FC configurations

ONTAP 9

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FC configurations

Configure FC or FC-NVME fabrics with ONTAP systems

It is recommended that you configure your FC and FC-NVMe SAN hosts using HA pairs and a minimum of two switches. This provides redundancy at the fabric and storage system layers to support fault tolerance and nondisruptive operations. You cannot directly attach FC or FC-NVMe SAN hosts to HA pairs without using a switch.

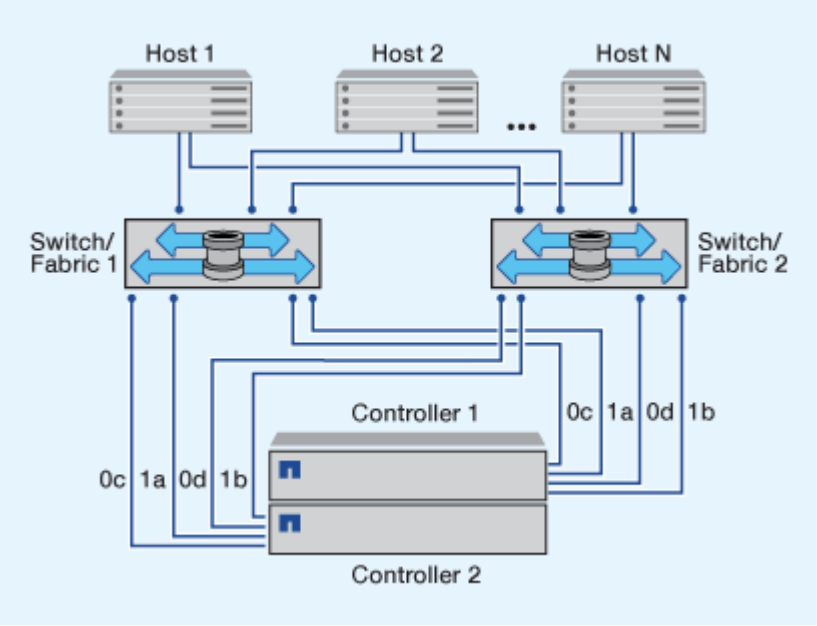
Cascade, partial mesh, full mesh, core-edge, and director fabrics are all industry-standard methods of connecting FC switches to a fabric, and all are supported. The use of heterogeneous FC switch fabrics is not supported, except in the case of embedded blade switches. Specific exceptions are listed on the Interoperability Matrix Tool. A fabric can consist of one or multiple switches, and the storage controllers can be connected to multiple switches.

Multiple hosts, using different operating systems, such as Windows, Linux, or UNIX, can access the storage controllers at the same time. Hosts require that a supported multipathing solution be installed and configured. Supported operating systems and multipathing solutions can be verified on the Interoperability Matrix Tool.

Multifabric FC and FC-NVMe configurations

In multifabric HA pair configurations, there are two or more switches connecting HA pairs to one or more hosts. For simplicity, the following multifabric HA pair figure shows only two fabrics, but you can have two or more fabrics in any multifabric configuration.

The FC target port numbers (0c, 0d, 1a, 1b) in the illustrations are examples. The actual port numbers vary depending on the model of your storage node and whether you are using expansion adapters.



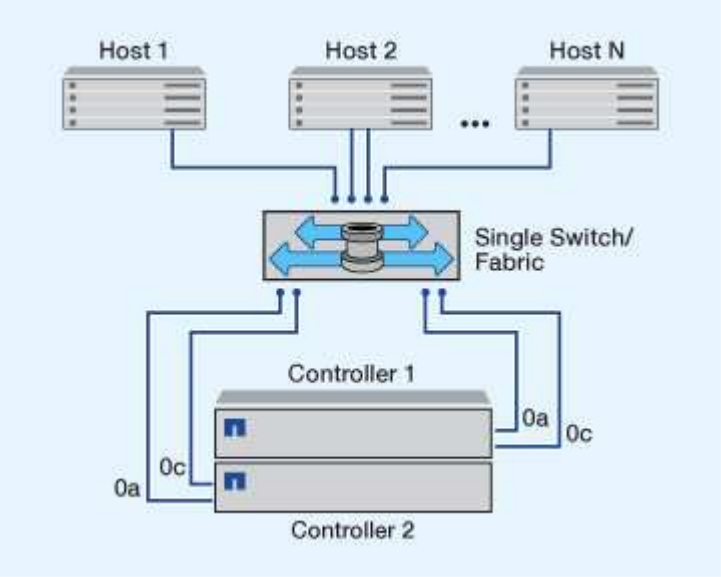
Single-fabric FC and FC-NVMe configurations

In single-fabric HA pair configurations, there is one fabric connecting both controllers in the HA pair to one or more hosts. Because the hosts and controllers are connected through a single switch, single-fabric HA pair

configurations are not fully redundant.

The FC target port numbers (0a, 0c) in the illustrations are examples. The actual port numbers vary depending on the model of your storage node and whether you are using expansion adapters.

All platforms that support FC configurations support single-fabric HA pair configurations.



Single-node configurations are not recommended because they do not provide the redundancy needed to support fault tolerance and nondisruptive operations.

Related information

- Learn how Selective LUN mapping (SLM) limits the paths that are used to access the LUNs owned by an HA pair.
- Learn about SAN LIFs.

Best practices to configure FC switches with ONTAP systems

For best performance, you should consider certain best practices when configuring your FC switch.

A fixed link speed setting is the best practice for FC switch configurations, especially for large fabrics because it provides the best performance for fabric rebuilds and can significantly save time. Although autonegotiation provides the greatest flexibility, FC switch configuration does not always perform as expected, and it adds time to the overall fabric-build sequence.

All of the switches that are connected to the fabric must support N_Port ID virtualization (NPIV) and must have NPIV enabled. ONTAP uses NPIV to present FC targets to a fabric.

For details about which environments are supported, see the NetApp Interoperability Matrix Tool.

For FC and iSCSI best practices, see NetApp Technical Report 4080: Best Practices for Modern SAN.

Recommended FC target port configuration and speeds for ONTAP systems

FC target ports can be configured and used for the FC-NVMe protocol in the exact same way they are configured and used for the FC protocol. Support for the FC-NVMe protocol varies based upon your platform and your ONTAP version. Use NetApp Hardware Universe to verify support.

For best performance and highest availability, you should use the recommended target port configuration listed in NetApp Hardware Universe for your specific platform.

Configuration for FC target ports with shared ASICs

The following platforms have port pairs with shared application-specific integrated circuits (ASICs). If you use an expansion adapter with these platforms, you should configure your FC ports so that they do not use the same ASIC for connectivity.

Controller	Port pairs with shared ASIC	Number of target ports: Recommended ports
• FAS8200 • AFF A300	0g+0h	1: 0g 2: 0g, 0h
• FAS2720 • FAS2750 • AFF A220	0c+0d 0e+0f	1: 0c 2: 0c, 0e 3: 0c, 0e, 0d 4: 0c, 0e, 0d, 0f

FC target port supported speeds

FC target ports can be configured to run at different speeds. All target ports used by a given host should be set to the same speed. You should set the target port speed to match the speed of the device to which it connects. Do not use autonegotiation for your port speed. A port that is set to autonegotiation can take longer to reconnect after a takeover/giveback or other interruption.

You can configure onboard ports and expansion adapters to run at the following speeds. Each controller and expansion adapter port can be configured individually for different speeds as needed.

4 Gb ports	8 Gb ports	16 Gb ports	32 Gb ports
• 4 Gb • 2 Gb • 1 Gb	• 8 Gb • 4 Gb • 2 Gb	• 16 Gb • 8 Gb • 4 Gb	• 32 Gb • 16 Gb • 8 Gb

For a full list of supported adapters and their supported speeds, see the NetApp Hardware Universe.

Configure ONTAP FC adapter ports

Onboard FC adapters and some FC expansion adapter cards can be individually configured as either initiators or targets ports. Other FC expansion adapters are configured as initiators or targets at the factory and cannot be changed. Additional FC ports are also available through supported UTA2 cards configured with FC SFP+ adapters.

Initiator ports can be used to connect directly to back-end disk shelves, and possibly foreign storage arrays. Target ports can be used to connect only to FC switches.

The number of onboard ports and CNA/UTA2 ports configured for FC varies depending on the model of the controller. The supported target expansion adapters also varies depending on controller model. See NetApp Hardware Universe for a complete list of onboard FC ports and supported target expansion adapters for your controller model.

Configure FC adapters for initiator mode

Initiator mode is used to connect the ports to tape drives, tape libraries, or third-party storage with Foreign LUN Import (FLI).

Before you begin

- LIFs on the adapter must be removed from any port sets of which they are members.
- All LIF's from every storage virtual machine (SVM) using the physical port to be modified must be migrated or destroyed before changing the personality of the physical port from target to initiator.

NVMe/FC does support initiator mode.

Steps

1. Remove all LIFs from the adapter:

```
network interface delete -vserver _SVM_name_ -lif _lif_name_,_lif_name_
```

2. Take your adapter offline:

```
network fcp adapter modify -node _node_name_ -adapter _adapter_port_
-status-admin down
```

If the adapter does not go offline, you can also remove the cable from the appropriate adapter port on the system.

3. Change the adapter from target to initiator:

```
system hardware unified-connect modify -t initiator _adapter_port_
```

4. Reboot the node hosting the adapter you changed.

5. Verify that the FC ports are configured in the correct state for your configuration:

```
system hardware unified-connect show
```

6. Bring the adapter back online:

```
node run -node _node_name_ storage enable adapter _adapter_port_
```

Configure FC adapters for target mode

Target mode is used to connect the ports to FC initiators.

The same steps are used to configure FC adapters for the FC protocol and the FC-NVMe protocol. However, only certain FC adapters support FC-NVMe. See the NetApp Hardware Universe for a list of adapters that support the FC-NVMe protocol.

Steps

1. Take the adapter offline:

```
node run -node _node_name_ storage disable adapter _adapter_name_
```

   If the adapter does not go offline, you can also remove the cable from the appropriate adapter port on the system.

2. Change the adapter from initiator to target:

```
system node hardware unified-connect modify -t target -node _node_name_
adapter _adapter_name_
```

3. Reboot the node hosting the adapter you changed.
4. Verify that the target port has the correct configuration:

```
network fcp adapter show -node _node_name_
```

5. Bring your adapter online:

```
network fcp adapter modify -node _node_name_ -adapter _adapter_port_
-state up
```

Configure FC adapter speed

You should configure your adapter target port speed to match the speed of the device to which it connects, instead of using autonegotiation. A port that is set to autonegotiation can take longer time to reconnect after a takeover/giveback or other interruption.

About this task

Because this task encompasses all storage virtual machines (SVMs) and all LIFs in a cluster, you must use the `-home-port` and `-home-lif` parameters to limit the scope of this operation. If you do not use these parameters, the operation applies to all LIFs in the cluster, which might not be desirable.

Before you begin

All LIFs that use this adapter as their home port must be offline.

Steps

1. Take all of the LIFs on this adapter offline:

   ```
   network interface modify -vserver * -lif * { -home-node node1 -home-port
   0c } -status-admin down
   ```

2. Take the adapter offline:

   ```
   network fcp adapter modify -node node1 -adapter 0c -state down
   ```

   If the adapter does not go offline, you can also remove the cable from the appropriate adapter port on the system.

3. Determine the maximum speed for the port adapter:

   ```
   fcp adapter show -instance
   ```

   You cannot modify the adapter speed beyond the maximum speed.

4. Change the adapter speed:

   ```
   network fcp adapter modify -node node1 -adapter 0c -speed 16
   ```

5. Bring the adapter online:

   ```
   network fcp adapter modify -node node1 -adapter 0c -state up
   ```

6. Bring all of the LIFs on the adapter online:

```
network interface modify -vserver * -lif * { -home-node node1 -home-port
0c } -status-admin up
```

ONTAP commands for managing FC adapters

You can use FC commands to manage FC target adapters, FC initiator adapters, and onboard FC adapters for your storage controller. The same commands are used to manage FC adapters for the FC protocol and the FC-NVMe protocol.

FC initiator adapter commands work only at the node level. You must use the `run -node node_name` command before you can use the FC initiator adapter commands.

Commands for managing FC target adapters

If you want to…	Use this command…
Display FC adapter information on a node	`network fcp adapter show`
Modify FC target adapter parameters	`network fcp adapter modify`
Display FC protocol traffic information	`run -node node_name sysstat -f`
Display how long the FC protocol has been running	`run -node node_name uptime`
Display adapter configuration and status	`run -node node_name sysconfig -v adapter`
Verify which expansion cards are installed and whether there are any configuration errors	`run -node node_name sysconfig -ac`
View a man page for a command	`man command_name`

Commands for managing FC initiator adapters

If you want to…	Use this command…
Display information for all initiators and their adapters in a node	`run -node node_name storage show adapter`
Display adapter configuration and status	`run -node node_name sysconfig -v adapter`

If you want to…	Use this command…
Verify which expansion cards are installed and whether there are any configuration errors	`run -node node_name sysconfig -ac`

Commands for managing onboard FC adapters

If you want to…	Use this command…
Display the status of the onboard FC ports	`system node hardware unified-connect show`

Related information

- network fcp adapter

Avoid connectivity loss to an ONTAP system using an X1133A-R6 adapter

You can prevent loss of connectivity during a port failure by configuring your system with redundant paths to separate X1133A-R6 HBAs.

The X1133A-R6 HBA is a 4-port, 16 Gb FC adapter consisting of two 2-port pairs. The X1133A-R6 adapter can be configured as target mode or initiator mode. Each 2-port pair is supported by a single ASIC (for example, Port 1 and Port 2 on ASIC 1 and Port 3 and Port 4 on ASIC 2). Both ports on a single ASIC must be configured to operate in the same mode, either target mode or initiator mode. If an error occurs with the ASIC supporting a pair, both ports in the pair go offline.

To prevent this loss of connectivity, you configure your system with redundant paths to separate X1133A-R6 HBAs, or with redundant paths to ports supported by different ASICs on the HBA.

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