



SAN protocol management

ONTAP 9

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SAN protocol management

Manage iSCSI

Configure your network for best performance

Ethernet networks vary greatly in performance. You can maximize the performance of the network used for iSCSI by selecting specific configuration values.

Steps

1. Connect the host and storage ports to the same network.

It is best to connect to the same switches. Routing should never be used.

2. Select the highest speed ports available, and dedicate them to iSCSI.

10 GbE ports are best. 1 GbE ports are the minimum.

3. Disable Ethernet flow control for all ports.

You should see the *ONTAP 9 Network Management Guide* for using the CLI to configure Ethernet port flow control.

[Network management](#)

4. Enable jumbo frames (typically MTU of 9000).

All devices in the data path, including initiators, targets, and switches, must support jumbo frames. Otherwise, enabling jumbo frames actually reduces network performance substantially.

Define a security policy method for an initiator

You can define a list of initiators and their authentication methods. You can also modify the default authentication method that applies to initiators that do not have a user-defined authentication method.

About this task

You can generate unique passwords using security policy algorithms in the product or you can manually specify the passwords that you want to use.



Not all initiators support hexadecimal CHAP secret passwords.

Steps

1. Use the `vserver iscsi security create` command to create a security policy method for an initiator.

```
vserver iscsi security create -vserver vs2 -initiator iqn.1991-05.com.microsoft:host1 -auth-type CHAP -user-name bob1 -outbound-user-name bob2
```

2. Follow the screen commands to add the passwords.

Creates a security policy method for initiator `iqn.1991-05.com.microsoft:host1` with inbound and outbound CHAP user names and passwords.

Related information

- [How iSCSI authentication works](#)
- [Guidelines for using CHAP authentication](#)
- [What CHAP authentication is](#)

Delete an iSCSI service for an SVM

You can delete an iSCSI service for a storage virtual machine (SVM) if it is no longer required.

What you'll need

The administration status of the iSCSI service must be in the “down” state before you can delete an iSCSI service. You can move the administration status to down with the `vserver iscsi modify` command.

Steps

1. Use the `vserver iscsi modify` command to stop the I/O to the LUN.

```
vserver iscsi modify -vserver vs1 -status-admin down
```

2. Use the `vserver iscsi delete` command to remove the iscsi service from the SVM.

```
vserver iscsi delete -vserver vs_1
```

3. Use the `vserver iscsi show` command to verify that you deleted the iSCSI service from the SVM.

```
vserver iscsi show -vserver vs1
```

Get more details in iSCSI session error recoveries

Increasing the iSCSI session error recovery level enables you to receive more detailed information about iSCSI error recoveries. Using a higher error recovery level might cause a minor reduction in iSCSI session performance.

About this task

By default, ONTAP is configured to use error recovery level 0 for iSCSI sessions. If you are using an initiator that has been qualified for error recovery level 1 or 2, you can choose to increase the error recovery level. The modified session error recovery level affects only the newly created sessions and does not affect existing sessions.

Beginning in ONTAP 9.4, the `max-error-recovery-level` option is not supported in the `iscsi show` and `iscsi modify` commands.

Steps

1. Enter advanced mode:

```
set -privilege advanced
```

2. Verify the current setting by using the `iscsi show` command.

```
iscsi show -vserver vs3 -fields max-error-recovery-level
```

```
vserver max-error-recovery-level
-----
vs3      0
```

3. Change the error recovery level by using the `iscsi modify` command.

```
iscsi modify -vserver vs3 -max-error-recovery-level 2
```

Register the SVM with an iSNS server

You can use the `vserver iscsi isns` command to configure the storage virtual machine (SVM) to register with an iSNS server.

About this task

The `vserver iscsi isns create` command configures the SVM to register with the iSNS server. The SVM does not provide commands that enable you to configure or manage the iSNS server. To manage the iSNS server, you can use the server administration tools or the interface provided by the vendor for the iSNS server.

Steps

1. On your iSNS server, ensure that your iSNS service is up and available for service.
2. Create the SVM management LIF on a data port:

```
network interface create -vserver SVM_name -lif lif_name -role data -data
-protocol none -home-node home_node_name -home-port home_port -address
IP_address -netmask network_mask
```

3. Create an iSCSI service on your SVM if one does not already exist:

```
vserver iscsi create -vserver SVM_name
```

4. Verify that the iSCSI service was created successfully:

```
iscsi show -vserver SVM_name
```

5. Verify that a default route exists for the SVM:

```
network route show -vserver SVM_name
```

6. If a default route does not exist for the SVM, create a default route:

```
network route create -vserver SVM_name -destination destination -gateway gateway
```

7. Configure the SVM to register with the iSNS service:

```
vserver iscsi isns create -vserver SVM_name -address IP_address
```

Both IPv4 and IPv6 address families are supported. The address family of the iSNS server must be the same as that of the SVM management LIF.

For example, you cannot connect an SVM management LIF with an IPv4 address to an iSNS server with an IPv6 address.

8. Verify that the iSNS service is running:

```
vserver iscsi isns show -vserver SVM_name
```

9. If the iSNS service is not running, start it:

```
vserver iscsi isns start -vserver SVM_name
```

Resolve iSCSI error messages on the storage system

There are a number of common iSCSI-related error messages that you can view with the `event log show` command. You need to know what these messages mean and what you can do to resolve the issues they identify.

The following table contains the most common error messages, and instructions for resolving them:

Message	Explanation	What to do
ISCSI: network interface identifier disabled for use; incoming connection discarded	The iSCSI service is not enabled on the interface.	You can use the <code>iscsi interface enable</code> command to enable the iSCSI service on the interface. For example: <pre>iscsi interface enable -vserver vs1 -lif lif1</pre>

Message	Explanation	What to do
ISCSI: Authentication failed for initiator nodename	CHAP is not configured correctly for the specified initiator.	<p>You should check the CHAP settings; you cannot use the same user name and password for inbound and outbound settings on the storage system:</p> <ul style="list-style-type: none"> • Inbound credentials on the storage system must match outbound credentials on the initiator. • Outbound credentials on the storage system must match inbound credentials on the initiator.

Troubleshoot iSCSI LUNs not visible on the host

The iSCSI LUNs appear as local disks to the host. If the storage system LUNs are not available as disks on the host, you should verify the configuration settings.

Configuration setting	What to do
Cabling	Verify that the cables between the host and storage system are properly connected.
Network connectivity	<p>Verify that there is TCP/IP connectivity between the host and storage system.</p> <ul style="list-style-type: none"> • From the storage system command line, ping the host interfaces that are being used for iSCSI: <pre>ping -node node_name -destination host_ip_address_for_iSCSI</pre> • From the host command line, ping the storage system interfaces that are being used for iSCSI: <pre>ping -node node_name -destination host_ip_address_for_iSCSI</pre>
System requirements	Verify that the components of your configuration are qualified. Also, verify that you have the correct host operating system (OS) service pack level, initiator version, ONTAP version, and other system requirements. The Interoperability Matrix contains the most up-to-date system requirements.
Jumbo frames	If you are using jumbo frames in your configuration, verify that jumbo frames are enabled on all devices in the network path: the host Ethernet NIC, the storage system, and any switches.

Configuration setting	What to do
iSCSI service status	Verify that the iSCSI service is licensed and started on the storage system.
Initiator login	Verify that the initiator is logged in to the storage system. If the <code>iscsi initiator show</code> command output shows no initiators are logged in, check the initiator configuration on the host. Also verify that the storage system is configured as a target of the initiator.
iSCSI node names (IQNs)	Verify that you are using the correct initiator node names in the <code>igroup</code> configuration. On the host, you can use the initiator tools and commands to display the initiator node name. The initiator node names configured in the <code>igroup</code> and on the host must match.
LUN mappings	Verify that the LUNs are mapped to an <code>igroup</code> . On the storage system console, you can use one of the following commands: <ul style="list-style-type: none"> • <code>lun mapping show</code> displays all LUNs and the <code>igroups</code> to which they are mapped. • <code>lun mapping show -igroup</code> displays the LUNs mapped to a specific <code>igroup</code>.
iSCSI LIFs enable	Verify that the iSCSI logical interfaces are enabled.

Related information

[NetApp Interoperability Matrix Tool](#)

Manage FC

Delete an FC service for an SVM

You can delete an FC service for a storage virtual machine (SVM) if it is no longer required.

What you'll need

The administration status must be "down" before you can delete a FC service for an SVM. You can set the administration status to down with either the `vserver fcp modify` command or the `vserver fcp stop` command.

Steps

1. Use the `vserver fcp stop` command to stop the I/O to the LUN.

```
vserver fcp stop -vserver vs_1
```

2. Use the `vserver fcp delete` command to remove the service from the SVM.

```
vserver fcp delete -vserver vs_1
```


3. Use the `vserver fcp show` to verify that you deleted the FC service from your SVM:

```
vserver fcp show -vserver vs_1
```

Recommended MTU configurations for FCoE jumbo frames

For Fibre Channel over Ethernet (FCoE), jumbo frames for the Ethernet adapter portion of the CNA should be configured at 9000 MTU. Jumbo frames for the FCoE adapter portion of the CNA should be configured at greater than 1500 MTU. Only configure jumbo frames if the initiator, target, and all intervening switches support and are configured for jumbo frames.

Manage systems with FC adapters

Manage systems with FC adapters

Commands are available to manage onboard FC adapters and FC adapter cards. These commands can be used to configure the adapter mode, display adapter information, and change the speed.

Most storage systems have onboard FC adapters that can be configured as initiators or targets. You can also use FC adapter cards configured as initiators or targets. Initiators connect to back-end disk shelves, and possibly foreign storage arrays (FlexArray). Targets connect only to FC switches. Both the FC target HBA ports and the switch port speed should be set to the same value and should not be set to auto.

Related information

[SAN configuration](#)

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	<code>network fcp adapter show</code>
Modify FC target adapter parameters	<code>network fcp adapter modify</code>
Display FC protocol traffic information	<code>run -node node_name sysstat -f</code>

If you want to...	Use this command...
Display how long the FC protocol has been running	<code>run -node <i>node_name</i> uptime</code>
Display adapter configuration and status	<code>run -node <i>node_name</i> sysconfig -v <i>adapter</i></code>
Verify which expansion cards are installed and whether there are any configuration errors	<code>run -node <i>node_name</i> sysconfig -ac</code>
View a man page for a command	<code>man <i>command_name</i></code>

Commands for managing FC initiator adapters

If you want to...	Use this command...
Display information for all initiators and their adapters in a node	<code>run -node <i>node_name</i> storage show adapter</code>
Display adapter configuration and status	<code>run -node <i>node_name</i> sysconfig -v <i>adapter</i></code>
Verify which expansion cards are installed and whether there are any configuration errors	<code>run -node <i>node_name</i> sysconfig -ac</code>

Commands for managing onboard FC adapters

If you want to...	Use this command...
Display the status of the onboard FC ports	<code>run -node <i>node_name</i> system hardware unified-connect show</code>

Configure FC adapters for initiator mode

You can configure individual FC ports of onboard adapters and certain FC adapter cards for initiator mode. Initiator mode is used to connect the ports to tape drives, tape libraries, or third-party storage with FlexArray Virtualization or Foreign LUN Import (FLI).

What you'll need

- 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.

About this task

Each onboard FC port can be individually configured as an initiator or a target. Ports on certain FC adapters can also be individually configured as either a target port or an initiator port, just like the onboard FC ports. A list of adapters that can be configured for target mode is available in the *Hardware Universe*.



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
```

Related information

[NetApp Hardware Universe](#)

Configure FC adapters for target mode

You can configure individual FC ports of onboard adapters and certain FC adapter cards for target mode. Target mode is used to connect the ports to FC initiators.

About this task

Each onboard FC port can be individually configured as an initiator or a target. Ports on certain FC adapters can also be individually configured as either a target port or an initiator port, just like the onboard FC ports. A list of adapters that can be configured for target mode is available in the *Hardware Universe*.

The same steps are used when configuring FC adapters for the FC protocol and the FC-NVMe protocol. However, only certain FC adapters support FC-NVMe. See *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 -d adapter_port
```

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 hardware unified-connect modify -t target adapter_port
```

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
```

Related information

[NetApp Hardware Universe](#)

Display information about an FC target adapter

You can use the `network fcp adapter show` command to display system configuration and adapter information for any FC adapter in the system.

Step

1. Display information about the FC adapter by using the `network fcp adapter show` command.

The output displays system configuration information and adapter information for each slot that is used.

```
network fcp adapter show -instance -node node1 -adapter 0a
```

Supported port configurations for X1143A-R6 adapters

The FC target mode is the default configuration for X1143A-R6 adapter ports. However, ports on this adapter can be configured as either 10-Gb Ethernet and FCoE ports or as 16-Gb FC ports.

When configured for Ethernet and FCoE, X1143A-R6 adapters support concurrent NIC and FCoE target traffic on the same 10-GBE port. When configured for FC, each two-port pair that shares the same ASIC can be individually configured for FC target or FC initiator mode. This means that a single X1143A-R6 adapter can support FC target mode on one two-port pair and FC initiator mode on another two-port pair.

Related information

[NetApp Hardware Universe](#)

[SAN configuration](#)

Configure the ports

To configure the unified target adapter (X1143A-R6), you must configure the two adjacent

ports on the same chip in the same personality mode.

Steps

1. Configure the ports as needed for Fibre Channel (FC) or Converged Network Adapter (CNA) using the `system node hardware unified-connect modify` command.
2. Attach the appropriate cables for FC or 10 Gb Ethernet.
3. Verify that you have the correct SFP+ installed:

```
network fcp adapter show -instance -node -adapter
```

For CNA, you should use a 10Gb Ethernet SFP. For FC, you should either use an 8 Gb SFP or a 16 Gb SFP, based on the FC fabric being connected to.

Change the UTA2 port from CNA mode to FC mode

You should change the UTA2 port from Converged Network Adapter (CNA) mode to Fibre Channel (FC) mode to support the FC initiator and FC target mode. You should change the personality from CNA mode to FC mode when you need to change the physical medium that connects the port to its network.

Steps

1. Take the adapter offline:

```
network fcp adapter modify -node node_name -adapter adapter_name -status-admin  
down
```

2. Change the port mode:

```
ucadmin modify -node node_name -adapter adapter_name -mode fcp
```

3. Reboot the node, and then bring the adapter online:

```
network fcp adapter modify -node node_name -adapter adapter_name -status-admin  
up
```

4. Notify your admin or VIF manager to delete or remove the port, as applicable:

- If the port is used as a home port of a LIF, is a member of an interface group (ifgrp), or hosts VLANs, then an admin should do the following:
 - i. Move the LIFs, remove the port from the ifgrp, or delete the VLANs, respectively.
 - ii. Manually delete the port by running the `network port delete` command.

If the `network port delete` command fails, the admin should address the errors, and then run the command again.

- If the port is not used as the home port of a LIF, is not a member of an ifgrp, and does not host VLANs, then the VIF manager should remove the port from its records at the time of reboot.

If the VIF manager does not remove the port, then the admin must remove it manually after the reboot by using the `network port delete` command.

```
net-f8040-34::> network port show
```

```
Node: net-f8040-34-01
```

Port	IPspace	Broadcast	Domain	Link	MTU	Speed (Mbps) Admin/Oper	Health Status
...							
e0i	Default	Default		down	1500	auto/10	-
e0f	Default	Default		down	1500	auto/10	-
...							

```
net-f8040-34::> ucadmin show
```

Admin	Node	Adapter	Current Mode	Current Type	Pending Mode	Pending Type
Status						
net-f8040-34-01	0e	cna	target	-	-	
offline						
net-f8040-34-01	0f	cna	target	-	-	
offline						
...						

```
net-f8040-34::> network interface create -vs net-f8040-34 -lif m  
-role  
node-mgmt-home-node net-f8040-34-01 -home-port e0e -address 10.1.1.1  
-netmask 255.255.255.0
```

```
net-f8040-34::> network interface show -fields home-port, curr-port
```

vserver	lif	home-port	curr-port
Cluster	net-f8040-34-01_clus1	e0a	e0a
Cluster	net-f8040-34-01_clus2	e0b	e0b
Cluster	net-f8040-34-01_clus3	e0c	e0c
Cluster	net-f8040-34-01_clus4	e0d	e0d
net-f8040-34			
	cluster_mgmt	e0M	e0M
net-f8040-34			
	m	e0e	e0i
net-f8040-34			
	net-f8040-34-01_mgmt1	e0M	e0M

```
7 entries were displayed.
```

```
net-f8040-34::> ucaadmin modify local 0e fc
```

```
Warning: Mode on adapter 0e and also adapter 0f will be changed to fc.
```

```
Do you want to continue? {y|n}: y
```

```
Any changes will take effect after rebooting the system. Use the "system node reboot" command to reboot.
```

```
net-f8040-34::> reboot local  
(system node reboot)
```

```
Warning: Are you sure you want to reboot node "net-f8040-34-01"?  
{y|n}: y
```

5. Verify that you have the correct SFP+ installed:

```
network fcp adapter show -instance -node -adapter
```

For CNA, you should use a 10Gb Ethernet SFP. For FC, you should either use an 8 Gb SFP or a 16 Gb SFP, before changing the configuration on the node.

Change the CNA/UTA2 target adapter optical modules

You should change the optical modules on the unified target adapter (CNA/UTA2) to support the personality mode you have selected for the adapter.

Steps

1. Verify the current SFP+ used in the card. Then, replace the current SFP+ with the appropriate SFP+ for the preferred personality (FC or CNA).
2. Remove the current optical modules from the X1143A-R6 adapter.
3. Insert the correct modules for your preferred personality mode (FC or CNA) optics.
4. Verify that you have the correct SFP+ installed:

```
network fcp adapter show -instance -node -adapter
```

Supported SFP+ modules and Cisco-branded Copper (Twinax) cables are listed in the *Hardware Universe*.

Related information

[NetApp Hardware Universe](#)

View adapter settings

To view the settings for your unified target adapter (X1143A-R6), you must run the `system hardware unified-connect show` command to display all modules on your controller.

Steps

1. Boot your controller without the cables attached.
2. Run the `system hardware unified-connect show` command to see the port configuration and modules.
3. View the port information before configuring the CNA and ports.

Prevent loss of connectivity when using the 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.

Manage NVMe

Manage NVMe

Beginning in ONTAP 9.4, NVMe/FC is supported. Beginning with ONTAP 9.5 a license is required to support NVMe. If NVMe is enabled in ONTAP 9.4, a 90 day grace period is given to acquire the license after upgrading to ONTAP 9.5.

You can enable the license using the following command:

```
system license add -license-code NVMe_license_key
```

Start the NVMe service for an SVM

Before you can use the NVMe protocol on your storage virtual machine (SVM), you must start the NVMe service on the SVM.

What you'll need

NVMe must be allowed as a protocol on your system.

The following NVMe protocols are supported:

Protocol	Starting with...	Allowed by...
TCP	ONTAP 9.10.1	Default
FCP	ONTAP 9.4	Default

Steps

1. Change the privilege setting to advanced:


```
set -privilege advanced
```

2. Verify that NVMe is allowed as a protocol:

```
vserver nvme show
```

3. Create the NVMe protocol service:

```
vserver nvme create
```

4. Start the NVMe protocol service on the SVM:

```
vserver nvme modify -status -admin up
```

Delete NVMe service from an SVM

If needed, you can delete the NVMe service from your storage virtual machine (SVM).

Steps

1. Change the privilege setting to advanced:

```
set -privilege advanced
```

2. Stop the NVMe service on the SVM:

```
vserver nvme modify -status -admin down
```

3. Delete the NVMe service:

```
vserver nvme delete
```

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