Set up and manage LUNs for FC and iSCSI

ONTAP 9

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LUN guidelines

The FC protocol and iSCSI protocol both provision storage through the use of LUNs. After you have setup your LUNs, you can perform various management tasks, such as increasing or decreasing the size of a LUN. After configuring your volume and setting the appropriate OS type, you must complete the steps that are necessary to setup your LUN.

Guidelines for assigning LUN IDs

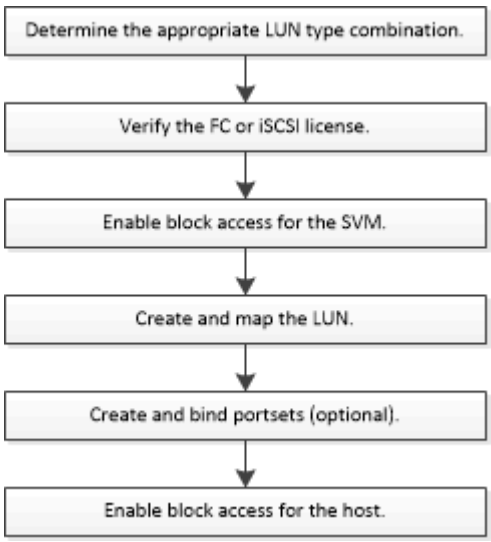
Typically, the default LUN ID begins with 0 and is assigned in increments of 1 for each additional mapped LUN. The host associates the LUN ID with the location and path name of the LUN. The range of valid LUN ID numbers depends on the host. For detailed information, see the documentation provided with your Host Utilities.

Guidelines for mapping LUNs to igroups

- You can map a LUN to only one igroup.
- You can map a LUN to only one specific initiator through the igroup.
- You can add a single initiator to multiple igroups, but the initiator can be mapped to only one LUN.
- You cannot use the same LUN ID for two LUNs mapped to the same igroup.
- You should use the same protocol type for igroups and port sets.

LUN setup workflow

To set up your LUN, you must determine the best LUN type for your needs. Then you can follow a series of tasks to verify your protocol license, enable block access, create and map your LUN, and enable block access on your host. You can also optionally create and bind portsets as part of the LUN setup workflow.



Set up LUNs

Configure switches for FCoE

You must configure your switches for FCoE before your FC service can run over the existing Ethernet infrastructure.

What you'll need

- Your SAN configuration must be supported.

  For more information about supported configurations, see the Interoperability Matrix.

- A Unified Target Adapter (UTA) must be installed on your storage system.

  If you are using a UTA2, it must be set to `cna` mode.

- A converged network adapter (CNA) must be installed on your host.

Steps

1. Use your switch documentation to configure your switches for FCoE.
2. Use the `dcb show` command to verify that the DCB settings for each node in the cluster have been correctly configured.

   ```
   run -node node1 -command dcb show
   ```

   DCB settings are configured on the switch. Consult your switch documentation if the settings are incorrect.

3. Use the `fcp adapter show` command to verify that the FCoE login is working when the FC target port online status is `true`.

   ```
   cluster1::> fcp adapter show -fields node,adapter,status,state,speed,fabric-established,physical-protocol
   ```

   If the FC target port online status is `false`, consult your switch documentation.

Related information

NetApp Interoperability Matrix Tool

NetApp Technical Report 3800: Fibre Channel over Ethernet (FCoE) End-to-End Deployment Guide

Cisco MDS 9000 NX-OS and SAN-OS Software Configuration Guides

Brocade products

Prerequisites for setting up LUNs

Setting up LUNs involves creating a LUN, creating an igroup, and mapping the LUN to the igroup. Your system must meet certain prerequisites before you can set up your LUNs.

- The Interoperability Matrix must list your SAN configuration as supported.

- Your SAN environment must meet the SAN host and controller configuration limits specified in NetApp Hardware Universe for your version of the ONTAP software.
- A supported version of Host Utilities must be installed.

  The Host Utilities documentation provides more information.

- You must have SAN LIFs on the LUN owning node and the owning node's HA partner.

Related information

NetApp Interoperability Matrix Tool

ONTAP SAN Host Configuration

NetApp Technical Report 4017: Fibre Channel SAN Best Practices

Verify the license for FC or iSCSI

Before you can enable block access for a storage virtual machine (SVM) with FC or iSCSI, you must have a license.

Steps

1. Use the `system license show` command to verify that you have a license for FC or iSCSI.

   ```
   system license show
   ```

   ```
   Package           Type    Description           Expiration
    ----------------- ------- --------------------- --------------------
    Base              site    Cluster Base License  -
    NFS               site    NFS License           -
    CIFS              site    CIFS License          -
    iSCSI             site    iSCSI License         -
    FCP               site    FCP License           -
   ```

2. If you do not have a license for FC or iSCSI, use the `license add` command.

   ```
   license add -license-code your_license_code
   ```

Configure an SVM for iSCSI

To configure a storage virtual machine (SVM) for iSCSI, you must create LIFs for the SVM and assign the iSCSI protocol to those LIFs.

About this task

You need a minimum of one iSCSI LIF per node for each SVM serving data with the iSCSI protocol. For redundancy, you should create at least two LIFs per node.

Steps

1. Enable the SVMs to listen for iSCSI traffic:

```
vserver iscsi create -vserver vserver_name -target-alias vserver_name
```

2. Create a LIF for the SVMs on each node to use for iSCSI:

```
network interface create -vserver vserver_name -lif lif_name -role data -data
-protocol iscsi -home-node node_name -home-port port_name -address ip_address
-netmask netmask
```

3. Verify that you set up your LIFs correctly:

```
network interface show -vserver vserver_name
```

4. Verify that iSCSI is up and running and the target IQN for that SVM:

```
vserver iscsi show –vserver vserver_name
```

5. From your host, create iSCSI sessions to your LIFs.

Configure an SVM for FC

To configure a storage virtual machine (SVM) for FC, you must create LIFs for the SVM and assign the FC protocol to those LIFs.

What you'll need

You must have an FC license and it must be enabled. If the FC license is not enabled, the LIFs and SVMs appear to be online but the operational status is `down`. The FC service must be enabled for your LIFs and SVMs to be operational. You must use single initiator zoning for all of the FC LIFs in the SVM to host the initiators.

About this task

NetApp supports a minimum of one FC LIF per node for each SVM serving data with the FC protocol. You must use two LIFs per node and two fabrics, with one LIF per node attached. This provides for redundancy at the node layer and the fabric.

Steps

1. Enable FC service on the SVM:

```
vserver fcp create -vserver vserver_name -status-admin up
```

2. Create two LIFs for the SVMs on each node serving FC:

```
network interface create -vserver vserver_name -lif lif_name -role data -data
-protocol fcp -home-node node_name -home-port port
```

   The `-role` parameter should be `data` and the `data-protocol` parameter should be `fcp`.

3. Verify that your LIFs have been created and that their operational status is `online`:

```
network interface show -vserver vserver_name lif_name
```

Related information

NetApp Support

NetApp Interoperability Matrix Tool

Considerations for LIFs in cluster SAN environments

Create LUNs and mapping to igroups

As part of configuring your SAN environment, you must create LUNs, create your initiator groups (igroups), and map your LUNs to your igroups.

What you'll need

- You must have created your aggregates, volumes, and storage virtual machines (SVMs).
- You must have enabled block access with FC or iSCSI.
- You must have created SAN LIFs on all of the nodes in the cluster.

About this task

When you create a LUN, you must specify the LUN OS type. The actual size of the LUN might vary slightly based on the OS type of the LUN. The LUN OS type cannot be modified after the LUN is created.

The metadata for each LUN requires approximately 64 KB of space in the containing aggregate. When you create a LUN, you must ensure that the containing aggregate has enough space for the LUN's metadata. If the aggregate does not contain enough space for the LUN's metadata, some hosts might not be able to access the LUN.

If necessary, you can grow your LUN up to 10 times its original size. For example, if you create a 100 GB LUN, you can grow that LUN to 1,000 GB. You cannot exceed 16 TB, which is the maximum LUN size.

> The actual maximum size of the LUN might not be exactly 16 TB. ONTAP rounds down the limit to be slightly less.

Asymmetric logical unit access (ALUA) is always enabled during LUN creation. You cannot change the ALUA setting.

Steps

1. Create your LUNs:

   ```
   lun create -vserver vserver_name -volume volume_name -lun lun_name -size
   lun_size -ostype lun_ostype -space-reserve enabled|disabled
   ```

   Your LUN name cannot exceed 255 characters and cannot contain spaces.

   If your host operating system is Windows 2008 or later, use the `windows_2008` ostype. The `space-reserve` option is enabled by default. If you want a non-space-reserved LUN, you must set the `space-reserve` option to `disabled`.

   > The NVFAIL option is automatically enabled when a LUN is created in a volume.

2. Create your igroups:

   ```
   igroup create -vserver vserver_name -igroup igroup_name -protocol
   fcp|iscsi|mixed -ostype lun_ostype -initiator initiator_name
   ```

If your host operating system is Windows 2008 or later, use the `windows_2008` ostype.

3. Map your LUNs to igroups:

   ```
   lun mapping create -vserver vserver_name -volume volume_name -lun lun_name
   -igroup igroup_name
   ```

4. Verify that your LUNs are configured correctly:

   ```
   lun show -vserver vserver_name
   ```

Related information

Disk and aggregate management

Logical storage management

Network management

Enable block access for a specific host

You must enable block access on your specific host so that your initiators can access your targets.

What you'll need

- You must have network connectivity between the host and the LIFs on the SVM.
- Your FC or iSCSI service must be on and operational.
- You must have LUNs that are mapped to initiator groups (igroups).

Steps

1. Follow steps in your host documentation for enabling block access on your specific hosts.
2. Use the Host Utilities to complete the FC or iSCSI mapping and to discover your LUNs on the host.

Related information

ONTAP SAN host configuration

Manage LUNs for FC and iSCSi

Increase the size of a LUN

The size to which you can increase your LUN varies depending upon your version of ONTAP.

ONTAP version	Maximum LUN size
ONTAP 9.8 and later	• 128 TB for All SAN Arrays (ASAs) • 16 TB for non-ASAs

ONTAP version	Maximum LUN size
ONTAP 9.5, 9.6, 9.7	16TB
ONTAP 9.4 or earlier	10 times the original LUN size, but not greater than 16TB For example, if you create a 100 GB LUN, you can only grow it to 1,000 GB.

You do not need to take the LUN offline to increase the size. However, after you have increased the size, you must rescan the LUN on the host for the host to recognize the change in size.

See the Command Reference page for the `lun resize` command for more information about resizing a LUN.

Solaris LUNs cannot be resized.

Steps

1. Increase the size of the LUN:

   `lun resize -vserver` *`vserver_name`* `-volume` *`volume_name`* `-lun` *`lun_name`* `-size` *`lun_size`*

2. Verify the increased LUN size:

   `lun show -vserver` *`vserver_name`*

   ONTAP operations round down the actual maximum size of the LUN so it is slightly less than the expected value. Also, actual LUN size might vary slightly based on the OS type of the LUN. To obtain the exact resized value, run the following commands in advanced mode:

   `set -unit B`

   `lun show -fields max-resize-size -volume` *`volume_name`* `-lun` *`lun_name`*

3. Rescan the LUN on the host.
4. Follow your host documentation to make the newly created LUN size visible to the host file system.

Decrease the size of a LUN

Before you decrease the size of a LUN, the host needs to migrate the blocks containing the LUN data into the boundary of the smaller LUN size. You should use a tool such as SnapDrive for Windows to ensure that the LUN is properly decreased without truncating blocks containing LUN data. Manually decreasing the size of your LUN is not recommended.

About this task

After you decrease the size of your LUN, ONTAP automatically notifies the initiator that the LUN size has decreased. However, additional steps might be required on your host for the host to recognize the new LUN size. Check your host documentation for specific information about decreasing the size of the host file structure.

Move a LUN

You can move a LUN across volumes within a storage virtual machine (SVM), but you cannot move a LUN across SVMs. LUNs moved across volumes within an SVM are moved immediately and without loss of connectivity.

What you'll need

If your LUN is using Selective LUN Map (SLM), the SLM reporting nodes must have been modified to include the destination node and its HA partner.

About this task

Storage efficiency features, such as deduplication, compression, and compaction are not preserved during a LUN move. They must be reapplied after the LUN move is completed.

Data protection through Snapshot copies occurs at the volume level. Therefore, when you move a LUN, it falls under the data protection scheme of the destination volume. If you do not have Snapshot copies established for the destination volume, Snapshot copies of the LUN are not created. Also, all of the Snapshot copies of the LUN stay in the original volume until those Snapshot copies are deleted.

You cannot move a LUN to the following volumes:

- A SnapMirror destination volume
- The SVM root volume

You cannot move the following types of LUNs:

- A LUN that has been created from a file
- A LUN that is in NVFail state
- A LUN that is in a load-sharing relationship
- A protocol-endpoint class LUN

For Solaris os_type LUNs that are 1 TB or larger, the host might experience a timeout during the LUN move. For this LUN type, you should unmount the LUN before initiating the move.

System Manager procedure

Starting with ONTAP 9.10.1, you can use System Manager to create a new volume when you move a single LUN. In ONTAP 9.9 and 9.8, the volume to which you are moving your LUN must exist before you begin the LUN move.

Steps

1. In ONTAP System Manager, click **Storage>LUNs**.
2. Right click the LUN you want to move, then click ⋮ and select **Move LUN**.

   In ONTAP 9.10.1, select to move the LUN to **An existing volume** or to a **New volume**.

   If you select to create a new volume, provide the volume specifications.

3. Click **Move**.

CLI procedure

Steps

1. Move the LUN: `lun move start`.

   During a very brief period, the LUN is visible on both the origin and destination volume. This is expected and is resolved upon completion of the move.

2. Track the status of the move and verify successful completion: `lun move show`.

Related information

- Selective LUN Map
- Modifying the SLM reporting-nodes list

Delete LUNs

You can delete a LUN from a storage virtual machine (SVM) if you no longer need the LUN.

What you'll need

The LUN must be unmapped from its igroup before you can delete it.

Steps

1. Verify that the application or host is not using the LUN.
2. Unmap the LUN from the igroup:

   ```
   lun mapping delete
   ```

   ```
   lun mapping delete -vserver vs5 -volume vo5 -lun lun5 -igroup igr5
   ```

3. Delete the LUN:

   ```
   lun delete
   ```

   ```
   lun delete -vserver vs5 -volume vol5 -lun lun5
   ```

4. Verify that you deleted the LUN:

   ```
   lun show
   ```

   ```
   lun show -vserver vs5
   ```

   ```
   Vserver   Path              State    Mapped  Type     Size
   --------- ----------------- -------- ------- -------- ------
   vs5       /vol/vol16/lun8   online   mapped  windows  10.00GB
   ```

Considerations for copying LUNs

There are considerations you should be aware of when copying a LUN.

Cluster administrators can copy a LUN across storage virtual machines (SVMs) within the cluster by using the `lun copy` command. Cluster administrators must establish the storage virtual machine (SVM) peering relationship using the `vserver peer create` command before an inter-SVM LUN copy operation is performed. There must be enough space in the source volume for a SIS clone.

LUNs in Snapshot copies can be used as source LUNs for the `lun copy` command. When you copy a LUN using the `lun copy` command, the LUN copy is immediately available for read and write access. The source LUN is unchanged by creation of a LUN copy. Both the source LUN and the LUN copy exist as unique LUNs with different LUN serial numbers. Changes made to the source LUN are not reflected in the LUN copy, and changes made to the LUN copy are not reflected in the source LUN. The LUN mapping of the source LUN is not copied to the new LUN; the LUN copy must be mapped.

Data protection through Snapshot copies occurs at the volume level. Therefore, if you copy a LUN to a volume different from the volume of the source LUN, the destination LUN falls under the data protection scheme of the destination volume. If you do not have Snapshot copies established for the destination volume, Snapshot copies are not created of the LUN copy.

Copying LUNs is a nondisruptive operation.

You cannot copy the following types of LUNs:

- A LUN that has been created from a file
- A LUN that is in NVFAIL state
- A LUN that is in a load-sharing relationship
- A protocol-endpoint class LUN

Recommended volume and file or LUN configuration combinations

Recommended volume and file or LUN configuration combinations overview

There are specific combinations of FlexVol volume and file or LUN configurations you can use, depending on your application and administration requirements. Understanding the benefits and costs of these combinations can help you determine the right volume and LUN configuration combination for your environment.

The following volume and LUN configuration combinations are recommended:

- Space-reserved files or LUNs with thick volume provisioning
- Non-space-reserved files or LUNs with thin volume provisioning
- Space-reserved files or LUNs with semi-thick volume provisioning

You can use SCSI thin provisioning on your LUNs in conjunction with any of these configuration combinations.

Space-reserved files or LUNs with thick volume provisioning

Benefits:

- All write operations within space-reserved files are guaranteed; they will not fail due to insufficient space.
- There are no restrictions on storage efficiency and data protection technologies on the volume.

Costs and limitations:

- Enough space must be set aside from the aggregate up front to support the thickly provisioned volume.
- Space equal to twice the size of the LUN is allocated from the volume at LUN creation time.

Non-space-reserved files or LUNs with thin volume provisioning

Benefits:

- There are no restrictions on storage efficiency and data protection technologies on the volume.
- Space is allocated only as it is used.

Costs and restrictions:

- Write operations are not guaranteed; they can fail if the volume runs out of free space.
- You must manage the free space in the aggregate effectively to prevent the aggregate from running out of free space.

Space-reserved files or LUNs with semi-thick volume provisioning

Benefits:

Less space is reserved up front than for thick volume provisioning, and a best-effort write guarantee is still provided.

Costs and restrictions:

- Write operations can fail with this option.

  You can mitigate this risk by properly balancing free space in the volume against data volatility.

- You cannot rely on retention of data protection objects such as Snapshot copies and FlexClone files and LUNs.
- You cannot use ONTAP block-sharing storage efficiency capabilities that cannot be automatically deleted, including deduplication, compression, and ODX/Copy Offload.

Determine the correct volume and LUN configuration combination for your environment

Answering a few basic questions about your environment can help you determine the best FlexVol volume and LUN configuration for your environment.

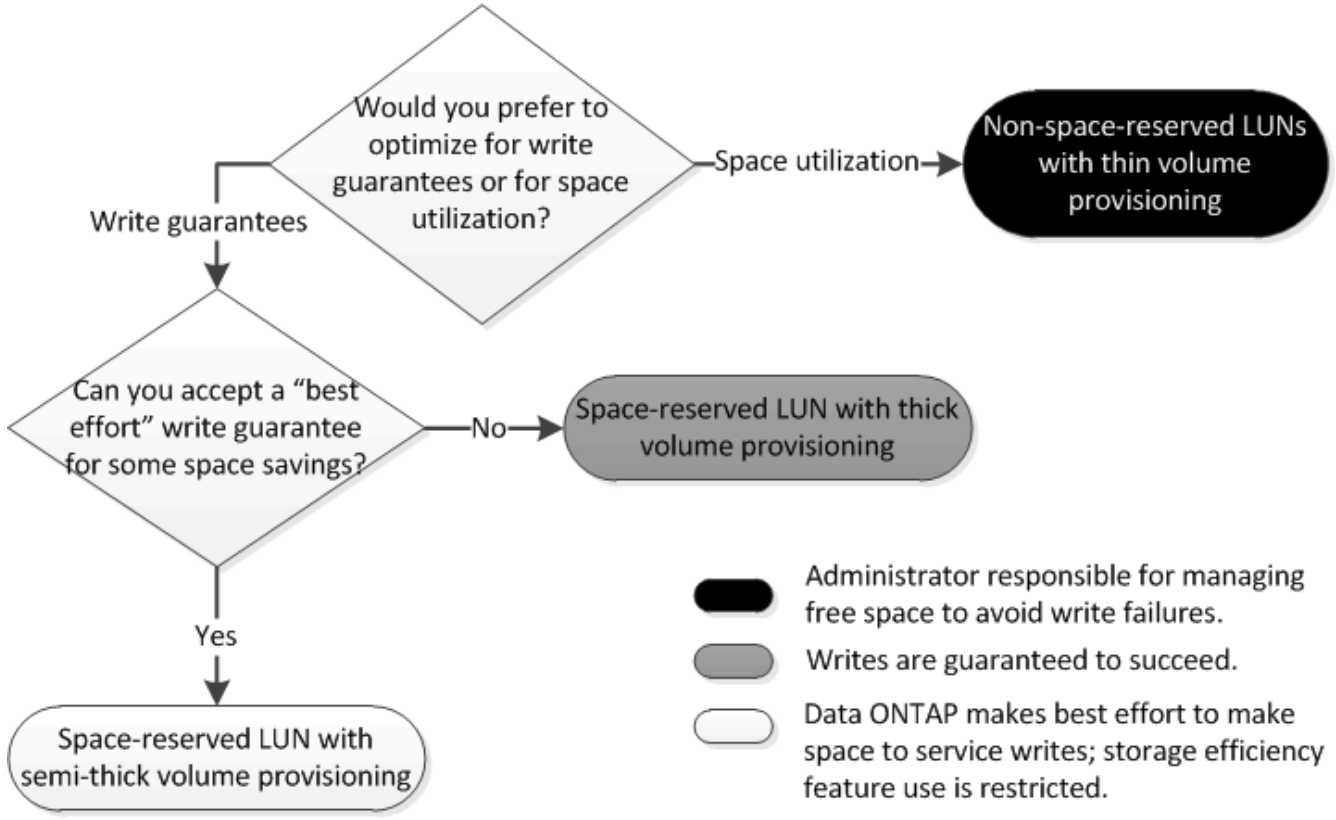
About this task

You can optimize your LUN and volume configurations for maximum storage utilization or for the security of write guarantees. Based on your requirements for storage utilization and your ability to monitor and replenish free space quickly, you must determine the FlexVol volume and LUN volumes appropriate for your installation.

You do not need a separate volume for each LUN.

Step

1. Use the following decision tree to determine the best volume and LUN configuration combination for your environment:



Calculate rate of data growth for LUNs

You need to know the rate at which your LUN data is growing over time to determine whether you should use space-reserved LUNs or non-space-reserved LUNs.

About this task

If you have a consistently high rate of data growth, then space-reserved LUNs might be a better option for you. If you have a low rate of data growth, then you should consider non-space-reserved LUNs.

You can use tools such as OnCommand Insight to calculate your rate of data growth or you can calculate it manually. The following steps are for manual calculation.

Steps

1. Set up a space-reserved LUN.
2. Monitor the data on the LUN for a set period of time, such as one week.

   Make sure that your monitoring period is long enough to form a representative sample of regularly occurring increases in data growth. For instance, you might consistently have a large amount of data growth at the end of each month.

3. Each day, record in GB how much your data grows.
4. At the end of your monitoring period, add the totals for each day together, and then divide by the number of days in your monitoring period.

   This calculation yields your average rate of growth.

Example

In this example, you need a 200 GB LUN. You decide to monitor the LUN for a week and record the following daily data changes:

- Sunday: 20 GB
- Monday: 18 GB
- Tuesday: 17 GB
- Wednesday: 20 GB
- Thursday: 20 GB
- Friday: 23 GB
- Saturday: 22 GB

In this example, your rate of growth is (20+18+17+20+20+23+22) / 7 = 20 GB per day.

Configuration settings for space-reserved files or LUNs with thick-provisioned volumes

This FlexVol volume and file or LUN configuration combination provides the ability to use storage efficiency technologies and does not require you to actively monitor your free space, because sufficient space is allocated up front.

The following settings are required to configure a space-reserved file or LUN in a volume using thick provisioning:

Volume setting	Value
Guarantee	Volume
Fractional reserve	100
Snapshot reserve	Any
Snapshot autodelete	Optional
Autogrow	Optional; if enabled, aggregate free space must be actively monitored.

File or LUN setting	Value
Space reservation	Enabled

Configuration settings for non-space-reserved files or LUNs with thin-provisioned volumes

This FlexVol volume and file or LUN configuration combination requires the smallest amount of storage to be allocated up front, but requires active free space management to prevent errors due to lack of space.

The following settings are required to configure a non-space-reserved files or LUN in a thin-provisioned

volume:

Volume setting	Value
Guarantee	None
Fractional reserve	0
Snapshot reserve	Any
Snapshot autodelete	Optional
Autogrow	Optional

File or LUN setting	Value
Space reservation	Disabled

Additional considerations

When the volume or aggregate runs out of space, write operations to the file or LUN can fail.

If you do not want to actively monitor free space for both the volume and the aggregate, you should enable Autogrow for the volume and set the maximum size for the volume to the size of the aggregate. In this configuration, you must monitor aggregate free space actively, but you do not need to monitor the free space in the volume.

Configuration settings for space-reserved files or LUNs with semi-thick volume provisioning

This FlexVol volume and file or LUN configuration combination requires less storage to be allocated up front than the fully provisioned combination, but places restrictions on the efficiency technologies you can use for the volume. Overwrites are fulfilled on a best-effort basis for this configuration combination.

The following settings are required to configure a space-reserved LUN in a volume using semi-thick provisioning:

Volume setting	Value
Guarantee	Volume
Fractional reserve	0
Snapshot reserve	0

Volume setting	Value
Snapshot autodelete	On, with a commitment level of destroy, a destroy list that includes all objects, the trigger set to volume, and all FlexClone LUNs and FlexClone files enabled for automatic deletion.
Autogrow	Optional; if enabled, aggregate free space must be actively monitored.

File or LUN setting	Value
Space reservation	Enabled

Technology restrictions

You cannot use the following volume storage efficiency technologies for this configuration combination:

- Compression
- Deduplication
- ODX and FlexClone Copy Offload
- FlexClone LUNs and FlexClone files not marked for automatic deletion (active clones)
- FlexClone subfiles
- ODX/Copy Offload

Additional considerations

The following facts must be considered when employing this configuration combination:

- When the volume that supports that LUN runs low on space, protection data (FlexClone LUNs and files, Snapshot copies) is destroyed.
- Write operations can time out and fail when the volume runs out of free space.

Compression is enabled by default for AFF platforms. You must explicitly disable compression for any volume for which you want to use semi-thick provisioning on an AFF platform.

Selective LUN Map

Selective LUN Map overview

Selective LUN Map (SLM) reduces the number of paths from the host to the LUN. With SLM, when a new LUN map is created, the LUN is accessible only through paths on the node owning the LUN and its HA partner.

SLM enables management of a single igroup per host and also supports nondisruptive LUN move operations that do not require portset manipulation or LUN remapping.

Portsets can be used with SLM just as in previous versions of ONTAP to further restrict access of certain targets to certain initiators. When using SLM with portsets, LUNs will be accessible on the set of LIFs in the

portset on the node that owns the LUN and on that node's HA partner.

SLM is enabled by default on all new LUN maps.

Determine whether SLM is enabled on a LUN map

If your environment has a combination of LUNs created in ONTAP and LUNs transitioned from previous versions, you might need to determine whether Selective LUN Map (SLM) is enabled on a specific LUN.

You can use the information displayed in the output of the `lun mapping show -fields reporting-nodes, node` command to determine whether SLM is enabled on your LUN map. If SLM is not enabled, "-" is displayed in the cells under the `reporting-nodes` column of the command output. If SLM is enabled, the list of nodes displayed under the `nodes` column is duplicated in the `reporting-nodes` column.

Create port sets and binding igroups to port sets

In addition to using Selective LUN Map (SLM), you can create a port set and bind the port set to an igroup to further limit which LIFs can be used by an initiator to access a LUN. If you do not bind a port set to an igroup, then all of the initiators in the igroup can access mapped LUNs through all of the LIFs on the node owning the LUN and the owning node's HA partner.

What you'll need

You must have at least one LIF and one igroup.

Unless you are using interface groups, two LIFs are recommended for redundancy for both iSCSI and FC. Only one LIF is recommended for interface groups.

About this task

It is advantageous to use ports sets with SLM when you have more than two LIFs on a node and you want to restrict a certain initiator to a subset of LIFs. Without port sets, all targets on the node will be accessible by all of the initiators with access to the LUN through the node owning the LUN and the owning node's HA partner.

Steps

1. Create a port set containing the appropriate LIFs:

   `portset create -vserver` *`vserver_name`* `-portset` *`portset_name`* `-protocol` *`protocol`* `-port-name` *`port_name`*

   If you are using FC, specify the `protocol` parameter as `fcp`. If you are using iSCSI, specify the `protocol` parameter as `iscsi`.

2. Bind the igroup to the port set:

   `lun igroup bind -vserver` *`vserver_name`* `-igroup` *`igroup_name`* `-portset` *`portset_name`*

3. Verify that your port sets and LIFs are correct:

   `portset show -vserver` *`vserver_name`*

```
Vserver   Portset   Protocol Port Names    Igroups
--------- --------- -------- ------------ --------
vs3       portset0  iscsi    lif0,lif1     igroup1
```

Modify the SLM reporting-nodes list

If you are moving a LUN or a volume containing LUNs to another high availability (HA) pair within the same cluster, you should modify the Selective LUN Map (SLM) reporting-nodes list before initiating the move to ensure that active, optimized LUN paths are maintained.

Steps

1. Add the destination node and its partner node to the reporting-nodes list of the aggregate or volume:

   `lun mapping add-reporting-nodes -vserver` *`vserver_name`* `-path` *`lun_path`* `-igroup` *`igroup_name`* `[-destination-aggregate` *`aggregate_name`*`|-destination-volume` *`volume_name`*`]`

   If you have a consistent naming convention, you can modify multiple LUN mappings at the same time by using **`-igroup`** instead of `igroup`.

2. Rescan the host to discover the newly added paths.
3. If your OS requires it, add the new paths to your multipath network I/O (MPIO) configuration.
4. Run the command for the needed move operation and wait for the operation to finish.
5. Verify that I/O is being serviced through the Active/Optimized path:

   `lun mapping show -fields reporting-nodes`

6. Remove the previous LUN owner and its partner node from the reporting-nodes list:

   `lun mapping remove-reporting-nodes -vserver` *`vserver_name`* `-path` *`lun_path`* `-igroup` *`igroup_name`* `-remote-nodes`

7. Verify that the LUN has been removed from the existing LUN map:

   `lun mapping show -fields reporting-nodes`

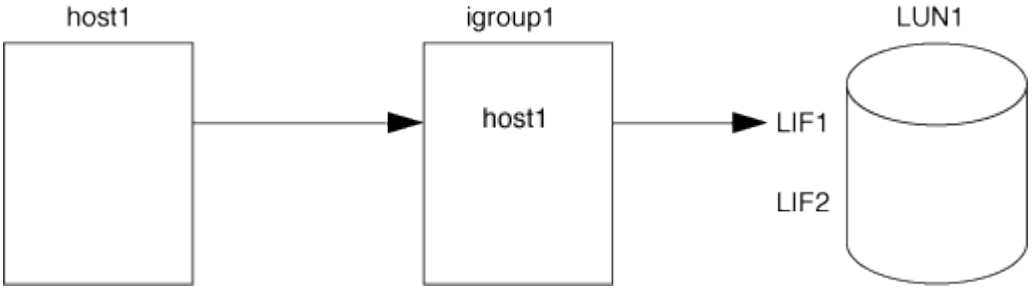
8. Remove any stale device entries for the host OS.
9. Change any multipathing configuration files if required.
10. Rescan the host to verify removal of old paths.
    See your host documentation for specific steps to rescan your hosts.

Ways to limit LUN access with port sets and igroups

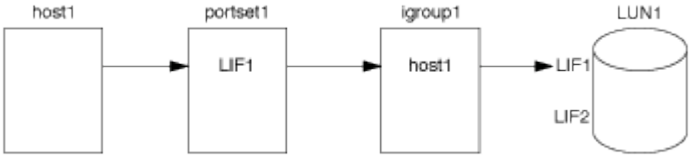
In addition to using Selective LUN Map (SLM), you can limit access to your LUNs through igroups and port sets.

Port sets can be used with SLM to further restrict access of certain targets to certain initiators. When using SLM with port sets, LUNs will be accessible on the set of LIFs in the port set on the node that owns the LUN and on that node's HA partner.

In the following example, initiator1 does not have a port set. Without a port set, initiator1 can access LUN1 through both LIF1 and LIF2.



You can limit access to LUN1 by using a port set. In the following example, initiator1 can access LUN1 only through LIF1. However, initiator1 cannot access LUN1 through LIF2 because LIF2 is not in port set1.



Related information

- Selective LUN Map
- Create port sets and binding igroups to port sets

Considerations for transitioning SAN configurations

In a SAN environment, a disruption in service is required during the transition of a 7-Mode volume to ONTAP. You need to shut down your hosts to complete the transition. After transition, you must update your host configurations before you can begin serving data in ONTAP

You need to schedule a maintenance window during which you can shut down your hosts and complete the transition.

Related information

Copy-based transition

Capabilities and restrictions of transitioned LUNs

LUNs that have been transitioned from Data ONTAP operating in 7-Mode to ONTAP have certain capabilities and restrictions that affect the way the LUNs can be managed.

You can do the following with transitioned LUNs:

- View the LUN using the `lun show` command

- View the inventory of LUNs transitioned from the 7-Mode volume using the `transition 7-mode show` command
- Restore a volume from a 7-Mode Snapshot copy

  Restoring the volume transitions all of the LUNs captured in the Snapshot copy

- Restore a single LUN from a 7-Mode Snapshot copy using the `snapshot restore-file` command
- Create a clone of a LUN in a 7-Mode Snapshot copy
- Restore a range of blocks from a LUN captured in a 7-Mode Snapshot copy
- Create a FlexClone of the volume using a 7-Mode Snapshot copy

You cannot do the following with transitioned LUNs:

- Access Snapshot copy-backed LUN clones captured in the volume

Examine configured and used space of a LUN

Knowing the configured space and actual space used for your LUNs can help you determine the amount of space that can be reclaimed when doing space reclamation, the amount of reserved space that contains data, and the total configured size versus the actual size used for a LUN.

Step

1. View the configured space versus the actual space used for a LUN:

   ```
   lun show
   ```

   The following example show the configured space versus the actual space used by the LUNs in the vs3 storage virtual machine (SVM):

   ```
   lun show -vserver vs3 -fields path, size, size-used, space-reserve
   ```

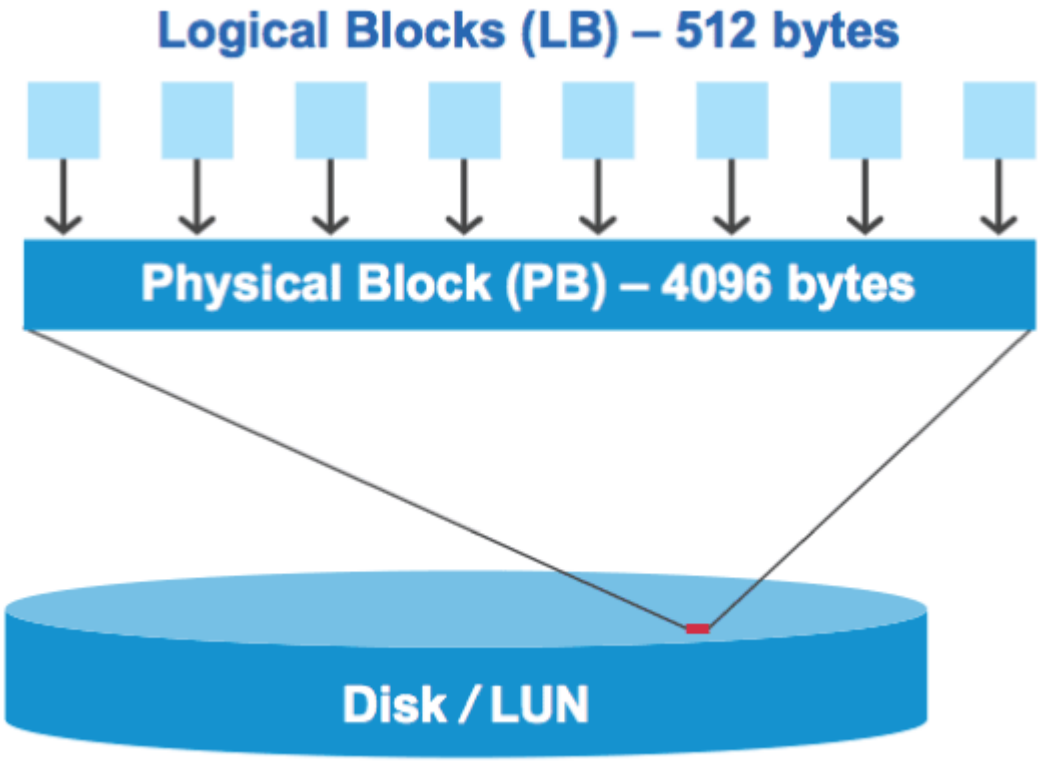
   ```
   vserver path                    size    space-reserve size-used
   ------- ------------------      ------- ------------- ---------
   vs3     /vol/vol0/lun1          50.01GB disabled      25.00GB
   vs3     /vol/vol0/lun1_backup   50.01GB disabled      32.15GB
   vs3     /vol/vol0/lun2          75.00GB disabled      0B
   vs3     /vol/volspace/lun0      5.00GB  enabled       4.50GB
   4 entries were displayed.
   ```

I/O misalignments might occur on properly aligned LUNs

I/O misalignments might occur on properly aligned LUNs overview

ONTAP might report I/O misalignments on properly aligned LUNs. In general, these misalignment warnings can be disregarded as long as you are confident that your LUN is properly provisioned and your partitioning table is correct.

LUNs and hard disks both provide storage as blocks. Because the block size for disks on the host is 512 bytes, LUNs present blocks of that size to the host while actually using larger, 4-KB blocks to store data. The 512-byte data block used by the host is referred to as a logical block. The 4-KB data block used by the LUN to store data is referred to as a physical block. This means that there are eight 512-byte logical blocks in each 4-KB physical block.



The host operating system can begin a read or write I/O operation at any logical block. I/O operations are only considered aligned when they begin at the first logical block in the physical block. If an I/O operation begins at a logical block that is not also the start of a physical block, the I/O is considered misaligned. ONTAP automatically detects the misalignment and reports it on the LUN. However, the presence of misaligned I/O does not necessarily mean that the LUN is also misaligned. It is possible for misaligned I/O to be reported on properly aligned LUNs.

If further investigation is required, technical support can run diagnostic commands that show detailed I/O alignment data to confirm the presence or absence of true LUN misalignment.

For more information about tools for correcting alignment problems, see the following documentation:

- Windows Unified Host Utilities 7.1
- Virtual Storage Console for VMware vSphere Installation and Administration Guide

Related information

Guest VM file system partition/disk alignment for VMware vSphere, other virtual environments, and NetApp storage systems

Achieve I/O alignment using LUN OS types

To achieve I/O alignment with your OS partitioning scheme, you should use the

recommended ONTAP LUN `ostype` value that most closely matches your operating system.

The partition scheme employed by the host operating system is a major contributing factor to I/O misalignments. Some ONTAP LUN `ostype` values use a special offset known as a “prefix” to enable the default partitioning scheme used by the host operating system to be aligned.

> In some circumstances, a custom partitioning table might be required to achieve I/O alignment. However, for `ostype` values with a “prefix” value greater than `0`, a custom partition might create misaligned I/O.

The LUN `ostype` values in the following table should be used based on your operating system.

LUN `ostype`	**Prefix (bytes)**	**Prefix (sectors)**	**Operating system**
`windows`	32,256	63	Windows 2000, 2003 (MBR format)
`windows_gpt`	17,408	34	Windows 2003 (GPT format)
`windows_2008`	0	0	Windows 2008 and later
`linux`	0	0	All Linux distributions
`xen`	0	0	Citrix XenServer
`vmware`	0	0	VMware ESX
`solaris`	1MB	2,048	Solaris
`solaris_efi`	17,408	34	Solaris
`hpux`	0	0	HP-UX
`aix`	0	0	AIX

Special I/O alignment considerations for Linux

Linux distributions offer a wide variety of ways to use a LUN including as raw devices for databases, various volume managers, and file systems. It is not necessary to create partitions on a LUN when used as a raw device or as physical volume in a logical volume.

For RHEL 5 and earlier and SLES 10 and earlier, if the LUN will be used without a volume manager, you should partition the LUN to have one partition that begins at an aligned offset, which is a sector that is an even multiple of eight logical blocks.

Special I/O alignment considerations for Solaris LUNs

You need to consider various factors when determining whether you should use the `solaris` ostype or the `solaris_efi` ostype.

See the *Solaris Host Utilities Installation and Administration Guide* for detailed information.

Related information

NetApp Documentation: Host Utilities (current releases)

ESX boot LUNs report as misaligned

LUNs used as ESX boot LUNs are typically reported by ONTAP as misaligned. ESX creates multiple partitions on the boot LUN, making it very difficult to align. Misaligned ESX boot LUNs are not typically a performance problem because the total amount of misaligned I/O is small. Assuming that the LUN was correctly provisioned with the VMware `ostype`, no action is needed.

Control and monitor I/O performance to LUNs by using Storage QoS

You can control input/output (I/O) performance to LUNs by assigning LUNs to Storage QoS policy groups. You might control I/O performance to ensure that workloads achieve specific performance objectives or to throttle a workload that negatively impacts other workloads.

About this task

Policy groups enforce a maximum throughput limit (for example, 100 MB/s). You can create a policy group without specifying a maximum throughput, which enables you to monitor performance before you control the workload.

You can also assign storage virtual machines (SVMs) with FlexVol volumes and LUNs to policy groups.

Note the following requirements about assigning a LUN to a policy group:

- The LUN must be contained by the SVM to which the policy group belongs.

  You specify the SVM when you create the policy group.

- If you assign a LUN to a policy group, then you cannot assign the LUN's containing volume or SVM to a policy group.

For more information about how to use Storage QoS, see the System administration reference.

Steps

1. Use the `qos policy-group create` command to create a policy group.
2. Use the `lun create` command or the `lun modify` command with the `-qos-policy-group` parameter to assign a LUN to a policy group.
3. Use the `qos statistics` commands to view performance data.
4. If necessary, use the `qos policy-group modify` command to adjust the policy group's maximum

throughput limit.

Tools available to effectively monitor your LUNs

Tools are available to help you effectively monitor your LUNs and avoid running out of space.

- Active IQ Unified Manager is a free tool that enables you to manage all storage across all clusters in your environment.
- System Manager is a graphical user interface built into ONTAP that enables you to manually manage storage needs at the cluster level.
- OnCommand Insight presents a single view of your storage infrastructure and enables you to set up automatic monitoring, alerts, and reporting when your LUNs, volumes, and aggregates are running out of storage space.

Ways to address issues when LUNs go offline

When no space is available for writes, LUNs go offline to preserve data integrity. LUNs can run out of space and go offline for various reasons, and there are several ways you can address the issue.

If the…	You can…
Aggregate is full	• Add more disks. • Use the `volume modify` command to shrink a volume that has available space. • If you have space-guarantee volumes that have available space, change the volume space guarantee to `none` with the `volume modify` command.
Volume is full but there is space available in the containing aggregate	• For space guarantee volumes, use the `volume modify` command to increase the size of your volume. • For thinly provisioned volumes, use the `volume modify` command to increase the maximum size of your volume. If volume autogrow is not enabled, use `volume modify -autogrow-mode` to enable it. • Delete Snapshot copies manually with the `volume snapshot delete` command, or use the `volume snapshot autodelete modify` command to automatically delete Snapshot copies.

Related information

Disk and aggregate management

Logical storage management