About SAN host provisioning

ONTAP 9

NetApp
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SAN provisioning with iSCSI

In SAN environments, storage systems are targets that have storage target devices. For iSCSI and FC, the storage target devices are referred to as LUNs (logical units). For Non-Volatile Memory Express (NVMe) over Fibre Channel, the storage target devices are referred to as namespaces.

You configure storage by creating LUNs for iSCSI and FC or by creating namespaces for NVMe. The LUNs or namespaces are then accessed by hosts using Internet Small Computer Systems Interface (iSCSI) or Fibre Channel (FC) protocol networks.

To connect to iSCSI networks, hosts can use standard Ethernet network adapters (NICs), TCP offload engine (TOE) cards with software initiators, converged network adapters (CNAs), or dedicated iSCSI host bus adapters (HBAs).

To connect to FC networks, hosts require FC HBAs or CNAs.

Supported FC protocols include:

- FC
- FCoE
- NVMe

iSCSI target node network connections and names

iSCSI target nodes can connect to the network in several ways:

- Over Ethernet interfaces using software that is integrated into ONTAP.
- Over multiple system interfaces, with an interface used for iSCSI that can also transmit traffic for other protocols, such as SMB and NFS.
- Using a unified target adapter (UTA) or a converged network adapter (CNA).

Every iSCSI node must have a node name.

The two formats, or type designators, for iSCSI node names are *iqn* and *eui*. The SVM iSCSI target always uses the iqn-type designator. The initiator can use either the iqn-type or eui-type designator.

Storage system node name

Each SVM running iSCSI has a default node name based on a reverse domain name and a unique encoding number.

The node name is displayed in the following format:

iqn.1992-08.com.netapp:sn.*unique-encoding-number*

The following example shows the default node name for a storage system with a unique encoding number:

iqn.1992-08.com.netapp:sn.812921059e6c11e097b3123478563412:vs.6

TCP port for iSCSI

The iSCSI protocol is configured in ONTAP to use TCP port number 3260.

ONTAP does not support changing the port number for iSCSI. Port number 3260 is registered as part of the iSCSI specification and cannot be used by any other application or service.

Related information

NetApp Documentation: ONTAP SAN Host Configuration

iSCSI service management

iSCSI service management

You can manage the availability of the iSCSI service on the iSCSI logical interfaces of the storage virtual machine (SVM) by using the `vserver iscsi interface enable` or `vserver iscsi interface disable` commands.

By default, the iSCSI service is enabled on all iSCSI logical interfaces.

How iSCSI is implemented on the host

iSCSI can be implemented on the host using hardware or software.

You can implement iSCSI in one of the following ways:

- Using Initiator software that uses the host's standard Ethernet interfaces.
- Through an iSCSI host bus adapter (HBA): An iSCSI HBA appears to the host operating system as a SCSI disk adapter with local disks.
- Using a TCP Offload Engine (TOE) adapter that offloads TCP/IP processing.

  The iSCSI protocol processing is still performed by host software.

How iSCSI authentication works

During the initial stage of an iSCSI session, the initiator sends a login request to the storage system to begin an iSCSI session. The storage system then either permits or denies the login request, or determine that a login is not required.

iSCSI authentication methods are:

- Challenge Handshake Authentication Protocol (CHAP)--The initiator logs in using a CHAP user name and password.

  You can specify a CHAP password or generate a hexadecimal secret password. There are two types of CHAP user names and passwords:

  - Inbound—The storage system authenticates the initiator.

Inbound settings are required if you are using CHAP authentication.

  - Outbound—This is an optional setting to enable the initiator to authenticate the storage system.

    You can use outbound settings only if you define an inbound user name and password on the storage system.

- deny—The initiator is denied access to the storage system.
- none—The storage system does not require authentication for the initiator.

You can define the list of initiators and their authentication methods. You can also define a default authentication method that applies to initiators that are not on this list.

Related information

Windows Multipathing Options with Data ONTAP: Fibre Channel and iSCSI

iSCSI initiator security management

ONTAP provides a number of features for managing security for iSCSI initiators. You can define a list of iSCSI initiators and the authentication method for each, display the initiators and their associated authentication methods in the authentication list, add and remove initiators from the authentication list, and define the default iSCSI initiator authentication method for initiators not in the list.

iSCSI endpoint isolation

Beginning with ONTAP 9.1 existing iSCSI security commands were enhanced to accept an IP address range, or multiple IP addresses.

All iSCSI initiators must provide origination IP addresses when establishing a session or connection with a target. This new functionality prevents an initiator from logging into the cluster if the origination IP address is unsupported or unknown, providing a unique identification scheme. Any initiator originating from an unsupported or unknown IP address will have their login rejected at the iSCSI session layer, preventing the initiator from accessing any LUN or volume within the cluster.

Implement this new functionality with two new commands to help manage pre-existing entries.

Add initiator address range

Improve iSCSI initiator security management by adding an IP address range, or multiple IP addresses with the `vserver iscsi security add-initiator-address-range` command.

```
cluster1::> vserver iscsi security add-initiator-address-range
```

Remove initiator address range

Remove an IP address range, or multiple IP addresses, with the `vserver iscsi security remove-initiator-address-range` command.

```
cluster1::> vserver iscsi security remove-initiator-address-range
```

What CHAP authentication is

The Challenge Handshake Authentication Protocol (CHAP) enables authenticated communication between iSCSI initiators and targets. When you use CHAP authentication, you define CHAP user names and passwords on both the initiator and the storage system.

During the initial stage of an iSCSI session, the initiator sends a login request to the storage system to begin the session. The login request includes the initiator's CHAP user name and CHAP algorithm. The storage system responds with a CHAP challenge. The initiator provides a CHAP response. The storage system verifies the response and authenticates the initiator. The CHAP password is used to compute the response.

Guidelines for using CHAP authentication

You should follow certain guidelines when using CHAP authentication.

- If you define an inbound user name and password on the storage system, you must use the same user name and password for outbound CHAP settings on the initiator. If you also define an outbound user name and password on the storage system to enable bidirectional authentication, you must use the same user name and password for inbound CHAP settings on the initiator.
- You cannot use the same user name and password for inbound and outbound settings on the storage system.
- CHAP user names can be 1 to 128 bytes.

  A null user name is not allowed.

- CHAP passwords (secrets) can be 1 to 512 bytes.

  Passwords can be hexadecimal values or strings. For hexadecimal values, you should enter the value with a prefix of "0x" or "0X". A null password is not allowed.

> ONTAP allows the use of special characters, non-English letters, numbers and spaces for CHAP passwords (secrets). However, this is subject to host restrictions. If any of these are not allowed by your specific host, they cannot be used.
>
> For example, the Microsoft iSCSI software initiator requires both the initiator and target CHAP passwords to be at least 12 bytes if IPsec encryption is not being used. The maximum password length is 16 bytes regardless of whether IPsec is used.
>
> For additional restrictions, you should see the initiator's documentation.

How using iSCSI interface access lists to limit initiator interfaces can increase performance and security

ISCSI interface access lists can be used to limit the number of LIFs in an SVM that an initiator can access, thereby increasing performance and security.

When an initiator begins a discovery session using an iSCSI `SendTargets` command, it receives the IP addresses associated with the LIF (network interface) that is in the access list. By default, all initiators have access to all iSCSI LIFs in the SVM. You can use the access list to restrict the number of LIFs in an SVM that an initiator has access to.

iSNS server registration requirement

What iSNS is

The Internet Storage Name Service (iSNS) is a protocol that enables automated discovery and management of iSCSI devices on a TCP/IP storage network. An iSNS server maintains information about active iSCSI devices on the network, including their IP addresses, iSCSI node names IQN's, and portal groups.

You can obtain an iSNS server from a third-party vendor. If you have an iSNS server on your network configured and enabled for use by the initiator and target, you can use the management LIF for a storage virtual machine (SVM) to register all the iSCSI LIFs for that SVM on the iSNS server. After the registration is complete, the iSCSI initiator can query the iSNS server to discover all the LIFs for that particular SVM.

If you decide to use an iSNS service, you must ensure that your storage virtual machines (SVMs) are properly registered with an Internet Storage Name Service (iSNS) server.

If you do not have an iSNS server on your network, you must manually configure each target to be visible to the host.

What an iSNS server does

An iSNS server uses the Internet Storage Name Service (iSNS) protocol to maintain information about active iSCSI devices on the network, including their IP addresses, iSCSI node names (IQNs), and portal groups.

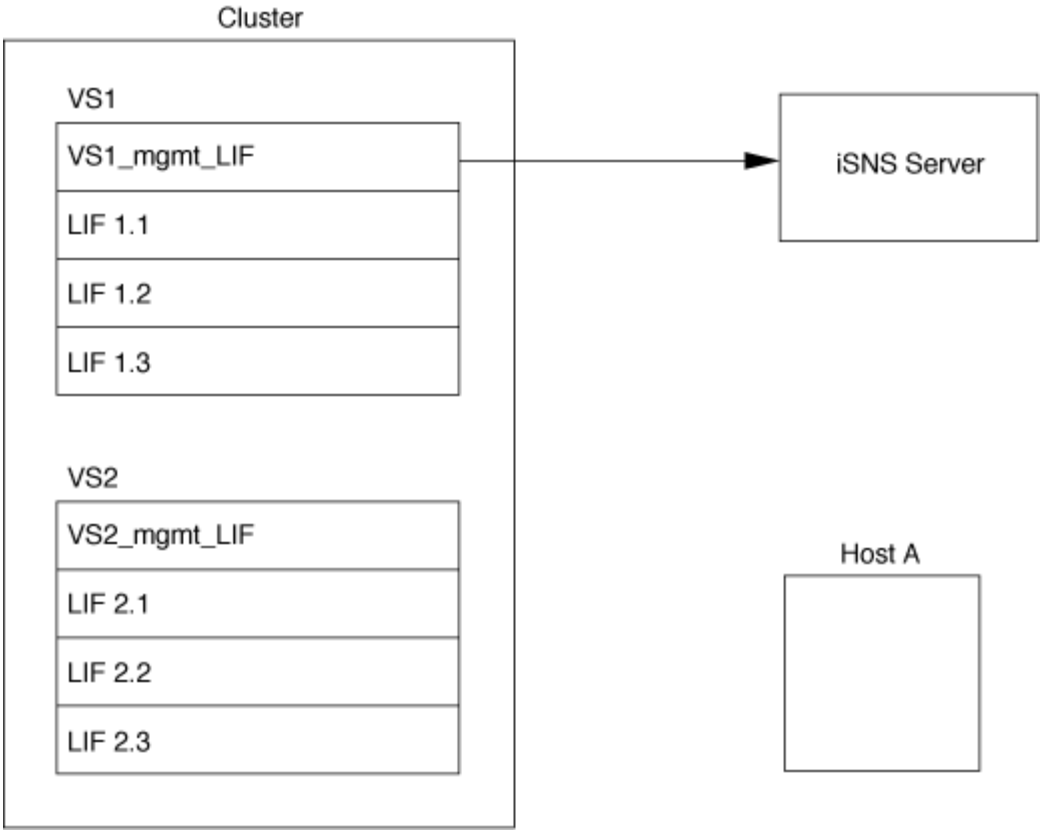
The iSNS protocol enables automated discovery and management of iSCSI devices on an IP storage network. An iSCSI initiator can query the iSNS server to discover iSCSI target devices.

NetApp does not supply or resell iSNS servers. You can obtain these servers from a vendor supported by NetApp.

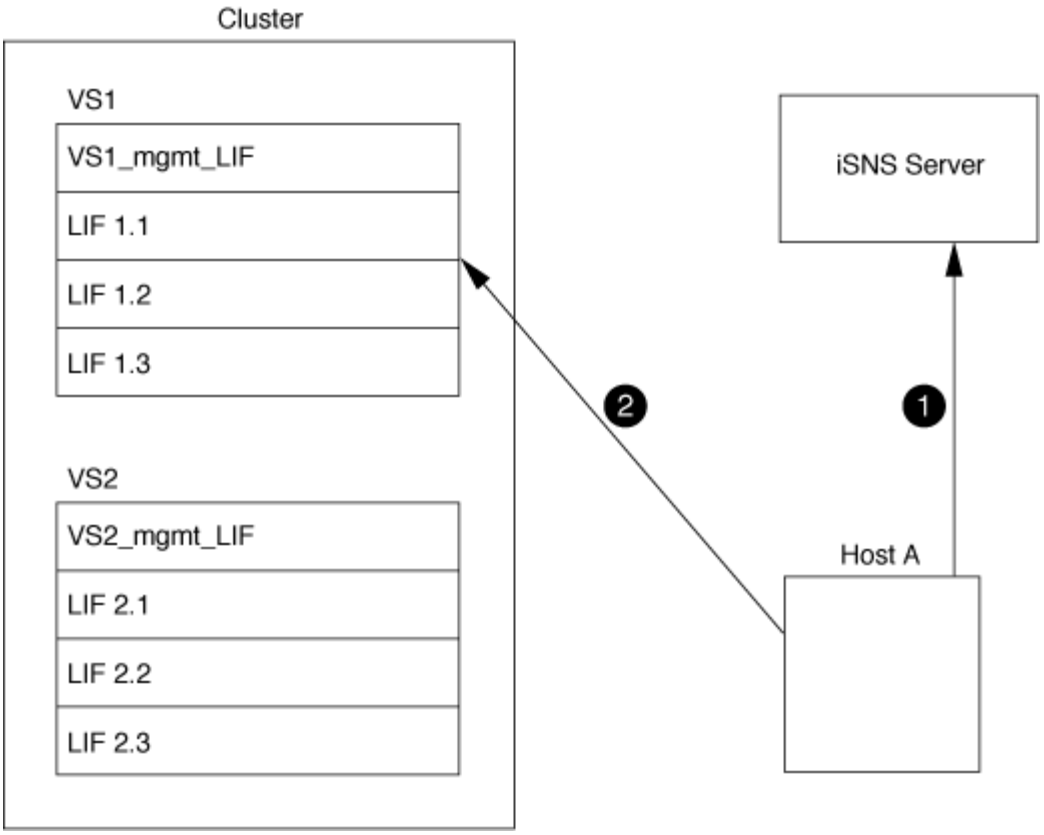
How SVMs interact with an iSNS server

The iSNS server communicates with each storage virtual machine (SVM) through the SVM management LIF. The management LIF registers all iSCSI target node name, alias, and portal information with the iSNS service for a specific SVM.

In the following example, SVM VS1 uses the SVM management LIF vs1_mgmt_lif to register with the iSNS server. During iSNS registration, an SVM sends all the iSCSI LIFs through the SVM management LIF to the iSNS Server. After the iSNS registration is complete, the iSNS server has a list of all the LIFs serving iSCSI in VS1. If a cluster contains multiple SVMs, each SVM must register individually with the iSNS server to use the iSNS service.



In the next example, after the iSNS server completes the registration with the target, Host A can discover all the LIFs for VS1 through the iSNS server as indicated in step 1. After Host A completes the discovery of the LIFs for VS1, Host A can establish a connection with any of the LIFs in VS1 as shown in step 2. Host A is not aware of any of the LIFs in VS2 until the management LIF VS2_mgmt_LIF for VS2 registers with the iSNS server.



However, if you define the interface access lists, the host can only use the defined LIFs in the interface access list to access the target.

After iSNS is initially configured, ONTAP automatically updates the iSNS server when the SVM configuration settings change.

A delay of a few minutes can occur between the time you make the configuration changes and when ONTAP sends the update to the iSNS server. Force an immediate update of the iSNS information on the iSNS server: `vserver iscsi isns update`

Commands for managing iSNS

ONTAP provides commands to manage your iSNS service.

If you want to…	Use this command…
Configure an iSNS service	`vserver iscsi isns create`
Start an iSNS service	`vserver iscsi isns start`
Modify an iSNS service	`vserver iscsi isns modify`
Display iSNS service configuration	`vserver iscsi isns show`
Force an update of registered iSNS information	`vserver iscsi isns update`

If you want to…	Use this command…
Stop an iSNS service	`vserver iscsi isns stop`
Remove an iSNS service	`vserver iscsi isns delete`
View the man page for a command	`man command name`

See the man page for each command for more information.

SAN provisioning with FC

You should be aware of the important concepts that are required to understand how ONTAP implements an FC SAN.

How FC target nodes connect to the network

Storage systems and hosts have adapters so that they can be connected to FC switches with cables.

When a node is connected to the FC SAN, each SVM registers the World Wide Port Name (WWPN) of its LIF with the switch Fabric Name Service. The WWNN of the SVM and the WWPN of each LIF is automatically assigned by ONTAP..

Direct-connection to nodes from hosts with FC is not supported, NPIV is required and this requires a switch to be used.With iSCSI sessions, communication works with connections that are either network routed or direct-connect. However, both of these methods are supported with ONTAP.

How FC nodes are identified

Each SVM configured with FC is identified by a worldwide node name (WWNN).

How WWPNs are used

WWPNs identify each LIF in an SVM configured to support FC. These LIFs utilize the physical FC ports in each node in the cluster, which can be FC target cards, UTA or UTA2 configured as FC or FCoE in the nodes.

- Creating an initiator group

  The WWPNs of the host's HBAs are used to create an initiator group (igroup). An igroup is used to control host access to specific LUNs. You can create an igroup by specifying a collection of WWPNs of initiators in an FC network. When you map a LUN on a storage system to an igroup, you can grant all the initiators in that group access to that LUN. If a host's WWPN is not in an igroup that is mapped to a LUN, that host does not have access to the LUN. This means that the LUNs do not appear as disks on that host.

  You can also create port sets to make a LUN visible only on specific target ports. A port set consists of a group of FC target ports. You can bind an igroup to a port set. Any host in the igroup can access the LUNs only by connecting to the target ports in the port set.

- Uniquely identifying FC LIFs

WWPNs uniquely identify each FC logical interface. The host operating system uses the combination of the WWNN and WWPN to identify SVMs and FC LIFs. Some operating systems require persistent binding to ensure that the LUN appears at the same target ID on the host.

How worldwide name assignments work

Worldwide names are created sequentially in ONTAP. However, because of the way ONTAP assigns them, they might appear to be assigned in a non-sequential order.

Each adapter has a pre-configured WWPN and WWNN, but ONTAP does not use these pre-configured values. Instead, ONTAP assigns its own WWPNs or WWNNs, based on the MAC addresses of the onboard Ethernet ports.

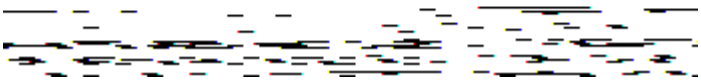
The worldwide names might appear to be non-sequential when assigned for the following reasons:

- Worldwide names are assigned across all the nodes and storage virtual machines (SVMs) in the cluster.
- Freed worldwide names are recycled and added back to the pool of available names.

How FC switches are identified

Fibre Channel switches have one worldwide node name (WWNN) for the device itself, and one worldwide port name (WWPN) for each of its ports.

For example, the following diagram shows how the WWPNs are assigned to each of the ports on a 16-port Brocade switch. For details about how the ports are numbered for a particular switch, see the vendor-supplied documentation for that switch.



Port **0**, WWPN 20:**00**:00:60:69:51:06:b4

Port **1**, WWPN 20:**01**:00:60:69:51:06:b4

Port **14**, WWPN 20:**0e**:00:60:69:51:06:b4

Port **15**, WWPN 20:**0f**:00:60:69:51:06:b4

SAN provisioning with NVMe

Beginning with ONTAP 9.4, NVMe/FC is supported in SAN environment. NVMe/FC enables storage administrators to provision namespaces and subsystems and then map the namespaces to subsystems, similar to the way LUNs are provisioned and mapped to igroups for FC and iSCSI.

An NVMe namespace is a quantity of non-volatile memory that can be formatted into logical blocks. Namespaces are the equivalent of LUNs for FC and iSCSI protocols, and an NVMe subsystem is analogous to an igroup. An NVMe subsystem can be associated with initiators so that namespaces within the subsystem

can be accessed by the associated initiators.

> Although analogous in function, NVMe namespaces do not support all features supported by LUNs.

Beginning with ONTAP 9.5 a license is required to support host-facing data access with 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
```

Related information

NetApp Technical Report 4684: Implementing and Configuring Modern SANs with NVMe/FC

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