



Planning for ONTAP use of array LUNs

ONTAP FlexArray

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Planning for ONTAP use of array LUNs

For ONTAP to use array LUNs, a storage array administrator must first create LUNs on the storage array and make them available to ONTAP. Then the ONTAP administrator must configure ONTAP to use the array LUNs that the storage array made available.

Planning how to provision array LUNs for ONTAP use includes the following considerations:

- The types of array LUNs that ONTAP supports
- ONTAP minimum and maximum array LUN sizes
- The number of array LUNs you need



ONTAP considers an array LUN to be a virtual disk.

How array LUNs are made available for host use

A storage array administrator must create array LUNs and make them available to specified FC initiator ports of ONTAP systems.

The process to make LUNs available to hosts and the terminology to describe it varies among storage array vendors. The basic process that the storage array administrator follows to make LUNs available for host use is as follows:

1. Creates logical devices (LDEVs).



LDEV is a term used by some vendors and this guide to describe a piece of logical RAID storage configured from disks.

2. Creates a host group (or vendor equivalent).

The host group includes the WWPNs of the initiator ports of the hosts that are allowed to see the LDEV.



To simplify management, most storage arrays enable you to define one or more host groups. You can define specific WWPNs (ports) and WWNs (hosts) to be members of the same group. You then associate specific array LUNs with a host group. Hosts in the host group can access the LUNs associated with the host group; hosts that are not in that host group cannot access those LUNs. Different vendors use different terms to describe this concept. The process of creating a host group differs among vendors.

3. Maps the LDEVs to host groups as LUNs.

How array LUNs become available for ONTAP storage use

An ONTAP system cannot use an array LUN presented to it until ONTAP has been configured to use the array LUN.

Although the storage array administrator makes an array LUN accessible to ONTAP, ONTAP cannot use the array LUN for storage until both of the following tasks are completed:

1. One ONTAP system (licensed to use array LUNs) must be assigned to be the *owner* of the array LUN.
2. The array LUN must be added to an aggregate.

When you assign an array LUN to an ONTAP system, ONTAP writes data to the array LUN to identify the assigned system as the owner of the array LUN. This logical relationship is referred to as *disk ownership*.

When you assign an array LUN to an ONTAP system, it becomes a spare LUN owned by that system and it is no longer available to any other ONTAP system.

A spare array LUN cannot be used for storage until you add it to an aggregate. Thereafter, ONTAP ensures that only the owner of the array LUN can write data to and read data from the LUN.

In an HA pair, both nodes must be able to see the same storage, but only one node in the pair is the owner of the array LUN. The partner node takes over read/write access to an array LUN in case of a failure of the owning node. The original owning node resumes ownership after the problem that caused unavailability of the node is fixed.

Considerations when planning for disk ownership

If you are deploying multiple ONTAP systems for use with array LUNs, you must determine which system *owns* which array LUNs. Disk ownership ensures that only the ONTAP system that owns a particular array LUN can read data from and write data to the array LUN.

You should consider the following when planning which system will own which array LUNs:

- The maximum assigned device limit supported by your platform

The *Hardware Universe* shows the maximum assigned device limit that is supported for different platforms. This is a hard-coded limit. If your system uses both array LUNs and disks, this maximum limit is the maximum of disks and array LUNs combined. You must account for both types of storage when determining how many array LUNs and disks you can assign to a system.

- The amount of load that you expect to be generated by different applications used in your environment

Some types of applications are likely to generate a lot of requests, whereas other applications (for example, archival applications) generate fewer requests. You might want to consider weighing ownership assignments based on expected load from specific applications.

Related information

[NetApp Hardware Universe](#)

Array LUN assignment changes

You can change assignment of a *spare* array LUN from one ONTAP system to another. You might want to change ownership for load balancing over nodes.

Array LUN type supported by ONTAP

You can map only storage array LUNs to ONTAP. You can map LUN 0 to ONTAP if it is a

storage type LUN.

Some storage arrays have a nonstorage *command* LUN. You cannot map a command type LUN to an ONTAP system.

Related information

[FlexArray virtualization implementation for third-party storage](#)

Factors that impact the number and size of array LUNs you need

You must consider a number of factors, including usable space in a LUN, when determining how many array LUNs you need and their size.

Factors impacting the required number of array LUNs

While planning for ONTAP use of array LUNs, you must consider factors such as array LUN size, ONTAP overhead, and checksum type that impact the number of array LUNs required in your ONTAP environment.

You should consider the following when determining the required number of array LUNs:

- The smaller the array LUNs, the more LUNs you require for the storage.

Ideally, creating one large array LUN from a given storage array RAID group is recommended.

- Device limits define the maximum number of disks and array LUNs that can be assigned to an ONTAP system.

The *Hardware Universe* contains information about device limits.

- The more usable space in an array LUN, the fewer array LUNs are required.

The amount of usable space in an array LUN is determined by the space that ONTAP requires, checksum type, and additional factors such as space required for optional Snapshot reserves.

- Different applications generate different loads.

When determining the assignment of array LUNs to ONTAP systems, you must consider what the storage will be used for and the number of requests that are likely to be generated by different applications.

Minimum number of array LUNs required per ONTAP system

The number of array LUNs that you need per ONTAP system depends on the location of the root volume.

The root volume can be either on a disk or on array LUNs. The location of the root volume then determines the minimum number of array LUNs you need. If the root volume is on a storage array, each stand-alone ONTAP system and each node in an HA pair must own at least one array LUN. If the root volume is on a native disk, the only array LUNs needed are those for data storage.

For a MetroCluster configuration that is using array LUNs, two array LUNs are required (one LUN from each site) if the root volume is on a storage array. The two LUNs are necessary so that the root volume can be mirrored.

Spare array LUN requirement for core dumps

For both stand-alone ONTAP systems and nodes in HA pairs, you must create a spare array LUN of adequate size to hold core dumps if no spare disk is available.

On a system that uses both disks and array LUNs, a spare array LUN is not required for a core dump if a spare disk is available. If neither a spare array LUN nor a spare disk is available, there is no place for the core to be dumped.

A core dump contains the contents of memory and NVRAM. During a system panic, ONTAP dumps core to a spare array LUN or spare disk, if a spare exists. Upon reboot, the core is read from the spare and saved to a core dump on the root filesystem. Technical support can then use the core dump to help troubleshoot the problem.

The *Hardware Universe* contains the minimum spare core array LUN size for each platform.

Related information

[NetApp Hardware Universe](#)

Minimum and maximum array LUN sizes supported for ONTAP configurations

The array LUNs presented from the storage arrays must fall within the minimum and maximum size requirements for an ONTAP configuration with array LUNs. ONTAP issues an error message identifying an array LUN that does not adhere to the minimum or maximum size requirements.

The minimum and maximum array LUN sizes are calculated according to the way that ONTAP defines units of measure. The ONTAP definition of a GB and TB is as follows:

One...	Equals...
GB	1000 x 1024 x 1024 bytes (1000 MB)
TB	1000 x 1000 x 1024 x 1024 bytes (1000 GB)

Different storage array vendors use different formulas for calculating units of measurement. You must use your vendor's units of measure to calculate the array LUN sizes equivalent to the minimum and maximum sizes supported with an ONTAP configuration.

The maximum LUN size that ONTAP supports differs with ONTAP releases. For information about the minimum and maximum array LUN sizes, see the *Hardware Universe*.



The minimum array LUN size for a data (storage) LUN is different from the minimum array LUN size for the root volume.

Related information

Array LUN size required for the root volume

You must set the size of the root volume to be greater than the supported minimum array LUN size, to ensure that there is sufficient space in the root volume for system files, log files, and core files. You must provide these files to technical support if a system issue occurs.

The *Hardware Universe* lists the minimum array LUN size for a root volume.

Related information

[NetApp Hardware Universe](#)

Elements that reduce the usable space in an array LUN

Several factors impact the usable space in an array LUN. When planning for the required number and size of the array LUNs, you must consider the usable space in the array LUN according to the checksum type you are using, and the elements you might configure.

When calculating the usable space in an array LUN, you must consider the following factors that reduce the usable space of the LUN:

- Space reserved for use by ONTAP
- Space for core dump
- Volume-level Snapshot reserve
- Aggregate-level Snapshot copy
- Checksum type (you assign one type):
 - Block checksum (BCS)
 - Advanced Zoned checksum (AZCS)

Considering checksum type when planning array LUN size and number

When planning the number and size of array LUNs that you need for ONTAP, you must consider the impact of the checksum type on the amount of usable space in the array LUN. A checksum type must be specified for each array LUN assigned to an ONTAP system.

When an array LUN on the storage array is mapped to be used by an ONTAP system, ONTAP treats the array LUN as a raw, unformatted disk. When you assign an array LUN to an ONTAP system you specify the checksum type, which tells ONTAP how to format the raw array LUN. The impact of the checksum type on usable space depends on the checksum type you specify for the LUN.

Characteristics of checksum types that ONTAP supports

ONTAP supports block checksum type (BCS) and advanced zoned checksum type (AZCS) for array LUNs, disks, and aggregates.

The type of checksum assigned to an array LUN in ONTAP can impact performance or the usable space of an array LUN. Therefore, the number and size of array LUNs you need can be impacted depending on the checksum type you assign to array LUNs.

Block checksum (BCS)

BCS is the default and recommended checksum type for array LUNs. BCS provides better performance for array LUNs than AZCS.

BCS has a greater impact on the usable space in an array LUN than AZCS. BCS uses 12.5 percent of the usable space in an array LUN.

Advanced zoned checksum (AZCS)

AZCS is an alternative to BCS. The impact of AZCS on usable space in an array LUN is less than with BCS; AZCS uses 1.56 percent of the device capacity. However, you must weigh the need for more usable space against performance. AZCS can sometimes cause performance problems for array LUNs.

AZCS is not recommended for array LUNs for high-performance random workloads. However, you can use AZCS with array LUNs for DR, archive, or similar workloads.

There is no AZCS performance impact on native disks.

The guidelines for checksum types differ according to disk size and type. See *TR3838 Storage Subsystem Configuration Guide* for more information.

Related information

[NetApp Technical Report 3838: Storage Subsystem Configuration Guide](#)

Formulas for calculating array LUN size based on checksum type

A number of elements, including checksum type, impact the usable capacity of an array LUN. You can use a formula to calculate how much usable capacity there would be in a given size array LUN, or to calculate how large an array LUN has to be to provide the amount of storage that you want.

A number of elements, including checksum type, impact the size of the array LUN you require for the amount of *usable capacity*. Usable capacity is the amount of space that is available for storage.

The following table shows the ways of calculating the array LUN size you require:

If you know...	You want to find out...
How large your array LUNs are	How much capacity is available for storage (usable capacity). You have to consider the amount of space required for all elements.
How much storage that you want in the array LUN	How large an array LUN you require. You have to take into account your required amount of storage and space required for other elements.



2 TB in these formulas represents 2 TiB, or 2199023255552 bytes, which is 2097.152 GnaB or 2.097 TnaB according to the way that ONTAP calculates measurements.

Formula for calculating the usable capacity

When you know how large your array LUNs are, you can use the following formula to determine the usable capacity for storage in an array LUN. This formula takes into account the Snapshot reserve.

- Y is the usable capacity for storage.
- N is the total capacity of the array LUN.

Checksum type	Formula
BCS—array LUNs less than 2 TB	$N \times \{0.875 \times 0.9 \times 0.99 \times (1 - \text{Snapshot reserve})\} = Y$
BCS—array LUNs greater than 2 TB	$N \times \{0.875 \times 0.9 \times 0.998 \times (1 - \text{Snapshot reserve})\} = Y$
AZCS—array LUNs less than 2 TB	$N \times \{0.984 \times 0.9 \times 0.99 \times (1 - \text{Snapshot reserve})\} = Y$
AZCS—array LUNs greater than 2 TB	$N \times \{0.984 \times 0.9 \times 0.998 \times (1 - \text{Snapshot reserve})\} = Y$

Example 1: calculations *with* a Snapshot reserve

In the following example, the total capacity of the array LUN is 4 GB, with a volume Snapshot reserve set at the default for Data ONTAP 8.1.1 (5 percent).

The following examples are for an array LUN less than 2 TB:

Checksum type	Formula
BCS (array LUN less than 2 TB)	$4 \times \{0.875 \times 0.9 \times 0.99 \times 0.95\} = 2.96 \text{ GB usable space for storage}$
AZCS (array LUN less than 2 TB)	$4 \times \{0.984 \times 0.9 \times 0.99 \times 0.95\} = 3.33 \text{ GB usable space for storage}$

Formula for calculating maximum array LUN size needed

When you know the array LUN capacity needed to obtain the storage capacity you want, you can use the following formula to determine the total array LUN size you need, considering elements that require space in the LUN.

- Y is the exact amount of space in the array LUN that you want.
- If you are using Snapshot copies, the Snapshot reserve is taken into account.

The following examples are for an array LUN less than 2 TB:

Checksum type	Formula
BCS (array LUN less than 2 TB)	$Y \div \{0.875 \times 0.9 \times 0.99 \times (1 - \text{Snapshot reserve})\} =$ Actual capacity required
AZCS (array LUN less than 2 TB)	$Y \div \{0.984 \times 0.9 \times 0.99 \times (1 - \text{Snapshot reserve})\} =$ Actual capacity required

Example 2: calculations *with* Snapshot reserves

In this example, the volume Snapshot reserve is the default setting for Data ONTAP 8.1.1 (5 percent).

The following examples are for an array LUN less than 2 TB:

Checksum type	Formula
BCS (array LUN less than 2 TB)	$10 \text{ GB} \div \{0.875 \times 0.9 \times 0.99 \times 0.95\} = 13.5 \text{ GB}$ actual capacity required
AZCS (array LUN less than 2 TB)	$10 \text{ GB} \div \{0.984 \times 0.9 \times 0.99 \times 0.95\} = 12.05 \text{ GB}$ actual capacity required

Example 3: calculations *without* Snapshot reserves

You want 10 GB of usable capacity for storage. The following example shows calculating actual array LUN size when you are not using Snapshot copies.

The following examples are for an array LUN less than 2 TB:

Checksum type	Formula
BCS (array LUN less than 2 TB)	$10 \text{ GB} \div \{0.875 \times 0.9 \times 0.99\} = 12.8 \text{ GB}$ actual capacity required
AZCS (array LUN less than 2 TB)	$10 \text{ GB} \div \{0.984 \times 0.9 \times 0.99\} = 11.41 \text{ GB}$ actual capacity required

Location of the root volume

The location of the root volume depends on whether the ONTAP system is pre-ordered with native disks or whether you are adding disks to an ONTAP system that is configured for array LUNs.

Follow these guidelines for determining the location of the root volume on the ONTAP system:

- The root volume can be on a storage array or on a native disk shelf.

However, you should install the root volume on a native disk if the ONTAP system has both native disks and array LUNs.

If you order your storage system with disks, the factory installs the root volume on a native disk.

- In an HA pair, the best practice is for the root volume to be located on the same type of storage for both the nodes—either on a native disk shelf or on a storage array for both the nodes.
- For MetroCluster configurations with both disks and array LUNs, you should create the root volume on a disk if you are setting up a new configuration.

If you are adding disks to an existing MetroCluster configuration with array LUNs, you can leave the root volume on an array LUN.

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