Cisco HyperFlex Storage Cluster Overview

- Cisco HX Data Platform Overview, on page 1
- Storage Cluster Physical Components Overview, on page 2
- Cisco HX Data Platform Capacity Overview, on page 3
- Cisco HX Data Platform High Availability Overview, on page 6
- Storage Cluster Status, on page 6
- Cisco HX Data Platform Cluster Tolerated Failures, on page 8
- Responses to Storage Cluster Node Failures, on page 10
- Cisco HX Data Platform ReadyClones Overview, on page 12
- Creating ReadyClone VMs, on page 12
- Configuring Live Migration, on page 15
- Cisco HX Data Platform Hyper-V Checkpoints, on page 16

Cisco HX Data Platform Overview

Cisco HyperFlex Data Platform (HX Data Platform) is a hyperconverged software appliance that transforms Cisco servers into a single pool of compute and storage resources. It eliminates the need for network storage and enables seamless interoperability between computing and storage in virtual environments. The Cisco HX Data Platform provides a highly fault-tolerant distributed storage system that preserves data integrity and optimizes performance for virtual machine (VM) storage workloads. In addition, native compression and deduplication reduce storage space occupied by the VMs and VM workloads.

Cisco HX Data Platform has many integrated components. These include: Cisco Fabric Interconnects (FIs), Cisco UCS Manager, Cisco HX specific servers, and Cisco compute only servers; Microsoft Hyper-V, Microsoft Windows servers with Hyper-V, Hyper-V Manager, Failover Cluster Manager, System Center Virtual Machine Manager (SCVMM) - (optional); and the Cisco HX Data Platform Installer, controller VMs, HX Connect, Powershell and hxcli commands.

Cisco HX Data Platform is installed on a virtualized platform such as Microsoft Hyper-V. During installation, after specifying the Cisco HyperFlex HX Cluster name, and the HX Data Platform creates a hyperconverged storage cluster on each of the nodes. As your storage needs to increase and you add nodes in the HX cluster, the HX Data Platform balances the storage across the additional resources. Compute only nodes can be added to increase compute only resources to the storage cluster.

Storage Cluster Physical Components Overview

Cisco HyperFlex storage clusters contain the following objects. These objects are monitored by the Cisco HX Data Platform for the storage cluster. They can be added and removed from the HX storage cluster.

- **Converged nodes**—Converged nodes are the physical hardware on which the VM runs. They provide computing and storage resources such as disk space, memory, processing, power, and network I/O.

  When a converged node is added to the storage cluster, a storage controller VM is installed. The Cisco HX Data Platform services are handled through the storage controller VM. Converged nodes add storage resources to your storage cluster through their associated drives.

  Run the *Cluster Expansion* workflow from the Cisco HX Data Platform Installer to add converged nodes to your storage cluster.

- **Compute nodes**—Compute nodes add compute resource but not storage capacity to the storage cluster. They are used as a means to add compute resources, including CPU and memory. They do not need to have any caching (SSD) or storage (HDD) drives. Compute nodes are optional in a HX storage cluster.

  Run the *Cluster Expansion* workflow from the Cisco HX Data Platform Installer to add compute nodes to your storage cluster.

- **Drives**—There are two types of drives that are a minimum required for any node in the storage cluster: Solid State Drive (SSD) and Hard Disk Drive (HDD). HDD typically provides the physical storage units associated with converged nodes. SSD typically supports management.

  Adding HDD to existing converged nodes, also adds storage capacity to the storage cluster. When storage is added to a HX node in the storage cluster, an equal amount of storage must be added to every node in the storage cluster.

  When disks are added or removed, the Cisco HX Data Platform rebalances the storage cluster to adjust for the change in storage resources.

  Adding or removing disks on your converged nodes is not performed through the Cisco HX Data Platform. Before adding or removing disks, review the best practices. See the server hardware guides for specific instructions to add or remove disks in nodes.

- **Datastores**—Storage capacity and datastore capacity. This is the combined consumable physical storage available to the storage cluster through datastores, and managed by the Cisco HX Data Platform.

  Datastores are logical containers that are used by the Cisco HX Data Platform to manage your storage use and storage resources.

  Datastores are where the host places virtual disk files and other VM files. Datastores hide the specifics of physical storage devices and provide a uniform model for storing VM files.

Note Modifying permissions on HX Datastores is not supported on Hyper-V.

Cisco HX Data Platform Capacity Overview

Note Capacity addition in a cluster through the addition of disks or nodes can result in a rebalance. This background activity can cause interference with regular User IO on the cluster and increase the latency. You must note the time duration for the storage capacity at the time where performance impact can be tolerated. Also, this operation may be performed in urgent situations that may warrant capacity addition

In the Cisco HX Data Platform the concept of capacity is applied to both datastores and storage clusters. Values are measured in base-2 (GB/TB).

- **Cleaner—**A process run on all the storage cluster datastores. After it completes, all the storage cluster datastores total capacity should be in a similar range to the total storage cluster capacity, excluding the metadata. Datastore capacity listed typically will not match the HX storage cluster capacity. See the Cisco HX Data Platform Command Line Interface Reference Guide for information on the `cleaner` command.
- **Cluster capacity—**All the storage from all the disks on all the nodes in the storage cluster. This includes uncleaned data and the metadata overhead for each disk.

  The total/used/free capacity of cluster is based on overall storage capacity and how much storage is used.
- **Condition—**When the HX Storage Cluster enters a space event state, the **Free Space Status** fields are displayed. The **Condition** field lists the space event state. The options are: **Warning**, **Critical**, and **Alert**.
- **Available Datastore capacity—**The amount of storage available for provisioning to datastores without over-provisioning. Generally, this is similar to the cleaned storage cluster capacity, but it is not an exact match. It does not include metadata or uncleaned data.

  The provisioned/used/free capacity of each datastore is based on datastore (thin) provisioned capacity. Because the datastore is thin provisioned, the provisioned capacity (specified by the administrator when creating the datastore) can be well above the actual storage.
- **Free Capacity, storage cluster—**Same as available capacity. For the storage cluster, this is the difference between the amount available to the storage cluster and the amount used in the storage cluster.
- **Free capacity, datastore—**Same as available capacity. For all the storage cluster datastores, this is the difference between the amount provisioned to all the storage cluster datastores and the amount used on all the storage cluster datastores.

  The amount used on the whole storage cluster is not included in this datastore calculation. Because datastores are frequently over provisioned, the free capacity can indicate a large availability on all the storage cluster datastores, while the storage cluster capacity can indicate a much lower availability.
- **Multiple users—**Can have different datastores with different provisioned capacities. At any point in time, users do not fully utilize their allocated datastore capacity. When allocating datastore capacity to multiple users, it is up to the administrator to ensure that each user's provisioned capacity is honored at all time.
- **Over-provisioning—**Occurs when the amount of storage capacity allocated to all the datastores exceeds the amount available to the storage cluster.

It is a common practice to initially over-provision. It allows administrators to allocate the capacity now and backfill the actual storage later.

The value is the difference between the usable capacity and provisioned capacity.

It displays zero (0) value, unless more space has been allocated than the maximum physical amount possible.

Review the over provisioned capacity and ensure that your system does not reach an out-of-space condition.

- **Provisioned—**Amount of capacity allowed to be used by and allocated to the storage cluster datastores.

  The provisioned amount is not set aside for the sole use of the storage cluster datastores. Multiple datastores can be provisioned storage from the same storage capacity.

- **Space Needed—**When the HX Storage Cluster enters a space event state, the **Free Space Status** fields are displayed. **Space Needed** indicates the amount of storage that needs to be made available to clear the listed **Condition**.

- **Used—**Amount of storage capacity consumed by the listed storage cluster or datastore.

  Cisco HX Data Platform internal meta-data uses 0.5% to 1% space. This might cause the Cisco HX Data Platform Plug-in or Cisco HX Connect to display a Used Storage value even if you have no data in your datastore.

  Storage Used shows how much datastore space is occupied by virtual machine files, including configuration and log files, snapshots, and clones. When the virtual machine is running, the used storage space also includes swap files.

- **Usable Capacity—**Amount of storage in the storage cluster available for use to store data.

Understanding Capacity Savings

The Capacity portlet on the Summary tab displays the deduplication and compression savings provided by the storage cluster. For example, with 50% overall savings, a 6TB capacity storage cluster can actually store 9 TB of data.

The total storage capacity saved by the HX Data Platform system is a calculation of two elements:

- **Compression**—How much of the data is compressed.
- **Deduplication**—How much data is deduplicated. Deduplication is a method of reducing storage space by eliminating redundant data. It stores only one unique instance of the data.

Deduplication savings and compression savings are not simply added together. They are not independent operations. They are correlated using the following elements where essentially the amount of unique bytes used for storage is reduced through deduplication. Then the deduplicated storage consumption is compressed to make even more storage available to the storage cluster.

Deduplication and compression savings are useful when working with VM clones.

If the savings is showing 0%, this indicates the storage cluster is new. The total ingested data to the storage cluster is insufficient to determine meaningful storage savings. Wait until sufficient data is written to the storage cluster.

For example:

1. Initial values

   Given a VM of 100 GB that is cloned 2 times.

   ```
   Total Unique Used Space (TUUS) = 100GB

   Total Addressable Space (TAS) = 100x2 = 200 GB
   ```

   Given, for this example:

   ```
   Total Unique Bytes (TUB) = 25 GB
   ```

2. Deduplication savings

   ```
   = (1 - TUUS/TAS) * 100

   = (1 - 100GB / 200GB) *100

   = 50%
   ```

3. Compression Savings

   ```
   = (1 - TUB/TUUS) * 100

   = (1 - 25GB / 100GB) * 100

   = 75%
   ```

4. Total savings calculated

   ```
   = (1 - TUB/TAS) * 100

   = (1 - 25GB / 200GB) * 100

   = 87.5%
   ```

Storage Capacity Event Messages

Cluster storage capacity includes all the storage from all the disks on all the nodes in the storage cluster. This available capacity is used to manage your data.

Error messages are issued if your data storage needs consume high amounts of available capacity, the performance and health of your storage cluster are affected. The error messages are displayed in, Cisco HX Connect, and ,TBD

Note **When the warning or critical errors appear:**

Add additional drives or nodes to expand capacity. Additionally, consider deleting unused virtual machines and snapshots. Performance is impacted until storage capacity is reduced.

- **SpaceWarningEvent** – Issues an error. This is a first level warning.

  Cluster performance is affected.

  Reduce the amount of storage capacity used to below the warning threshold, of 70% total HX Storage Cluster capacity.

- **SpaceAlertEvent** – Issues and error. Space capacity usage remains at error level.

  This alert is issued after storage capacity has been reduced, but is still above the warning threshold.

  Cluster performance is affected.

  Continue to reduce the amount of storage capacity used, until it is below the warning threshold, of 80% total HX Storage Cluster capacity.

- **SpaceCriticalEvent** – Issues and error. This is a critical level warning.

  Cluster is in a read only state.

  Do not continue the storage cluster operations until you reduce the amount of storage capacity used to below this warning threshold, of 92% total HX Storage Cluster capacity.

- **SpaceRecoveredEvent** - This is informational. The cluster capacity has returned to normal range.

  Cluster storage space usage is back to normal.

Cisco HX Data Platform High Availability Overview

The Cisco HX Data Platform High Availability (HA) feature ensures that the storage cluster maintains at least two copies of all your data during normal operation with three or more fully functional nodes.

If nodes or disks in the storage cluster fail, the cluster's ability to function is affected. If more than one node fails or one node and disk(s) on a different node fail, it is called a *simultaneous failure*.

The number of nodes in the storage cluster, combined with the Data Replication Factor and Access Policy settings, determine the state of the storage cluster that results from node failures.

Storage Cluster Status

Cisco HX Data Platform storage cluster status information is available through HX Connect, the HX Data Platform Plug-in, and the storage controller VM `hxcli` commands. Storage cluster status is described through resiliency and operational status values.

Storage cluster status is described through the following reported status elements:

- **Operational Status**—Describes the ability of the storage cluster to perform the functions storage management and storage cluster management of the cluster. Describes how well the storage cluster can perform operations.
- **Resiliency Status**—Describes the ability of the storage clusters to tolerate node failures within the storage cluster. Describes how well the storage cluster can handle disruptions.

The following settings take effect when the storage cluster transitions into particular operational and resiliency status states.

- **Data Replication Factor** —Sets the number of redundant data replicas.
- **Cluster Access Policy**—Sets the level of data protection and data loss.
- Operational Status Values, on page 7
- Resiliency Status Values, on page 7

Operational Status Values

Cluster Operational Status indicates the operational status of the storage cluster and the ability for the applications to perform I/O.

The Operational Status options are:

- **Online—**Cluster is ready for IO.
- **Offline—**Cluster is not ready for IO.
- **Out of space**—Either the entire cluster is out of space or one or more disks are out of space. In both cases, the cluster cannot accept write transactions, but can continue to display static cluster information.
- **Readonly—**Cluster cannot accept write transactions, but can continue to display static cluster information.
- **Unknown—**This is a transitional state while the cluster is coming online.

Other transitional states might be displayed during cluster upgrades and cluster creation.

Color coding and icons are used to indicated various status states. Click icons to display additional information such as reason messages that explain what is contributing to the current state.

Resiliency Status Values

Resiliency status is the data resiliency health status and ability of the storage cluster to tolerate failures.

Resiliency Status options are:

- **Healthy**—The cluster is healthy with respect to data and availability.
- **Warning**—Either the data or the cluster availability is being adversely affected.
- **Unknown**—This is a transitional state while the cluster is coming online.

Color coding and icons are used to indicate various status states. Click an icon to display additional information, such as reason messages that explain what is contributing to the current state.

Cisco HX Data Platform Cluster Tolerated Failures

If nodes or disks in the Cisco HX storage cluster fail, the cluster's ability to function is affected. If more than one node fails or one node and disk(s) on a different node fail, it is called a *simultaneous failure*.

How the number of node failures affect the storage cluster is dependent upon:

- **Number of nodes in the cluster**—The response by the storage cluster is different for clusters with 3 to 4 nodes and 5 or greater nodes.
- **Data Replication Factor**—Set during Cisco HX Data Platform installation and cannot be changed. The options are 2 or 3 redundant replicas of your data across the storage cluster.

Attention Data Replication Factor of 3 is recommended.

- **Access Policy**—Can be changed from the default setting after the storage cluster is created. The options are strict for protecting against data loss, or lenient, to support longer storage cluster availability.

Cluster State with Number of Failed Nodes

The tables below list how the storage cluster functionality changes with the listed number of simultaneous node failures.

Cluster State in 5+ Node Cluster with Number of Failed Nodes

Replication Factor	Access Policy	Number of Failed Nodes		
		Read/Write	Read-Only	Shutdown
3	Lenient	2	--	3
3	Strict	1	2	3
2	Lenient	1	--	2
2	Strict	--	1	2

Cluster State in 3- and 4-Node Clusters with Number of Failed Nodes

Replication Factor	Access Policy	Number of Failed Nodes		
		Read/Write	Read-Only	Shutdown
3	Lenient or Strict	1	--	2
2	Lenient	1	--	2
2	Strict	--	1	2

Cluster State with Number of Nodes with Failed Disks

The table below lists how the storage cluster functionality changes with the number of nodes that have one or more failed disks. Note that the node itself has not failed but disk(s) within the node have failed. **For example:** 2 indicates that there are 2 nodes that each have at least one failed disk.

There are two possible types of disks on the servers: SSDs and HDDs. When we talk about multiple disk failures in the table below, it's referring to the disks used for storage capacity. **For example:** If a cache SSD fails on one node and a capacity SSD or HDD fails on another node, the storage cluster remains highly available, even with an Access Policy strict setting.

The table below lists the worst case scenario with the listed number of failed disks. This applies to any storage cluster 3 or more nodes. **For example:** A 3-node cluster with Replication Factor 3, while self-healing is in progress, only shuts down if there is a total of 3 simultaneous disk failures on 3 separate nodes.

Note HX storage clusters are capable of sustaining serial disk failures, (separate disk failures over time). The only requirement is that there is sufficient storage capacity available for support self-healing. The worst-case scenarios listed in this table only apply during the small window while HX is completing the automatic self-healing and rebalancing.

3+ Node Cluster with Number of Nodes with Failed Disks

Replication Factor	Access Policy	Failed Disks on Number of Different Nodes		
		Read/Write	Read Only	Shutdown
3	Lenient	2	--	3
3	Strict	1	2	3
2	Lenient	1	--	2
2	Strict	--	1	2

Data Replication Factor Settings

Note Data Replication Factor cannot be changed after the storage cluster is configured.

Data Replication Factor is set when you configure the storage cluster. Data Replication Factor defines the number of redundant replicas of your data across the storage cluster. The options are 2 or 3 redundant replicas of your data.

- If you have hybrid servers (servers that contain both SSD and HDDs), then the default is 3.
- If you have all flash servers (servers that contain only SSDs), then you must explicitly select either 2 or 3 during Cisco HX Data Platform installation.

Choose a Data Replication Factor. The choices are:

- Data Replication Factor 3 — Keep three redundant replicas of the data. This consumes more storage resources, and ensures the maximum protection for your data in the event of node or disk failure.

  Attention Data Replication Factor 3 is the recommended option.

- Data Replication Factor 2 — Keep two redundant replicas of the data. This consumes fewer storage resources, but reduces your data protection in the event of node or disk failure.

Cluster Access Policy

The Cluster Access Policy works with the Data Replication Factor to set levels of data protection and data loss prevention. There are two Cluster Access Policy options. The default is `lenient`. It is not configurable during installation, but can be changed after installation and initial storage cluster configuration.

- **Strict -** Applies policies to protect against data loss.

  If nodes or disks in the storage cluster fail, the cluster's ability to function is affected. If more than one node fails or one node and disk(s) on a different node fail, it is called a simultaneous failure. The strict setting helps protect the data in event of simultaneous failures.

- **Lenient -** Applies policies to support longer storage cluster availability. This is the default.

Responses to Storage Cluster Node Failures

A storage cluster healing timeout is the length of time Cisco HX Connect or Cisco HX Data Platform Plug-in waits before automatically healing the storage cluster. If a disk fails, the healing timeout is 1 minute. If a node fails, the healing timeout is 2 hours. A node failure timeout takes priority if a disk and a node fail at same time or if a disk fails after node failure, but before the healing is finished.

When the cluster resiliency status is Warning, the Cisco HX Data Platform system supports the following storage cluster failures and responses.

Optionally, click the associated Cluster Status/Operational Status or Resiliency Status/Resiliency Health in Cisco HX Connect and Cisco HX Data Platform Plug-in, to display reason messages that explain what is contributing to the current state.

Review the table and perform the necessary action.

Cluster Size	Number of Simultaneous Failures	Entity Failed	Maintenance Action to Take
3 nodes	1	One node.	The storage cluster does not automatically heal. Replace the failed node to restore storage cluster health.

Cluster Size	Number of Simultaneous Failures	Entity Failed	Maintenance Action to Take
3 nodes	2	Two or more disks on two nodes are blacklisted or failed.	**a.** If one SSD fails, the storage cluster does not automatically heal. Replace the faulty SSD and restore the system by rebalancing the cluster **b.** If one HDD fails or is removed, the disk is blacklisted immediately. The storage cluster automatically begins healing within a minute. **c.** If more than one HDD fails, the system might not automatically restore storage cluster health. If the system is not restored, replace the faulty disks and restore the system by rebalancing the cluster.
4 nodes	1	One node.	If the node does not recover in two hours, the storage cluster starts healing by rebalancing data on the remaining nodes. To recover the failed node immediately and fully restore the storage cluster: **a.** Check that the node is powered on and restart it if possible. You might need to replace the node. **b.** Rebalance the cluster.
4 nodes	2	Two or more disks on two nodes.	If two SSDs fail, the storage cluster does not automatically heal. If the disk does not recover in one minute, the storage cluster starts healing by rebalancing data on the remaining nodes.
5+ nodes	2	Up to two nodes.	If the node does not recover in two hours, the storage cluster starts healing by rebalancing data on the remaining nodes. To recover the failed node immediately and fully restore the storage cluster: **a.** Check that the node is powered on and restart it if possible. You might need to replace the node. **b.** Rebalance the cluster. If the storage cluster shuts down, see Troubleshooting, Two Nodes Fail Simultaneously Causes the Storage Cluster to Shutdown section.
5+ nodes	2	Two nodes with two or more disk failures on each node.	The system automatically triggers a rebalance after a minute to restore storage cluster health.

Cluster Size	Number of Simultaneous Failures	Entity Failed	Maintenance Action to Take
5+ nodes	2	One node and One or more disks on a different node.	If the disk does not recover in **one minute**, the storage cluster starts healing by rebalancing data on the remaining nodes. If the node does not recover in **two hours**, the storage cluster starts healing by rebalancing data on the remaining nodes. If a node in the storage cluster fails and a disk on a different node also fails, the storage cluster starts healing the failed disk (without touching the data on the failed node) in one minute. If the failed node does not come back up after two hours, the storage cluster starts healing the failed node as well. To recover the failed node immediately and fully restore the storage cluster: **a.** Check that the node is powered on and restart it if possible. You might need to replace the node. **b.** Rebalance the cluster.

Cisco HX Data Platform ReadyClones Overview

Cisco HX Data Platform ReadyClones is a pioneer storage technology that enables you to rapidly create and customize multiple cloned VMs from a host VM. It allows you to create multiple copies of VMs that can then be used as standalone VMs.

A ReadyClone, similar to a standard clone, is a copy of an existing VM. The existing VM is called the host VM. When the cloning operation is complete, the ReadyClone is a separate guest VM.

Changes made to a ReadyClone do not affect the host VM. A ReadyClone's MAC address and UUID are different from that of the host VM.

Installing a guest operating system and applications can be time consuming. With ReadyClone, you can make many copies of a VM from a single installation and configuration process.

Clones are useful when you deploy many identical VMs to a group.

Creating ReadyClone VMs

You can create Cisco HyperFlex Data Platform ReadyClones in a Hyper-V environment using a powershell script that is available for download from the Cisco CCO web site. The ReadyClone script automates the VM cloning process which involves exporting the original VM to a temporary folder, importing, and then registering the saved VM to a new location. After the successful creation of ReadyClone VMs, the exported temp folder is deleted automatically. The VM is later added to the cluster if that option is chosen.

Note The VM in the below example is generation 2 Windows Server 2016.

Step 1 Download the Cisco HyperFlex Data Platform Hyper-V ReadyClone powershell script from the Cisco CCO Software Download page for HyperFlex HX Data Platform Release 4.0(1b).

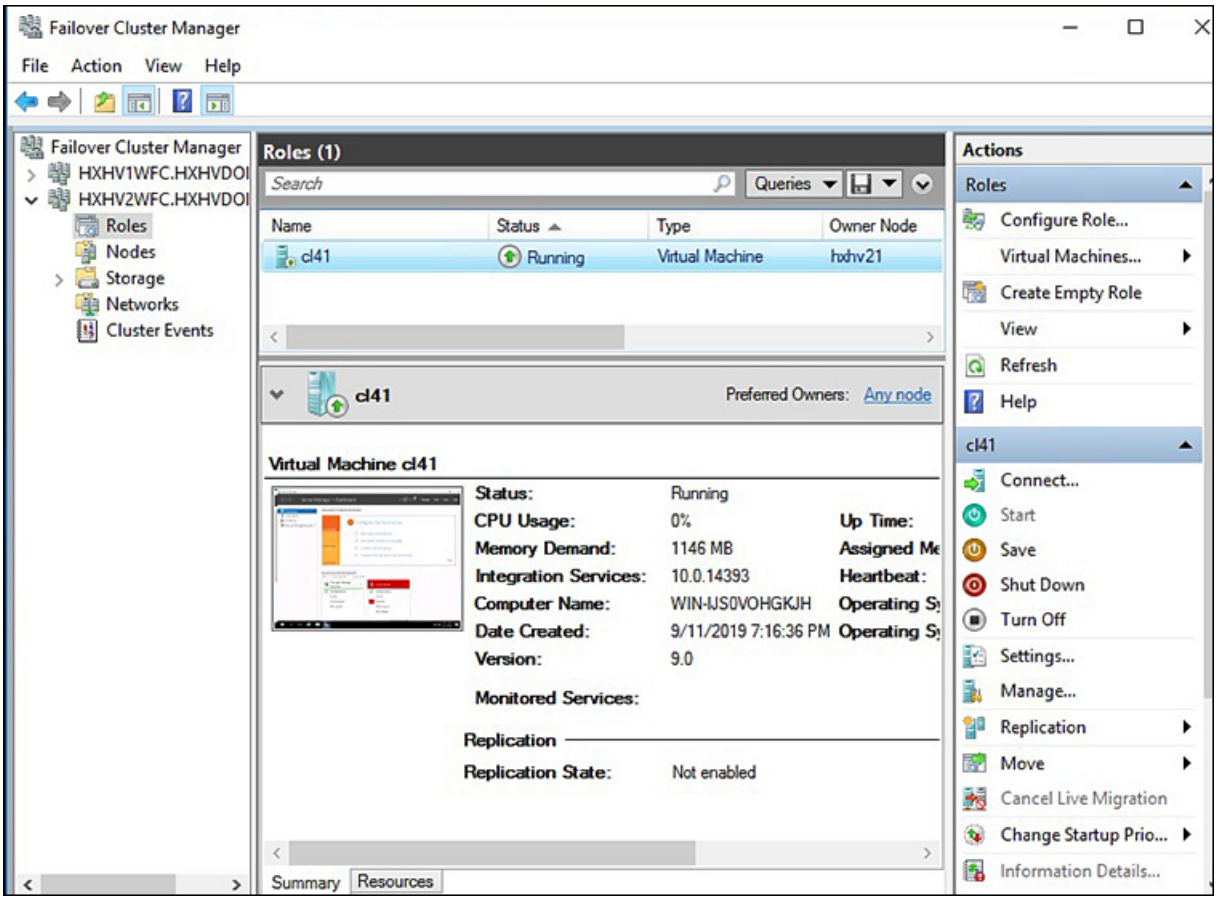
Step 2 Run the following command:

HxClone-HyperV-v4.0.1b-33133.ps1 -VmName <VM Name> -ClonePrefix <Prefix> -CloneCount <number> -AddToCluster <$false/$true>

```
PS C:\Users\administrator.HXHVDOM2>
PS C:\Users\administrator.HXHVDOM2> C:\HxClone-HyperV-v4.0.1b-33133.ps1 -VmName RCVM1 -ClonePrefix cl4 -CloneCount 1 -AddToCluster $true


    Directory: \\hxhv2smb.hxhvdom2.local\hxds1\Hyper-V\Virtual Hard Disks


Mode                 LastWriteTime         Length Name
----                 -------------         ------ ----
d-----        9/11/2019   7:16 PM                tmp1417411279
\\hxhv2smb.hxhvdom2.local\hxds1\Hyper-V\Virtual Hard Disks\tmp1417411279\RCVM1\Virtual Machines\9b535cbb-c0a8-4b77-9142-284525fb3033.vmcx


    Directory: \\hxhv2smb.hxhvdom2.local\hxds1


Mode                 LastWriteTime         Length Name
----                 -------------         ------ ----
d-----        9/11/2019   7:16 PM                cl41
\\hxhv2smb.hxhvdom2.local\hxds1\cl41

Name      : cl41
OwnerNode : hxhv21
State     : Offline


PS C:\Users\administrator.HXHVDOM2> _
```

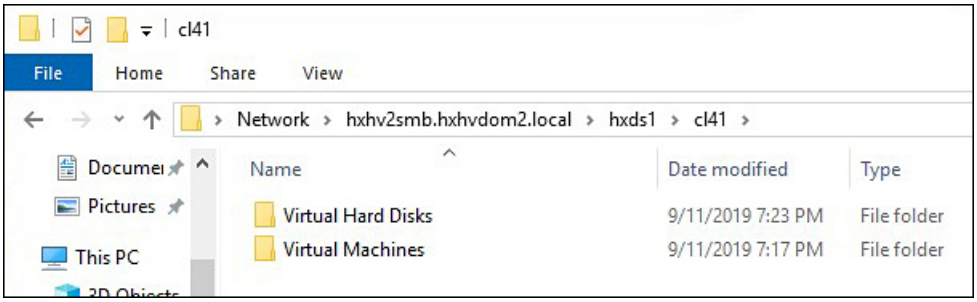
Step 3 A new VM created with ReadyClone will now be in the saved state. Use the Failover Cluster Manager, Hyper-V Manager or SCVMM to turn it on.

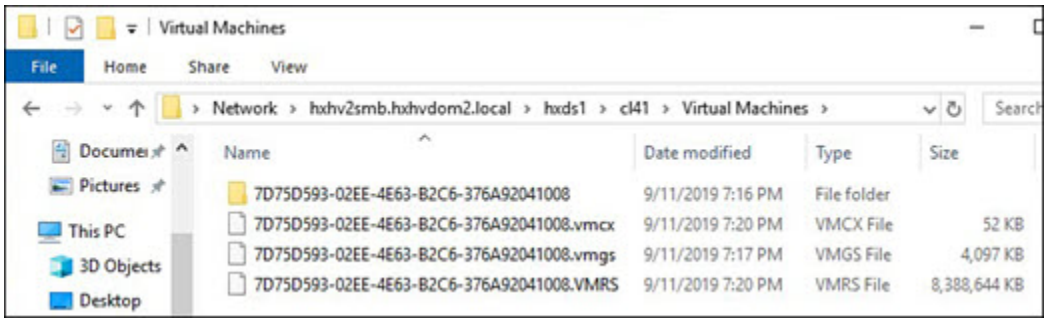
If the AddToCluster parameter is set to *$true*, then the ReadyClone VMs are converted to highly available clustered roles which can be seen and managed from the Failover Cluster Manager. It will also be visible in the Hyper-V Manager.



A folder in the name of the guest VM (cl41 in this case) is created inside the HX datastore `\\hxhv2smb.hxhvdom2.local\hxds1`

This folder contains snapshots (if there are any available at the time of creating ReadyClones), Virtual Hard Disk and Virtual Machine files.





After the successful creation of ReadyClones, there is no further relationship with the original VM. During the creation of ReadyClones, the original VM is exported to a temporary folder location, and then from that location, the VM is imported using the Copy the VM option to another location in the HX Datastore with new unique IDs for the restored VMs.

After deleting the ReadyClone VMs, the VM configuration files are deleted, but the folder structure and the virtual hard disk file remain. This may require manual clean up.

What to do next

ReadyClone powershell script parameters are documented in the following table.

Table 1: ReadyClone PowerShell Script Parameters

Parameters	Value	Description
VmName	**<Name value>**	Enter the Name of the running VM used for creating ReadyClones.
ClonePrefix	**<Prefix value>**	Enter a prefix for the guest virtual machine name. This prefix is added to the name of each ReadyClone created.
CloneCount	**<#>**	Enter a value to create the number of ReadyClones.
AddToCluster	**<$false>** **<$true>**	*$false* – creates standalone VMs (only visible in Hyper-V Manager) *$true* – creates a highly available clustered ReadyClone VMs (visible in Failover Cluster Manager and Hyper-V Manager as well)

Configuring Live Migration

Starting with HyperFlex 4.0(2a), the HX installer can configure Live Migration on Hyper-V cluster nodes, if the information is provided during install or expand workflows.

Note Additional steps may be necessary in some situations to automatically configure Live Migration during cluster expansion workflow using the HyperFlex 4.0(2a) installer. Check if the following conditions are true:

- Live Migration was not configured during a fresh cluster install workflow using the HyperFlex 4.0(2a) installer.
- Cluster is upgraded to 4.0(2a)

In such cases, complete the following steps, then proceed to the cluster expansion workflow.

Step 1 Manually configure Live Migration IP addresses on all nodes.

For more information, see Configuring a Static IP address for Live Migration and VM Network in the Cisco HyperFlex Systems Installation Guide for Microsoft Hyper-V, Release 4.0.

Note This is applicable only if you have not done so already using the HX Installer.

Step 2 Run `update-inventory.py` to sync your network configuration changes with HyperFlex.

This file is located at `/usr/share/springpath/storfs-misc/update-inventory.py` on the cluster management IP node.

This updates the HyperFlex inventory with Live Migration information on each Hyper-V node. Cluster expansion workflow will then show the corresponding Live Migration UI fields.

Step 3 Run the cluster expansion workflow and provide Live Migration information in the installer UI for the node(s) being expanded.

Expansion should be aware that Live Migration is configured for the existing HX cluster and show the corresponding UI fields.

Cisco HX Data Platform Hyper-V Checkpoints

Note Cisco HX Data Platform Native Snapshots are not supported in Hyper-V. Use Hyper-V Checkpoints.

Choose between standard or production checkpoints in Hyper-V.

Applies To: Windows Server 2016, Microsoft Hyper-V Server 2019

Starting with Windows Server 2016, you can choose between standard and production checkpoints for each virtual machine. Production checkpoints are the default for new virtual machines.

Production checkpoints are "point in time" images of a virtual machine, which can be restored later on in a way that is completely supported for all production workloads. This is achieved by using backup technology inside the guest to create the checkpoint, instead of using saved state technology.

Standard checkpoints capture the state, data, and hardware configuration of a running virtual machine and are intended for use in development and test scenarios. Standard checkpoints can be useful if you need to recreate a specific state or condition of a running virtual machine so that you can troubleshoot a problem.