log in to HX Connect as an administrator.

Step 2 Select **Replication** > **Protection Groups** > **Create Protection Group**.

Step 3 Enter the information in the dialog fields.

UI Element	Essential Information
Protection Group Name field	Enter a name for the new protection group for this local cluster. Protection groups are unique to each cluster. The name is referenced on the remote cluster, but not editable on the remote cluster. You can create multiple protection groups on the cluster.
Protect virtual machines in this group every field	Select how often the virtual machines are to be replicated to the paired cluster. Default is every 1 hour. The pull-down menu options are: 5 minutes, 15 minutes, 30 minutes, 1 hour, 90 minutes, 2 hours, 4 hours, 8 hours, 12 hours, 24 hours
Start protecting the virtual machines immediately radio button	Select this radio button if you want the first replication to start immediately after you add the first virtual machine to this protection group.
Start protecting the virtual machines at radio button	Select this radio button if you want to set a specific time for the first replication to start. Before you start replication ensure: • At least one virtual machine is added to the protection group. • The scheduled start time is reached. To specify the protection start time: **a.** Check the **Start protecting the virtual machines at** radio button. **b.** Click in the time field and select an hour and minute. Then click out of the field. **Cluster time zone** and **Current time on cluster** are references to help you to choose the appropriate replication start time. Start time is based on the local cluster clock. For example: 10 hours, 3 minutes from now with Current time on cluster, 1:56:15PM, means that the first replication occurs at 11:59:00PM. The *hours, minutes from now* states when the first replication will occur. This is updated when you change the time field setting.
Use VMware Tools to quiesce the virtual machine check box	To have HX Data Platform quiesce the virtual machines before taking the replication snapshot, click this check box. This only applies to virtual machines with VMware Tools installed.

Step 4 Click **Create Protection Group**.

HX Data Platform adds the new group to the **Protection Groups** tab. This protection group is available to protect virtual machines on this cluster.

Step 5 Click the **Replication** > **Protection Groups** to view or edit the new protection group.

If the number of VMs is zero, add virtual machines to this new protection group to apply the replication schedule set in this protection group.

Editing Protection Groups

Change the replication interval (schedule) for the virtual machines in the protection group.

Step 1 Login to HX Connect as an administrator.

Step 2 Select **Replication** > **Protection Groups** > **Edit Schedule**.

Step 3 Edit the information in the dialog fields.

UI Element	Essential Information
Protect virtual machines in this group every field	Select from the pull-down list how often the virtual machines are to be replicated to the paired cluster. The options are: 5 minutes, 15 minutes, 30 minutes, 1 hour, 90 minutes, 2 hours, 4 hours, 8 hours, 12 hours, 24 hours
Use VMware Tools to quiesce the virtual machine check box	To have HX Data Platform quiesce the virtual machines before taking the replication snapshot, click this checkbox. This only applies to virtual machines with VMware Tools installed.

Step 4 Click **Save Changes**.

HX Data Platform updates the interval and start time for the protection group. See the **Protection Groups** tab to view the new interval frequency.

Deleting Protection Groups

Before you begin

Remove all virtual machines from the protection group.

Step 1 Select **Replication** > **Protection Groups** > ***protection_group_name***

Step 2 Click **Delete**. Click **Delete** in the verification pop-up.

Protecting Virtual Machines with an Existing Protection Group

This task describes how to protect multiple virtual machines using an existing protection group.

Using an **Existing protection group—**Select one or more virtual machines and add them to an existing protection group. The schedule and VMware quiesce option settings are applied to all the virtual machines in

the protection group. When the protection group settings are changed, the changes are applied to all the virtual machines in the protection group.

Before you begin

Replication network and replication pair configured.

Create protection group prior to adding the virtual machines.

Step 1 Log in to HX Connect with administrator privileges and select **Virtual Machines**.

This lists the virtual machines on the local cluster.

Step 2 Select two or more unprotected virtual machines from the list.

Click in the virtual machine row to select it. As you click a virtual machine row, the corresponding virtual machine check box is selected.

Step 3 Click **Protect**.

The **Protect Virtual Machines** wizard, **Protection Group** page is displayed.

Step 4 Click the radio button, **Add to an existing protection group**

UI Element	Essential Information
Set the protection parameters table	Verify the selected virtual machine **Name**. Use the **Storage Provisioned** and **Storage Used** to check you have sufficient resources available on the remote HX Storage Cluster.
Add to an existing protection group radio button	Select an existing protection group from the pull-down list. The interval and schedule settings of the protection group are applied to this virtual machine.
Create a new protection group radio button	Enter a name for the new protection group for this local cluster. Protection groups are unique to each cluster. The name is referenced on the remote cluster, but not editable on the remote cluster. You can create multiple protection groups on the cluster.

Step 5 Select a protection group from the pull-down list and click **Next**.

Be sure the protection group you choose has the schedule interval desired.

The **Protect Virtual Machines** wizard, **Summary** page is displayed.

Step 6 Confirm the information in the **Summary** page and click **Add to Protection Group**.

HX Data Platform adds the virtual machines to replication protection. View the **Replication** or **Virtual Machines** pages to confirm. Notice on the Replication page the Protection Group is listed.

Protecting Virtual Machines with a New Protection Group

This task describes how to protect multiple virtual machines by creating a new protection group.

Using a **New protection group—**Select two or more virtual machines and choose to create a new protection group. Define the protection group name, schedule, and VMware quiesce option settings. These settings are applied to all the virtual machines in the protection group. When the protection group settings are changed, the changes are applied to all the virtual machines in the protection group.

Before you begin

Replication network and replication pair configured.

Step 1 Login to HX Connect with administrator privileges and select **Virtual Machines**.

This lists the virtual machines on the local cluster.

Step 2 Select two or more unprotected virtual machine from the list.

Click in the virtual machine row to select it. As you click a virtual machine row, the corresponding virtual machine checkbox is selected.

Step 3 Click **Protect**.

The **Protect Virtual Machines** wizard, **Protection Group** page is displayed.

Step 4 Click the radio button, **Create a new protection group**, add a name for the protection group, and click **Next**.

The **Protection Schedule Wizard Page** wizard page is displayed.

Step 5 Complete the schedule and VMware quiesce option, as needed, and click **Next**.

UI Element	Essential Information
Protect virtual machines in this group every field	Select how often the virtual machines are to be replicated to the paired cluster. Default is every 1 hour.
Start protecting the virtual machines immediately radio button	Select this radio button if you want the first replication to start immediately after you add the first virtual machine to this protection group.

UI Element	Essential Information
Start protecting the virtual machines at radio button	Select this radio button if you want to set a specific time for the first replication to start. To start replication requires: • At least one virtual machine is added to the protection group. • The scheduled start time is reached. To specify the protection start time: **a.** Check the **Start protecting the virtual machines at** radio button. **b.** Click in the time field and select an hour and minute. Then click out of the field. The *hours, minutes from now* states when the first replication will occur. This is updated when you change the time field setting. **Cluster time zone** and **Current time on cluster** are references to help you to choose the appropriate replication start time. Start time is based on the local cluster clock. For example: 10 hours, 3 minutes from now with Current time on cluster, 1:56:15PM, means that the first replication occurs at 11:59:00PM.
Use VMware Tools to quiesce the virtual machine check box	To have HX Data Platform quiesce the virtual machines before taking the replication snapshot, click this checkbox. This only applies to virtual machines with VMware Tools installed.

The **Protect Virtual Machines** wizard, **Summary** page is displayed.

Step 6 Confirm the information in the **Summary** page and click **Add to Protection Group**.

Review the summary content to confirm the settings to apply to the selected virtual machines.

- Name of the protection group
- Number of virtual machines to protect
- Names of virtual machines
- Storage provisioned for each virtual machine
- Storage used (consumed) by each virtual machine

HX Data Platform adds the virtual machines to replication protection. View the **Replication** or **Virtual Machines** pages to confirm. Notice on the Replication page the Protection Group is listed.

Protecting Individual Virtual Machines

This task describes how to protect a virtual machine.

- **Independently—**Select one virtual machine and configure. You set the replication schedule and the VMware quiesce option for the specific virtual machine. Changes to the replication settings only affect the independently protected virtual machine. The virtual machine in not included in a protection group.
- **Existing protection group—**Select one or more virtual machines and add them to an existing protection group. The schedule and VMware quiesce option settings are applied to all the virtual machines in the protection group. When the protection group settings are changed, the changes are applied to all the virtual machines in the protection group.

Before you begin

Replication network and replication pair configured.

Step 1 Log in to HX Connect with administrator privileges and select **Virtual Machines**.

Step 2 Select one unprotected virtual machine from the list. Click in the virtual machine row to select it.

Click in the virtual machine row to select it. As you click a virtual machine row, the corresponding virtual machine check box is selected.

Step 3 Click **Protect**.

The **Protect Virtual Machine** dialog box is displayed.

Step 4 Complete the fields as needed.

UI Element	Essential Information
Add to an existing protection group radio button	Select an existing protection group from the pull-down list. The interval and schedule settings of the protection group are applied to this virtual machine. No additional configuration is required, click **Protect Virtual Machine**.
Protect this virtual machine independently radio button	Enables the interval, schedule options, and VMware Tools option for defining protection for this virtual machine.
Protect this virtual machine every field	Select from the pull-down list how often the virtual machines are to be replicated to the paired cluster. The options are: 5 minutes, 15 minutes, 30 minutes, 1 hour, 90 minutes, 2 hours, 4 hours, 8 hours, 12 hours, 24 hours
Start protecting the virtual machines immediately radio button	Select this radio button if you want the first replication to start immediately after you add the first virtual machine to this protection group.

UI Element	Essential Information
Start protecting the virtual machines at radio button	Select this radio button if you want to set a specific time for the first replication to start. To start replication requires: • At least one virtual machine is added to the protection group. • The scheduled start time is reached. To specify the protection start time: **a.** Check the **Start protecting the virtual machines at** radio button. **b.** Click in the time field and select an hour and minute. Then click out of the field. The *hours, minutes from now* states when the first replication will occur. This is updated when you change the time field setting. **Cluster time zone** and **Current time on cluster** are references to help you to choose the appropriate replication start time. Start time is based on the local cluster clock. For example: 10 hours, 3 minutes from now with Current time on cluster, 1:56:15PM, means that the first replication occurs at 11:59:00PM.
VMware Tools to quiesce the virtual machine check box	To have HX Data Platform quiesce the virtual machines before taking the replication snapshot, click this checkbox. This only applies to virtual machines with VMware Tools installed.

Step 5 Click **Protect Virtual Machine**.

The virtual machine status is updated in the **Virtual Machine** page and the **Replication** page. Notice on the Replication page no Protection Group is listed.

Replication is now enabled on this virtual machine.

Unprotecting Virtual Machines

Note You do not need to unprotect virtual machines to pause replication for cluster activities. See Pausing Replication, on page 37.

Note The Unprotect process may take several minutes to complete if the replication bandwidth is at 50 Mbps or lower and/or high latency (75ms and higher).

Step 1 Log in to HX Connect as an administrator.

Step 2 Select **Virtual Machines**.

Step 3 Select a protected virtual machine from the list. Click in the virtual machine row.

You can unprotect one virtual machine at a time.

Step 4 Click **Unprotect** and click to confirm.

The state changes for the virtual machine from **protected** to **unprotected**.

Disaster Recovery Overview

Disaster recovery is performed when the source site is unreachable and you want to failover the VMs and the protected groups to the target cluster. The process of recovery recovers the VM on the target cluster. Recovering virtual machines is restoring a most recent replication snapshot from the recovery (target) cluster.

Testing VM recovery—Testing VM recovery gives you the ability to test recovery without breaking replication. It can bring up your VM workload on the target to verify the contents of the VM.

Recovering virtual machines—Recovering virtual machines is restoring a most recent replication snapshot from the target (recovery) cluster. Once you start Recovery, all the scheduled replication will be stopped.

Planned migration—Performing planned migration pauses the replication schedule, replicates the most recent copy, recovers on the target, switches the ownership from the source to the target, and resumes replication on the target that is now the new source.

Disaster Recovery and Reprotect—Recovers the VM on the target, switches the ownership from the source to the target, and resumes replication on the target that is now the new source.

Protecting VMs after disaster—In the event of a disaster, you may lose the source site altogether. After the recovery is performed, complete this task to protect the recovered VMs to a newer cluster.

Compatibility Matrix for Disaster Recovery Operations

The following compatibility matrix lists the DR operations that are supported when a cluster at HX Data Platform version 3.5(x) is paired with a cluster at HX Data Platform version 3.5(x) or 3.0(1x).

Feature	3.5(x) Paired With 3.5(x)	3.5(x) Paired With 3.0(1x)
Replication	√	√
Cluster Pairing	√	√
Datastore Mapping	√	√
Protection	√	√
Planned Migration (Single click using HX Connect)	√	**X**
Planned Migration (Multi-step stcli or WebCLI and HX Connect for Recovery)	√	√

Feature	3.5(x) Paired With 3.5(x)	3.5(x) Paired With 3.0(1x)
Test Recover using HX Connect	√	√
Recover using HX Connect	√	√
Re-protect using HX Connect	√	**X**
Re-protect (Multi-step stcli or WebCLI)	√	√

Testing Virtual Machine Recovery

Testing VM recovery gives you the ability to test recovery without breaking replication. It can bring up your VM workload on the target to verify the contents of the VM.

Note

- Testing recovery does not disrupt the running clusters. The intent is to verify, in the event of an actual disaster, that the VMs are recoverable.
- Using the HX Connect user interface, to test VM recovery, you can run a maximum of 10 tasks in a sequence without waiting for the previously submitted task to complete.

Before you begin

Before you begin the test virtual machine recovery process, ensure the following:

- The target cluster is up and in good health.
- The protected virtual machines completed a recent replication to the target cluster. These replicated virtual machines are stored as snapshots on the target clusters.

Important Only one copy of the test recovered VM can be made at any point. If you need to have another test recovered VM, please delete the previously created VM.

Step 1 Log in to HX Connect on the target cluster as administrator.

Step 2 Navigate to **Replication** > **Remote VMs Tab** > ***protected_vm***.

Step 3 To test the recovery process, click the **Test Recovery** button.

Note When you configure recovery settings, the following fields are auto-populated.

UI Element	Essential Information
Resource Pool drop-down list	Select a location for the test VM to be stored.

UI Element	Essential Information
Folders drop-down list	Select a location for the test VM to be stored, for example: • Discovered Virtual Machine • HX Test Recovery
Power On/Off radio button	By default Power ON option is selected. The recovered VM is powered on or left off after it is created as per the selected option.
VM Name field	Enter a new name for the created test VM.
Test Networks radio button	Select which HX Storage Cluster network to use for transferring the data from the replication snapshot. Network options for example: • Storage Controller Data Network • Storage Controller Management Network • Storage Controller Replication Network • VM Network
Map Networks radio button	Select to create a map between the source and the target cluster networks. • Source Network—Network name at the source side on which the VM is connected. • Target Network—Select target network from the drop-down list, where the VM has to be connected.

Step 4 Click **Recover VM**.

Step 5 For VMs that are part of a protection group, perform a test recovery on each VM in the group.

Step 6 Verify the contents of the recovered VM.

Recovering Virtual Machines

Recovering virtual machines is restoring a most recent replication snapshot from the target (recovery) cluster.

Attention

- You may configure the folder, network, or resource pool parameters to be used during recovery, test recovery and migrate operations. If the global recovery setting is not configured, you will need to explicitly map individual VMs at the time of recovery.
- Recover VM is not supported between different vSphere versions. If the Target is at a lower version vSphere environment and does not support the hardware version of a protected VM on the primary, VM test recovery and recovery may fail. Cisco recommends to test recover each protected VM to validate the support on the target site.

  Upgrade the target environment to enable recovery of protected VMs.
- When running recovery on virtual machines, you may specify explicit network mapping when recovering the VMs to avoid unintentional network connections to recovered VMs.

  You can skip specifying network mapping in the following cases:
  - If the source VMs use vSphere Standard Switches and if all ESXi hosts on the recovery side have standard switch networks with the same name.
  - If the source VMs use vSphere Distributed Switch (vDS) port groups and if the recovery site has identically named vDS port groups.
- If you want to specify network mapping, ensure that both the name and the type of the VM network matches between the source and the target.
- When running recovery on virtual machines that are individually protected, or that are in different protection groups, the maximum number of concurrent recovery operations on a cluster is 20.

Before you begin

Ensure the following:

- The target cluster is up and in good health.
- The protected virtual machines completed a recent replication to the target cluster. These replicated virtual machines are stored as snapshots on the target clusters.

On the target cluster, perform the following to do disaster recovery.

Step 1 Log in to HX Connect as administrator.

Step 2 Select **Replication** > > **Remote VMs tab** > > ***protected_vm*** and click **Recover**.

Step 3 To recover the VM and build a new VM on the local cluster, click the **Recover VM** button.

Note When you configure recovery settings, the following fields are auto-populated.

UI Element	Essential Information
Resource Pool drop-down list	Select a location for the new VM to be stored.
Folders drop-down list	Select a location for the new VM to be stored.

UI Element	Essential Information
Power On/Off radio button	By default Power ON option is selected. The recovered VM is powered on or left off after it is created as per the selected option.
Map Networks	Select to create a map between the source and target cluster networks. • Source Network—Network name at the source side on which the VM is connected. • Target Network—Select target network from the drop-down list, where the VM has to be connected. Network options for example: • Storage Controller Data Network • Storage Controller Management Network • Storage Controller Replication Network • VM Network

Step 4 Click **Recover VM**.

Step 5 Wait for the recovery to complete. View the recovered VM in the target vCenter.

Recovering Virtual Machines in Protection Groups

Step 1 Select a *protected-vm* and click **Recover**.

All VMs will be moved from the protection group and the selected VMs will be recovered. Recovered VMs show protection status as *Recovered* and the remaining (protection group) VMs show protection status as *Recovering*. The protection group will go in *Recovered* state and is not reusable. You can delete it from the primary site.

The recovered VMs are displayed in the **Standalone Protected VMs** subpane.

Step 2 Recover the remaining virtual machines from the **Standalone Protected VMs** subpane, which were a part of the protection group. See Recovering Virtual Machines, on page 30 for more details.

Planned Migration

Performing planned migration pauses the replication schedule, replicates the most recent copy, recovers on the target, switches the ownership from the source to the target, and resumes replication on the target that is now the new source.

Attention

- This process cannot be rolled back.
- For a single vCenter deployment, the **Migrate** workflow performed entirely through the HX Connect UI is not supported. To perform a planned migration:

  1. Using the WebCLI, run the following command to prepare for failover on the source:

     ```
     # stcli dp vm prepareFailover -vmid <VMID>
     ```

     Result: The task ID is returned.

  2. Log in to vSphere Web Client Navigator of the primary site and remove the VM from the primary site to unregister the VM.

     Right-click on the virtual machine and select **All vCenter Actions** > **Remove from Inventory**.

  3. Log in to HX Connect of the secondary site. Select **Replication** > **Remote VMs Tab** > ***protected_vm***. Click **Migrate**.

  4. After the Migrate task has completed successfully, log in to vSphere Web Client of the secondary site and manually register the VM.

     a. Log in to vSphere Web Client Navigator. Select **Configuration** > **Storage**.

     b. Right-click on the appropriate datastore and click **Browse Datastore**.

        Navigate to the *virtualmachine name*.vmx file, right-click on the file and click **Add to Inventory**. Follow the wizard to manually register the VM.

Step 1 Log in to HX connect of the target cluster. The target cluster is where the replication snapshots were copied to.

Step 2 On the target cluster, select **Replication** > **Remote VMs Tab** > ***protected_vm***.

Step 3 Click **Migrate**.

Note All the fields that are listed here are optional.

UI Element	Essential Information
Resource Pool drop-down list	Select a location for the new VM to be stored.
Folders drop-down list	Select a location for the new VM to be stored.
Power On/Off radio button	By default Power ON option is selected. The recovered VM is powered on or left off after it is created as per the selected option.

UI Element	Essential Information
Map Networks	Select to create a map between the source and target cluster networks. • Source Network—Network name at the source side on which the VM is connected. • Target Network—Select target network from the drop-down list, where the VM has to be connected. Network options for example: • Storage Controller Data Network • Storage Controller Management Network • Storage Controller Replication Network • VM Network

Step 4 Monitor the progress on the **Activity** page.

Migrating Virtual Machines in Protection Groups

Using the HX Connect user interface, to migrate VMs, you can run a maximum of 4 tasks in a sequence without waiting for the previously submitted task to complete.

Step 1 Select a *protected-vm* and click **Migrate**.

All the VMs are now moved out from the protection group and are displayed in the **Standalone Protected VMs** subpane. Only the selected VM is recovered.

Step 2 Migrate the remaining virtual machines from the **Standalone Protected VMs** subpane, which were a part of the protection group. See Planned Migration, on page 32 for more details.

Disaster Recovery and Re-protect

Performing disaster recovery recovers the VM on the target, switches the ownership from the source to the target, and resumes replication on the target that is now the new source. Disaster recovery is typically done when disaster occurs, and when you want to reverse the direction of protection.

Attention

- This process cannot be rolled back.
- For a single vCenter deployment, the Disaster Recovery workflow performed entirely through the HX Connect UI is not supported. To perform Disaster Recovery and Re-protect:
  1. Log in to vSphere Web Client Navigator of the primary site and remove the VM from the primary site to unregister the VM.

     Right-click on the virtual machine and select **All vCenter Actions** > **Remove from Inventory**.
  2. Log in to HX Connect of the secondary site. Select **Replication** > **Remote VMs Tab** > ***protected_vm***. Click **Recover**.
  3. When the primary site comes back up, log in to HX Connect of the secondary site. Select **Replication** > **Remote VMs Tab** > ***protected_vm***. Click **Re-protect**.
  4. After Re-protect has completed successfully, log in to vSphere Web Client of the secondary site and manually register the VM.
     a. Log in to vSphere Web Client Navigator. Select **Configuration** > **Storage**.
     b. Right-click on the appropriate datastore and click **Browse Datastore**.

        Navigate to the *virtualmachine name*.vmx file, right-click on the file and click **Add to Inventory**. Follow the wizard to manually register the VM.
- Using the HX Connect user interface, you can run a maximum of 5 re-protect tasks in a sequence without waiting for the previously submitted task to complete.

Step 1 Log in to HX connect of the source and the target. The target cluster is where the replication snapshots were copied to. The source cluster is the cluster where the virtual machines reside.

Step 2 Select a VM from the remote VM list. Execute Recover VM on this cluster workflow.

Note If both the target and source clusters are on the same vCenter, then unregister the VM on the source cluster. This ensures that vCenter no longer has a record of the VM and it stops managing the VM, but it retains the data for the VM.

Step 3 Select **Replication** > > **Remote VMs tab** > > ***protected_vm*** and click **Recover**.

Step 4 To recover on the target VM and build a new VM on the local cluster, click the **Recover VM** button.

Complete the following fields in the **Recover VM on this cluster** dialog box.

UI Element	Essential Information
Resource Pool drop-down list	Select a location for the new VM to be stored.
Folders drop-down list	Select a location for the new VM to be stored.
Power On/Off radio button	By default Power ON option is selected. The recovered VM is powered on or left off after it is created as per the selected option.

UI Element	Essential Information
Map Networks	Select to create a map between the source and target cluster networks. • Source Network—Network name at the source side on which the VM is connected. • Target Network—Select target network from the drop-down list, where the VM has to be connected. Network options for example: • Storage Controller Data Network • Storage Controller Management Network • Storage Controller Replication Network • VM Network

Step 5 Click **Recover VM**.

Step 6 On the target cluster, select **Replication** > **Remote VMs Tab** > ***protected_vm***.

Step 7 Click **Re-protect**.

Attention
- If both the target cluster and source cluster are on the same vCenter, manually register the VM on the source cluster.
- When the Re-protect task fails and in the HX Connect UI the **Re-protect** tab is not available, execute *stcli reverseprotect* to complete the Re-protect operation.

Protection status of the VM shows as **Protected**.

Step 8 After the original primary comes up, to migrate back to the primary do the following:

a) On the target cluster, select **Replication** > **Remote VMs Tab** > ***protected_vm***.

b) Click **Migrate** to unregister the target VM and transfer the VM ownership to the original primary. Protection status of the VM shows as **Protected**.

Protecting Virtual Machines After Disaster

In the event of a disaster, you may lose the source site altogether. After the recovery is performed, you may want to protect the recovered VMs to a newer cluster.

Step 1 Recover the Virtual Machines. Perform standalone recovery (Recovering VMs) or group recovery (Recovering VMs in protection groups). See Recovering Virtual Machines, on page 30 for more details.

Step 2 Forget the pairing, run the following command in the HX Connect WebCLI:

```
stcli dp peer forget --all
```

Now the cluster is no longer paired to the original source.

Step 3 Unprotect all the local and remote VMs. See Unprotecting Virtual Machines, on page 27 for more details.

Step 4 Pair to the new cluster. See the *Creating a Replication Pair* section for more details.

Step 5 Protect the virtual machines.

Replication Maintenance Overview

Replication, when configured, runs in the background as per the defined schedule. Replication maintenance tasks include:

- **Testing recovery—**Testing if the recovery methods are working. See Testing Virtual Machine Recovery, on page 29 for more details.
- **Pausing replication—**When you are preparing to upgrade the HX Storage Cluster and you have replication configured, you must pause the replication activity.

  Use the `stcli dp schedule pause` command.
- **Resuming replication—**After HX Storage Cluster maintenance activities are complete, resume the replication schedule.

  Use the `stcli dp schedule resume` command.
- **Migration—**The option to shift VMs from one source cluster to the replication paired target cluster, making the target cluster the new source cluster for the migrated VMs.

Pausing Replication

Before you perform a storfs or platform upgrade, if replication is configured in the network, you must pause the replication activity.

Step 1 Log in to a Storage Controller VM.

Step 2 From the command line, run the `stcli dp schedule pause` command.

Step 3 Perform your upgrade task.

Step 4 Resume the replication schedule.

Resuming Replication

After successfully upgrading the HX Storage Cluster which had replication configured, do the following to resume the replication schedule.

Before you begin

Ensure your HX Storage Cluster is paused and you have completed your maintenance or upgrade tasks.

Step 1 Login to a Storage Controller VM.

Step 2 From the command line, run the `stcli dp schedule resume` command.

The previously configured replication schedule for all the protected virtual machines begins.