



# About SAN volumes

ONTAP 9

NetApp  
June 30, 2023

# Table of Contents

- About SAN volumes . . . . . 1
  - About SAN volumes overview . . . . . 1
  - Configure volume provisioning options . . . . . 3
  - SAN volume configuration options . . . . . 4
  - Requirement for moving volumes in SAN environments . . . . . 4
  - Considerations for setting fractional reserve . . . . . 5

# About SAN volumes

## About SAN volumes overview

ONTAP provides three basic volume provisioning options: thick provisioning, thin provisioning, and semi-thick provisioning. Each option uses different ways to manage the volume space and the space requirements for ONTAP block sharing technologies. Understanding how the options work enables you to choose the best option for your environment.



Putting SAN LUNs and NAS shares in the same FlexVol volume is not recommended. You should provision separate FlexVol volumes specifically for your SAN LUNs and you should provision separate FlexVol volumes specifically to your NAS shares. This simplifies management and replication deployments and parallels the way FlexVol volumes are supported in Active IQ Unified Manager (formerly OnCommand Unified Manager).

### Thin provisioning for volumes

When a thinly provisioned volume is created, ONTAP does not reserve any extra space when the volume is created. As data is written to the volume, the volume requests the storage it needs from the aggregate to accommodate the write operation. Using thin-provisioned volumes enables you to overcommit your aggregate, which introduces the possibility of the volume not being able to secure the space it needs when the aggregate runs out of free space.

You create a thin-provisioned FlexVol volume by setting its `-space-guarantee` option to `none`.

### Thick provisioning for volumes

When a thick-provisioned volume is created, ONTAP sets aside enough storage from the aggregate to ensure that any block in the volume can be written to at any time. When you configure a volume to use thick provisioning, you can employ any of the ONTAP storage efficiency capabilities, such as compression and deduplication, to offset the larger upfront storage requirements.

You create a thick-provisioned FlexVol volume by setting its `-space-slo` (service level objective) option to `thick`.

### Semi-thick provisioning for volumes

When a volume using semi-thick provisioning is created, ONTAP sets aside storage space from the aggregate to account for the volume size. If the volume is running out of free space because blocks are in use by block-sharing technologies, ONTAP makes an effort to delete protection data objects (Snapshot copies and FlexClone files and LUNs) to free up the space they are holding. As long as ONTAP can delete the protection data objects fast enough to keep pace with the space required for overwrites, the write operations continue to succeed. This is called a “best effort” write guarantee.

**Note:** The following functionality is not supported on volumes that use semi-thick provisioning:

- storage efficiency technologies such as deduplication, compression, and compaction
- Microsoft Offloaded Data Transfer (ODX)

You create a semi-thick-provisioned FlexVol volume by setting its `-space-slo` (service level objective) option to `semi-thick`.

## Use with space-reserved files and LUNs

A space-reserved file or LUN is one for which storage is allocated when it is created. Historically, NetApp has used the term “thin-provisioned LUN” to mean a LUN for which space reservation is disabled (a non-space-reserved LUN).

**Note:** Non-space-reserved files are not generally referred to as “thin-provisioned files”.

The following table summarizes the major differences in how the three volume provisioning options can be used with space-reserved files and LUNs:

Volume provisioning	LUN/file space reservation	Overwrites	Protection data <sup>2</sup>	Storage efficiency <sup>3</sup>
Thick	Supported	Guaranteed <sup>1</sup>	Guaranteed	Supported
Thin	No effect	None	Guaranteed	Supported
Semi-thick	Supported	Best effort <sup>1</sup>	Best effort	Not supported

### Notes

1. The ability to guarantee overwrites or provide a best-effort overwrite assurance requires that space reservation is enabled on the LUN or file.
2. Protection data includes Snapshot copies, and FlexClone files and LUNs marked for automatic deletion (backup clones).
3. Storage efficiency includes deduplication, compression, any FlexClone files and LUNs not marked for automatic deletion (active clones), and FlexClone subfiles (used for Copy Offload).

## Support for SCSI thin-provisioned LUNs

ONTAP supports T10 SCSI thin-provisioned LUNs as well as NetApp thin-provisioned LUNs. T10 SCSI thin provisioning enables host applications to support SCSI features including LUN space reclamation and LUN space monitoring capabilities for blocks environments. T10 SCSI thin provisioning must be supported by your SCSI host software.

You use the ONTAP `space-allocation` setting to enable/disable support for the T10 thin provisioning on a LUN. You use the ONTAP `space-allocation enable` setting to enable T10 SCSI thin provisioning on a LUN.

The `[-space-allocation {enabled|disabled}]` command in the ONTAP Command Reference Manual has more information to enable/disable support for the T10 thin provisioning and to enable T10 SCSI thin provisioning on a LUN.

### ONTAP 9 commands

# Configure volume provisioning options

You can configure a volume for thin provisioning, thick provisioning, or semi-thick provisioning.

## About this task

Setting the `-space-slo` option to `thick` ensures the following:

- The entire volume is preallocated in the aggregate. You cannot use the `volume create` or `volume modify` command to configure the volume's `-space-guarantee` option.
- 100% of the space required for overwrites is reserved. You cannot use the `volume modify` command to configure the volume's `-fractional-reserve` option

Setting the `-space-slo` option to `semi-thick` ensures the following:

- The entire volume is preallocated in the aggregate. You cannot use the `volume create` or `volume modify` command to configure the volume's `-space-guarantee` option.
- No space is reserved for overwrites. You can use the `volume modify` command to configure the volume's `-fractional-reserve` option.
- Automatic deletion of Snapshot copies is enabled.

## Step

1. Configure volume provisioning options:

```
volume create -vserver vs1 -volume vol1 -aggregate  
aggregate_name -space-slo none|thick|semi-thick -space-guarantee none|volume
```

The `-space-guarantee` option defaults to `none` for AFF systems and for non-AFF DP volumes. Otherwise, it defaults to `volume`. For existing FlexVol volumes, use the `volume modify` command to configure provisioning options.

The following command configures vol1 on SVM vs1 for thin provisioning:

```
cluster1::> volume create -vserver vs1 -volume vol1 -space-guarantee  
none
```

The following command configures vol1 on SVM vs1 for thick provisioning:

```
cluster1::> volume create -vserver vs1 -volume vol1 -space-slo thick
```

The following command configures vol1 on SVM vs1 for semi-thick provisioning:

```
cluster1::> volume create -vserver vs1 -volume vol1 -space-slo semi-  
thick
```

# SAN volume configuration options

You must set various options on the volume containing your LUN. The way you set the volume options determines the amount of space available to LUNs in the volume.

## Autogrow

You can enable or disable Autogrow. If you enable it, autogrow allows ONTAP to automatically increase the size of the volume up to a maximum size that you predetermine. There must be space available in the containing aggregate to support the automatic growth of the volume. Therefore, if you enable autogrow, you must monitor the free space in the containing aggregate and add more when needed.

Autogrow cannot be triggered to support Snapshot creation. If you attempt to create a Snapshot copy and there is insufficient space on the volume, the Snapshot creation fails, even with autogrow enabled.

If autogrow is disabled, the size of your volume will remain the same.

## Autoshrink

You can enable or disable Autoshrink. If you enable it, autoshrink allows ONTAP to automatically decrease the overall size of a volume when the amount of space consumed in the volume decreases a predetermined threshold. This increases storage efficiency by triggering volumes to automatically release unused free space.

## Snapshot autodelete

Snapshot autodelete automatically deletes Snapshot copies when one of the following occurs:

- The volume is nearly full.
- The Snapshot reserve space is nearly full.
- The overwrite reserve space is full.

You can configure Snapshot autodelete to delete Snapshot copies from oldest to newest or from newest to oldest. Snapshot autodelete does not delete Snapshot copies that are linked to Snapshot copies in cloned volumes or LUNs.

If your volume needs additional space and you have enabled both autogrow and Snapshot autodelete, by default, ONTAP attempts to acquire the needed space by triggering autogrow first. If enough space is not acquired through autogrow, then Snapshot autodelete is triggered.

## Snapshot reserve

Snapshot reserve defines the amount of space in the volume reserved for Snapshot copies. Space allocated to Snapshot reserve cannot be used for any other purpose. If all of the space allocated for Snapshot reserve is used, then Snapshot copies begin to consume additional space on the volume.

# Requirement for moving volumes in SAN environments

Before you move a volume that contains LUNs or namespaces, you must meet certain requirements.

- For volumes containing one or more LUNs, you should have a minimum of two paths per LUN (LIFs)

connecting to each node in the cluster.

This eliminates single points of failure and enables the system to survive component failures.

- For volumes containing namespaces, the cluster must be running ONTAP 9.6 or later.

Volume move is not supported for NVMe configurations running ONTAP 9.5.

## Considerations for setting fractional reserve

Fractional reserve, also called *LUN overwrite reserve*, enables you to turn off overwrite reserve for space-reserved LUNs and files in a FlexVol volume. This can help you maximize your storage utilization, but if your environment is negatively affected by write operations failing due to lack of space, you must understand the requirements that this configuration imposes.

The fractional reserve setting is expressed as a percentage; the only valid values are 0 and 100 percent. The fractional reserve setting is an attribute of the volume.

Setting fractional reserve to 0 increases your storage utilization. However, an application accessing data residing in the volume could experience a data outage if the volume is out of free space, even with the volume guarantee set to `volume`. With proper volume configuration and use, however, you can minimize the chance of writes failing. ONTAP provides a “best effort” write guarantee for volumes with fractional reserve set to 0 when *all* of the following requirements are met:

- Deduplication is not in use
- Compression is not in use
- FlexClone sub-files are not in use
- All FlexClone files and FlexClone LUNs are enabled for automatic deletion

This is not the default setting. You must explicitly enable automatic deletion, either at creation time or by modifying the FlexClone file or FlexClone LUN after it is created.

- ODX and FlexClone copy offload are not in use
- Volume guarantee is set to `volume`
- File or LUN space reservation is `enabled`
- Volume Snapshot reserve is set to 0
- Volume Snapshot copy automatic deletion is enabled with a commitment level of `destroy`, a destroy list of `lun_clone`, `vol_clone`, `cifs_share`, `file_clone`, `sfsr`, and a trigger of `volume`

This setting also ensures that FlexClone files and FlexClone LUNs are deleted when necessary.

Note that if your rate of change is high, in rare cases the Snapshot copy automatic deletion could fall behind, resulting in the volume running out of space, even with all of the above required configuration settings in use.

In addition, you can optionally use the volume autogrow capability to decrease the likelihood of volume Snapshot copies needing to be deleted automatically. If you enable the autogrow capability, you must monitor the free space in the associated aggregate. If the aggregate becomes full enough that the volume is prevented

from growing, more Snapshot copies will probably be deleted as the free space in the volume is depleted.

If you cannot meet all of the above configuration requirements and you need to ensure that the volume does not run out of space, you must set the volume's fractional reserve setting to 100. This requires more free space up front, but guarantees that data modification operations will succeed even when the technologies listed above are in use.

The default value and allowed values for the fractional reserve setting depend on the guarantee of the volume:

Volume guarantee	Default fractional reserve	Allowed values
Volume	100	0, 100
None	0	0, 100



## Copyright information

Copyright © 2023 NetApp, Inc. All Rights Reserved. Printed in the U.S. No part of this document covered by copyright may be reproduced in any form or by any means—graphic, electronic, or mechanical, including photocopying, recording, taping, or storage in an electronic retrieval system—without prior written permission of the copyright owner.

Software derived from copyrighted NetApp material is subject to the following license and disclaimer:

THIS SOFTWARE IS PROVIDED BY NETAPP “AS IS” AND WITHOUT ANY EXPRESS OR IMPLIED WARRANTIES, INCLUDING, BUT NOT LIMITED TO, THE IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE, WHICH ARE HEREBY DISCLAIMED. IN NO EVENT SHALL NETAPP BE LIABLE FOR ANY DIRECT, INDIRECT, INCIDENTAL, SPECIAL, EXEMPLARY, OR CONSEQUENTIAL DAMAGES (INCLUDING, BUT NOT LIMITED TO, PROCUREMENT OF SUBSTITUTE GOODS OR SERVICES; LOSS OF USE, DATA, OR PROFITS; OR BUSINESS INTERRUPTION) HOWEVER CAUSED AND ON ANY THEORY OF LIABILITY, WHETHER IN CONTRACT, STRICT LIABILITY, OR TORT (INCLUDING NEGLIGENCE OR OTHERWISE) ARISING IN ANY WAY OUT OF THE USE OF THIS SOFTWARE, EVEN IF ADVISED OF THE POSSIBILITY OF SUCH DAMAGE.

NetApp reserves the right to change any products described herein at any time, and without notice. NetApp assumes no responsibility or liability arising from the use of products described herein, except as expressly agreed to in writing by NetApp. The use or purchase of this product does not convey a license under any patent rights, trademark rights, or any other intellectual property rights of NetApp.

The product described in this manual may be protected by one or more U.S. patents, foreign patents, or pending applications.

LIMITED RIGHTS LEGEND: Use, duplication, or disclosure by the government is subject to restrictions as set forth in subparagraph (b)(3) of the Rights in Technical Data -Noncommercial Items at DFARS 252.227-7013 (FEB 2014) and FAR 52.227-19 (DEC 2007).

Data contained herein pertains to a commercial product and/or commercial service (as defined in FAR 2.101) and is proprietary to NetApp, Inc. All NetApp technical data and computer software provided under this Agreement is commercial in nature and developed solely at private expense. The U.S. Government has a non-exclusive, non-transferrable, nonsublicensable, worldwide, limited irrevocable license to use the Data only in connection with and in support of the U.S. Government contract under which the Data was delivered. Except as provided herein, the Data may not be used, disclosed, reproduced, modified, performed, or displayed without the prior written approval of NetApp, Inc. United States Government license rights for the Department of Defense are limited to those rights identified in DFARS clause 252.227-7015(b) (FEB 2014).

## Trademark information

NETAPP, the NETAPP logo, and the marks listed at <http://www.netapp.com/TM> are trademarks of NetApp, Inc. Other company and product names may be trademarks of their respective owners.