Abstract
This guide outlines the reconfiguration of NetApp® H-Series compute nodes in an existing NetApp HCI installation configuration from six network interfaces to two interfaces.
TABLE OF CONTENTS

1 Introduction ........................................................................................................................................... 4
  1.1 Prerequisites ...................................................................................................................................................4
  1.2 Resulting Configuration ...................................................................................................................................4

2 Related Documentation ....................................................................................................................... 4

3 Preparation ............................................................................................................................................ 5
  3.1 Compute Node Network Interfaces .................................................................................................................5
  3.2 Planning Networking for NetApp HCI ..............................................................................................................5
  3.3 Gathering Switch Port Configuration Details ...................................................................................................6
  3.4 Inspecting the Compute Node Configuration in vSphere ................................................................................7
  3.5 NetApp HCI-Compliant vSphere Distributed Switch ........................................................................................7
  3.6 vSphere Network I/O Control for iSCSI ......................................................................................................... 10

4 Reconfiguration in vSphere ............................................................................................................... 10
  4.1 Overview ....................................................................................................................................................... 10
  4.2 Enabling Maintenance Mode on Host ........................................................................................................... 10
  4.3 Reconfiguring the Switch Ports ..................................................................................................................... 11
  4.4 Adding Host to VDS, Reassigning Uplinks and VMkernel Adapters ............................................................. 11
  4.5 Verifying Port Group Policy for iSCSI and vMotion VMkernel Adapters ........................................................ 14
  4.6 Exiting Host Maintenance Mode ................................................................................................................... 15
  4.7 Repeating with More Hosts ........................................................................................................................... 16
  4.8 Migrating Virtual Machines to the Reconfigured Network ............................................................................. 16

5 Conclusion .......................................................................................................................................... 16

Where to Find Additional Information .................................................................................................... 17

Version History ......................................................................................................................................... 17

LIST OF TABLES
Table 1) Mapping from compute node to switch port .....................................................................................................6
Table 2) Assigning interfaces as uplinks ..................................................................................................................... 11
Table 3) Assigning VMkernel adapters to the port groups of the VDS ........................................................................ 12

LIST OF FIGURES
Figure 1) Network interfaces on the NetApp H410C. .....................................................................................................5
Figure 2) Cabling before and after reconfiguration to use two SFP28/SFP+ interfaces ................................................. 6
Figure 3) Logical networks before and after reconfiguration to use two SFP28/SFP+ interfaces .............................. 6
Figure 4) iSCSI port group showing VLAN ID in vCenter Server 6.5 ....................................................................... 7
Figure 5) New VDS with four uplinks and new target network configuration. .................................................................8
Figure 6) MTU setting on newly created VDS. ..................................................................................................................9
Figure 7) Adjusting failover order for iSCSI port groups. .............................................................................................9
Figure 8) Entering maintenance mode in vSphere Client 6.5. .......................................................................................11
Figure 9) Assigning uplinks to the newly created VDS. ...............................................................................................12
Figure 10) Assigning Vmkernel adapters to port groups on the newly created VDS. ..................................................13
Figure 11) Removing vSphere Standard Switches from host. .......................................................................................13
Figure 12) Noncompliant VMkernels mapped to iSCSI software adapter. ...............................................................14
Figure 13) Compliant VMkernel configuration mapped to iSCSI software adapter. .....................................................15
Figure 14) Exiting maintenance mode in vSphere Client 6.5. ......................................................................................15
Figure 15) Picking new networks as part of virtual machine migration. .................................................................16
1 Introduction

This guide outlines the reconfiguration of NetApp H-Series compute nodes from six network interfaces to two interfaces in an existing NetApp HCI installation configuration. By moving from six to two interfaces on compute nodes, you can reduce connectivity costs such as cabling and switch ports. In addition, you can free up switch ports and simplify network configuration for future expansion.

During the conversion to a two-interface configuration, downtime is required for one compute node at a time but not for the compute cluster. As an extra safeguard, NetApp recommends scheduling a maintenance window. The compute nodes are not returned to factory image but are reconfigured in place using VMware vSphere Client.

The time required to perform a reconfiguration depends on the number of virtual machines, their activity (memory change rate, storage I/O), and the number of compute nodes that must be reconfigured.

1.1 Prerequisites

To reconfigure NetApp HCI to two cables, you must have the following:

- Knowledge about the networking environment, such as switching topology and the switches used by NetApp HCI
- VMware vSphere running on NetApp HCI and licensed at vSphere Enterprise Plus level
  
  Note: NetApp HCI with two interfaces uses vSphere Distributed Switches (VDS).
- Credentials and access to
  - VMware vCenter Server 6.0 or later used by NetApp HCI
  - Network switch infrastructure used by NetApp HCI
- A healthy NetApp HCI installation with at least four storage nodes and two H-Series compute nodes
- NetApp HCI running software version 1.4 or later. Existing installations can be updated by
  - Installing management node version 11.0 or later
  - Updating NetApp Element® software to version 11.0 or later
  - Installing NetApp Element Plug-in for VMware vCenter version 4.2 or later

  Note: If you perform a reconfiguration on NetApp HCI installations running software earlier than version 1.4, then it’s not possible to scale NetApp HCI after the conversion until you upgrade to version 1.4 or later.

1.2 Resulting Configuration

After you use this reconfiguration guide, the following is true for the NetApp HCI configuration:

- All reconfigured NetApp HCI compute nodes in a vSphere cluster have the following attributes:
  - They use the same network configuration.
  - They have two physical network interfaces configured as active uplinks.
  - They are connected to a single vSphere Distributed Switch (VDS).
- Configuration is recognized as a valid configuration to expand in NetApp HCI 1.4 and later.

2 Related Documentation

NetApp recommends reviewing the related documentation before working through this reconfiguration. These documents outline network guidance and best practices for NetApp HCI and vSphere Networking in detail.
1. NetApp HCI 1.4 Deployment Guide (specifically networking guidance): 
   http://docs.netapp.com/hci/index.jsp
2. vSphere Networking in the VMware vSphere documentation (specifically the chapters on vSphere Distributed Switches and their configuration, and iSCSI): https://docs.vmware.com/en/VMware-vSphere/

3 Preparation

3.1 Compute Node Network Interfaces

This guide assumes that you are familiar with the networking options for the NetApp H-Series compute nodes: H300E, H500E, H700E, and the new H410C. Figure 1 shows the interface outline for these compute nodes. Refer to the NetApp HCI Documentation Center for in-depth information about the interfaces and their uses.

Figure 1) Network interfaces on the NetApp H410C.

3.2 Planning Networking for NetApp HCI

NetApp HCI uses a minimum of three network segments: management, storage, and virtual machines /vMotion. Usually, these network segments exist as logically separated virtual LANs (VLANs) in the network infrastructure that is required for a NetApp HCI deployment. Switch ports that are configured for storage and vMotion networks must support a maximum transmission unit (MTU) of 9000 bytes, you can check the MTU in the jumbo frame configuration instructions for the make and model of your switch.

The way compute and storage nodes connect to these network segments depends on the desired network topology and cabling of nodes. For example, in a configuration with six cables and without tagging VLANs, dedicated interfaces on the compute nodes are used to connect to specific network segments. The appropriate VLANs are configured on the switch ports. In a configuration that uses only two interfaces on the NetApp HCI compute nodes, all networks are accessed over a single set of two SFP28/SFP+ interfaces, and all networks must be configured on the switch ports used by the interfaces on the compute nodes. The physical cabling and the VLAN configuration are shown in Figure 2.

Note: In a two-interface configuration, the storage (VLAN ID Y) and vMotion (VLAN ID Z) networks must be tagged on the host side. Host-side tagging of management traffic is optional.
This guide assumes that all interswitch connectivity is already configured appropriately; that is, all trunk ports between switches are configured to all appropriate VLANs for management, storage, vMotion, and virtual machine traffic.

### 3.3 Gathering Switch Port Configuration Details

Before you begin the reconfiguration of the compute nodes and the network, you must determine which port the switches in the infrastructure use for the NetApp HCI compute nodes. Then you must determine which networks (VLANs) are configured on these switch ports. As part of the reconfiguration, all networks that were previously split out over six interfaces are combined onto interfaces D and E. (see Figure 3). Storage and vMotion networks are tagged on the compute node side after the reconfiguration.

As a best practice, you should create a mapping from each compute node interface to the switch ports to determine the current VLAN configuration for interfaces A through F and the desired VLAN configuration for interfaces D and E. Refer to the documentation provided by your switch vendor about retrieving the port and VLAN configuration.

<table>
<thead>
<tr>
<th>Node</th>
<th>Node interface</th>
<th>Switch</th>
<th>Switch ports</th>
<th>VLANs (current)</th>
<th>VLANs (new)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Compute-1 (Management IP: 10.117.178.7)</td>
<td>A</td>
<td>SN2010-Rack1-A</td>
<td>1</td>
<td>2140 (tagged)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>B</td>
<td>SN2010-Rack1-B</td>
<td>1</td>
<td>2140 (tagged)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>C</td>
<td>SN2010-Rack1-A</td>
<td>2</td>
<td>2143 (tagged)</td>
<td></td>
</tr>
</tbody>
</table>
### Node Configuration Table

<table>
<thead>
<tr>
<th>Node</th>
<th>Node interface</th>
<th>Switch</th>
<th>Switch ports</th>
<th>VLANs (current)</th>
<th>VLANs (new)</th>
</tr>
</thead>
<tbody>
<tr>
<td>D</td>
<td>SN2010-Rack1-A</td>
<td>3</td>
<td>2153 (tagged)</td>
<td>2140 (tagged)</td>
<td>2140 (tagged)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>2143 (tagged)</td>
<td>2143 (tagged)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>2153 (tagged)</td>
<td>2153 (tagged)</td>
</tr>
<tr>
<td>E</td>
<td>SN2010-Rack1-B</td>
<td>3</td>
<td>2153 (tagged)</td>
<td>2140 (tagged)</td>
<td>2140 (tagged)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>2143 (tagged)</td>
<td>2143 (tagged)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>2153 (tagged)</td>
<td>2153 (tagged)</td>
</tr>
<tr>
<td>F</td>
<td>SN2010-Rack1-B</td>
<td>2</td>
<td>2143 (tagged)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>...</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Compute-N (Management IP: a.b.c.d)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Note:** If you are using an all-tagged configuration as shown in Table 1 and have configured NetApp HCI compute nodes to use vSphere Distributed Switches (VDS), you could just reconfigure the switch ports used for compute node interfaces D and E to carry all networks. Then you can rework the failover order for all port groups on the VDS to enable all port groups to use the uplinks. See Table 2 for detailed vmnic, uplink, and vmkernel mapping.

### 3.4 Inspecting the Compute Node Configuration in vSphere

If the existing environment uses tagged VLANs, the VLAN information is also reflected in vSphere and can be inspected in vCenter Server (see Figure 4). When using vSphere standard switches (VSS), the information is maintained by each individual compute node; when using vSphere distributed switches (VDS), the configuration is maintained on the data center. You can use this information as a sanity check to validate the data gathered in the previous section.

![Figure 4] iSCSI port group showing VLAN ID in vCenter Server 6.5.

### 3.5 NetApp HCI-Compliant vSphere Distributed Switch

Compute nodes with only two interfaces require you to use VDS. In your vSphere data center, where the NetApp HCI compute cluster resides, create a VDS with at least two uplinks. The newly created VDS must be set up to represent the new target network configuration, including port groups for virtual machines.

**Note:** You need only two uplinks, but you can create and configure more than two. This guide does not cover the configuration of more uplinks beyond the required two SFP28/SFP+ interfaces labeled interfaces D and E, or more virtual machine networks.
As shown in Figure 5, the base configuration of a NetApp HCI-compliant VDS (shown in VMware vSphere Client 6.5) includes port groups on the VDS for:

- Management (named “Management”) with VLAN ID 2140; the management network can use VLAN tagging.
- iSCSI (named “iSCSI-A” and “iSCSI-B”) with VLAN ID 2153; the storage network must use host-side VLAN tagging.
- vMotion with VLAN ID 2143; the vMotion network must use host-side VLAN tagging.
- Virtual machines with no VLAN ID; no host-side tagging in the example screenshots.

To allow easier virtual machine migration later, add any additional virtual machine networks to the VDS in this step. If a VDS using those names exists in the vCenter Server context, the names cannot be reused on the new VDS.

During later expansions of the NetApp HCI installation, NetApp Deployment Engine (NDE) 1.4 will not look for specific naming in compute node networking in the vSphere cluster. The naming of the port groups, uplinks, or the VDS itself is not part of the network validation during the expansion operation. However, all hosts in a compute cluster must use a uniform network configuration and NDE will look for the vmkernel adapters vmk0, vmk1, vmk2, and vmk3. NDE checks their usage and their mapping to the physical network interfaces of the compute node. For more mapping, see Table 2.

Also verify that the VDS supports jumbo frames for storage and vMotion traffic of 9000 bytes. Figure 6 shows the advanced settings dialog box for the newly created VDS in VMware vSphere Client.
ESXi's built-in iSCSI software adapter uses multipathing by using two independent VMkernels and dedicated uplink ports. You can prepare the newly created VDS by adjusting the failover order for the two iSCSI port groups on the new VDS to use only one specific uplink. In Figure 7, VMkernel port group iSCSI-A uses only Uplink 1 as an active uplink and iSCSI " would use only Uplink 2. Any other uplink should be marked as unused for the iSCSI VMkernel port groups.

Figure 7) Adjusting failover order for iSCSI port groups.
3.6 vSphere Network I/O Control for iSCSI

When NDE configures NetApp HCI compute nodes to use only two SFP28/SFP+ interfaces, it alters the standard settings in vSphere Network I/O Control (NIOC) on the VDS for iSCSI Traffic. NetApp recommends that you re-create this setting as part of this reconfiguration and set the physical adapter sharing to High. This setting prevents storage connectivity to the NetApp HCI built-in storage cluster from being starved if there is resource contention in a two-interface configuration.

4 Reconfiguration in vSphere

This section describes the reconfiguration that happens mostly within vCenter Server and one ESXi host at a time. Modification to the switch ports is required in this section as well.

4.1 Overview

The reconfiguration of NetApp HCI compute nodes follows this pattern:

1. Evacuation of workloads from the host being reconfigured
2. Host- and switch-side network reconfiguration
3. Clean-up and returning the host to operation
4. After critical mass of the newly reconfigured hosts has been established, you can migrate part of the virtual machine to the new networking as part of vMotion.

After this migration is started, you must complete the reconfiguration to allow virtual machines to move freely between hosts during vSphere DRS-initiated operations. Reconfiguring also enables proper operation of the entire NetApp HCI installation.

4.2 Enabling Maintenance Mode on Host

Start by using the vSphere Client to place a single NetApp HCI compute node into maintenance mode. If vSphere Distributed Resource Scheduler (DRS) is enabled on the compute cluster (default NetApp HCI configuration on vSphere Enterprise Plus), then virtual machines on this host start migrating to other hosts in the cluster before entering maintenance mode. If DRS is disabled in the NetApp HCI deployment, you should manually migrate vMotion virtual machines to the other host before placing the host into maintenance mode.
4.3 Reconfiguring the Switch Ports

When the host is no longer participating in virtual machine activity in the vSphere cluster, proceed to reconfigure the switch ports used by node interfaces D and E of that single node. (Do not reconfigure other switch ports.) As mentioned in section 3.3, Gathering Switch Port Configuration Details, these ports now must carry all networks (VLANs) used by NetApp HCI. Network operation should not be interrupted for this node, because ESXi manageability from the vCenter Server is performed through node interfaces A and D, which are mapped to vmk0 on the host.

4.4 Adding Host to VDS, Reassigning Uplinks and VMkernel Adapters

After you have reconfigured the switch ports, proceed with adding the host to the newly created VDS object.

When adding the host to the new VDS, you can assign the host’s physical interfaces (vmnicX) to the uplink port groups and VMkernel ports (vmkY) to port groups. For the uplinks, assign vmnic1 to “Uplink 1” and vmnic5 to “Uplink 2”.

<table>
<thead>
<tr>
<th>Initial Deployment with</th>
<th>Network interface in vSphere</th>
<th>Uplink assignment on new VDS</th>
</tr>
</thead>
<tbody>
<tr>
<td>VSS</td>
<td>Interface D is vmnic5</td>
<td>Assign vmnic1 to “Uplink 1” and vmnic5 to “Uplink 2”.</td>
</tr>
<tr>
<td></td>
<td>Interface E is vmnic1</td>
<td></td>
</tr>
<tr>
<td>VDS</td>
<td>Interface D is vmnic1</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Interface E is vmnic5</td>
<td></td>
</tr>
</tbody>
</table>
In addition to the configuration of uplinks, the Vmkernel adapters on the host must be reassigned to port groups on the VDS. Using Table 3, assign the existing Vmkernel adapters (vmkY) to the port groups of the VDS.

Table 3) Assigning Vmkernel adapters to the port groups of the VDS.

<table>
<thead>
<tr>
<th>Vmkernel adapter</th>
<th>Port group on new VDS</th>
<th>Used for</th>
<th>Uplinks and network adapters in vSphere</th>
</tr>
</thead>
<tbody>
<tr>
<td>vmk0</td>
<td>Management</td>
<td>Management</td>
<td>Uplink 1 and Uplink 2 (vmnic1, vmnic5)</td>
</tr>
<tr>
<td>vmk1</td>
<td>iSCSI-A</td>
<td>Storage</td>
<td>Uplink 1 (vmnic1)</td>
</tr>
<tr>
<td>vmk2</td>
<td>iSCSI-B</td>
<td></td>
<td>Uplink 2 (vmnic5)</td>
</tr>
<tr>
<td>vmk3</td>
<td>vMotion</td>
<td>vMotion</td>
<td>Uplink 1 and Uplink 2 (vmnic1, vmnic5)</td>
</tr>
</tbody>
</table>
After completing the wizard to add and manage hosts to the VDS in the vCenter Client, you can remove the dormant VSS from the host (Figure 11). You can then decommission the network cables from the now unused interfaces on that host and reconfigure the network cables on the switch side for other purposes as desired.

Figure 10) Assigning Vmkernel adapters to port groups on the newly created VDS.

Figure 11) Removing vSphere Standard Switches from host.
4.5 Verifying Port Group Policy for iSCSI and vMotion VMkernel Adapters

To verify that the iSCSI software adapter is compliant with the policy of using only one uplink per vmkernel (vmk1 and vmk2), check the network port binding for the iSCSI software adapter on the host (Host > Configure > Storage Adapters). If the port groups policy lists “not compliant” (Figure 12), follow the steps in section 3.5, NetApp HCI-Compliant vSphere Distributed Switch. Figure 13 shows a healthy configuration.

**Note:** Verify that vMotion is configured to use vmk3 only on all hosts.

Figure 12) Noncompliant VMkernels mapped to iSCSI software adapter.
Figure 13) Compliant VMkernel configuration mapped to iSCSI software adapter.

4.6 Exiting Host Maintenance Mode

After validating the VMkernel configuration for the iSCSI software adapter, the host can exit maintenance mode and rejoin the cluster for virtual machine operations (Figure 14). Because several port group names have changed as part of this configuration, virtual machines cannot yet move to the reconfigured hosts.

Figure 14) Exiting maintenance mode in vSphere Client 6.5.
4.7 Repeating with More Hosts

Repeat the reconfiguration steps until all hosts have been migrated to the new VDS. When at least two hosts have been reconfigured, consider migrating some virtual machines to the reconfigured hosts to avoid resource contention. Virtual machines might get “trapped” on the remaining hosts with the original network configuration.

4.8 Migrating Virtual Machines to the Reconfigured Network

When at least two hosts have been successfully reconfigured to use a reduced number of uplinks, virtual machines can be migrated to reconfigured hosts and the new networks. As part of the virtual machine migration or vMotion process (Figure 15), you must adjust the virtual machine networking to use the port groups provided by the new VDS on the reconfigured hosts. You should migrate virtual machines with lower-priority workloads first and continue migrating throughout the cluster reconfiguration.

Figure 15) Picking new networks as part of virtual machine migration.

5 Conclusion

Using only two SFP+/SFP28 interfaces as network uplinks for NetApp HCI compute nodes can reduce infrastructure costs. It can also make subsequent scale operations, including the required networking configuration and cabling, simpler with NetApp HCI 1.4 and later.

New NetApp HCI compute nodes can be added with the same, reduced number of configured interfaces. To access the expansion workflows to add more nodes to an existing NetApp HCI installation, refer to the NetApp HCI Deployment Guide at http://docs.netapp.com/hci/index.jsp.
Where to Find Additional Information

To learn more about the information that is described in this document, see the following documents or websites:

- NetApp Documentation Center
- NetApp HCI Documentation Resources

Version History

<table>
<thead>
<tr>
<th>Version</th>
<th>Date</th>
<th>Document Version History</th>
</tr>
</thead>
<tbody>
<tr>
<td>Version 1.0</td>
<td>December 2018</td>
<td>Initial version.</td>
</tr>
<tr>
<td>Version 1.1</td>
<td>May 2019</td>
<td>Updated for vMotion.</td>
</tr>
</tbody>
</table>
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