Cloud Volumes ONTAP 9.11.1 Release Notes

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NetApp
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Table of Contents

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What's new in Cloud Volumes ONTAP 9.11.1

Cloud Volumes ONTAP 9.11.1 includes new enhancements.

Additional features and enhancements are also introduced in the latest versions of Cloud Manager. See the Cloud Manager Release Notes for details.

9.11.1 GA (1 Aug 2022)

The General Availability (GA) release of Cloud Volumes ONTAP 9.11.1 is now available. The GA release includes bug fixes.

9.11.1 RC1 (7 June 2022)

Cloud Volumes ONTAP 9.11.1 Release Candidate 1 is now available in AWS, Azure, and Google Cloud. This release includes the following new features and enhancements.

Performance enhancement

We have enhanced the read performance of new aggregates created in 9.11.1 or later.

Increased storage efficiency

Starting with the 9.11.1 release, all new volumes enabled for storage efficiency will include a new compression feature called temperature-sensitive storage efficiency. The previous generation compression feature is no longer used.

Temperature-sensitive storage efficiency compresses data based on data temperature, or how often the data is used. Cold data, or data that is not used often, is recompressed with a higher compression ratio for increased storage efficiency.

VPC sharing in AWS

Cloud Volumes ONTAP HA pairs are now supported in AWS with VPC sharing. VPC sharing enables your organization to share subnets with other AWS accounts. Networking (the VPC, subnets, and route tables) reside in the VPC owner account, while the EC2 instances for the HA configuration reside in a participant account using shared subnets.

Learn how to deploy an HA pair in a shared subnet

New AWS region support

Cloud Volumes ONTAP is now supported in the AWS Jakarta region (ap-southeast-3).

View the full list of supported regions for Cloud Volumes ONTAP

New Azure region support

Cloud Volumes ONTAP is now supported in the Azure Brazil Southeast region.

View the full list of supported regions for Cloud Volumes ONTAP

Support for 24 storage VMs in Google Cloud

24 storage VMs are now supported with Cloud Volumes ONTAP in Google Cloud for most configurations.

- Learn more about storage VM limits in Google Cloud
- Learn how to create data-serving storage VMs for Cloud Volumes ONTAP in Google Cloud

New Google Cloud region support

Cloud Volumes ONTAP HA pairs are now supported in the Milan (europe-west8) region.

View the full list of supported regions for Cloud Volumes ONTAP

Modifying LIF services for new storage VMs

Starting with this release, if you create a new storage VM on a Cloud Volumes ONTAP HA pair in AWS or Azure, then you need to modify the network service policies for the storage VM. Modifying the services is required because it ensures that Cloud Volumes ONTAP can use the iSCSI LIF for outbound management connections.

Note that modifying LIF services is not required for Cloud Volumes ONTAP in Google Cloud because the Cloud Manager API sets the LIF services for you during creation.

The commands that you need to run are specified on the following pages:

- Learn how to create additional storage VMs in AWS
- Learn how to create additional storage VMs in Azure

New unsupported ONTAP feature

The new multi-admin verification feature introduced in ONTAP 9.11.1 is not supported with Cloud Volumes ONTAP. Enabling multi-admin verification on Cloud Volumes ONTAP will result in an unsupported configuration.

Upgrade notes

Read through these notes to learn more about upgrading to this release.

How to upgrade

Upgrades of Cloud Volumes ONTAP must be completed from Cloud Manager. You should not upgrade Cloud Volumes ONTAP by using System Manager or the CLI. Doing so can impact system stability.

Learn how to upgrade when Cloud Manager notifies you.

Supported upgrade path

You can upgrade to Cloud Volumes ONTAP 9.11.1 from the 9.11.0 release and from the 9.10.1 release. Cloud Manager will prompt you to upgrade eligible Cloud Volumes ONTAP systems to this release.

Required version of the Connector

The Cloud Manager Connector must be running version 3.9.19 or later to deploy new Cloud Volumes ONTAP 9.11.1 systems and to upgrade existing systems to 9.11.1.

Automatic upgrades of the Connector are enabled by default so you should be running the latest version.

Downtime

- The upgrade of a single node system takes the system offline for up to 25 minutes, during which I/O is interrupted.
- Upgrading an HA pair is nondisruptive and I/O is uninterrupted. During this nondisruptive upgrade process, each node is upgraded in tandem to continue serving I/O to clients.

c4, m4, and r4 instance types

Starting with the 9.8 release, c4, m4, and r4 instance types aren’t supported with new Cloud Volumes ONTAP systems. If you have an existing Cloud Volumes ONTAP system that’s running on a c4, m4, or r4 instance type, you can still upgrade to this release.

We recommend changing to an instance type in the c5, m5, or r5 instance family.

Licensing for Cloud Volumes ONTAP

Cloud Volumes ONTAP offers different licensing options that enable you to choose a consumption model that meets your needs.

The following licensing options are available for new customers.

Capacity-based licensing packages

Capacity-based licensing enables you to pay for Cloud Volumes ONTAP per TiB of capacity. The license is associated with your NetApp account and enables you to charge multiple systems against the license, as long as enough capacity is available through the license.

Capacity-based licensing is available in the form of a *package*. When you deploy a Cloud Volumes ONTAP system, you can choose from several licensing packages based on your business needs.

Keystone Flex Subscription

A pay-as-you-grow subscription-based service that delivers a seamless hybrid cloud experience for those preferring OpEx consumption models to upfront CapEx or leasing.

Charging is based on the size of your committed capacity for one or more Cloud Volumes ONTAP HA pairs in your Keystone Flex Subscription.

The previous by-node licensing model remains available for existing customers who have already purchased a license or who have an active marketplace subscription.

Learn more about these licensing options

Supported configurations

Supported configurations in AWS

Several Cloud Volumes ONTAP configurations are supported in AWS.

Supported number of nodes

Cloud Volumes ONTAP is available in AWS as a single node system and as a high-availability (HA) pair of nodes for fault tolerance and nondisruptive operations.

Upgrading a single node system to an HA pair is not supported. If you want to switch between a single node system and an HA pair, then you need to deploy a new system and replicate data from the existing system to the new system.

Supported storage

Cloud Volumes ONTAP supports several types of EBS disks, and S3 object storage for data tiering. The maximum storage capacity is determined by the license that you choose.

Storage support by license

Each license supports a different maximum system capacity. The maximum system capacity includes disk-based storage plus object storage used for data tiering. NetApp doesn't support exceeding this limit.

	Freemium	PAYGO Explore	PAYGO Standard	PAYGO Premium	Node-based BYOL	Capacity-based license
Maximum system capacity (disks + object storage) [1]	500 GiB	2 TiB	10 TiB	368 TiB [2]	368 TiB per license [2]	2 PiB [2]
Supported disk types	• General Purpose SSD (gp3 and gp2) [3] • Provisioned IOPS SSD (io1) [3] • Throughput Optimized HDD (st1) [4]					
Cold data tiering to S3	Supported	Not supported	Supported			

1. For an HA pair, the capacity limit is for the entire HA pair. It's not per node. For example, if you use the Premium license, you can have up to 368 TiB of capacity between both nodes.
2. For some configurations, disk limits prevent you from reaching the capacity limit by using disks alone. In those cases, you can reach the capacity limit by tiering inactive data to object storage. For information about disk limits, refer to storage limits.
3. Enhanced write performance is enabled when using SSDs with all Cloud Volumes ONTAP configurations, except for PAYGO Explore.

4. Tiering data to object storage is not recommended when using Throughput Optimized HDDs (st1).

Supported disk sizes

In AWS, an aggregate can contain up to 6 disks that are all the same size. But if you have a configuration that supports the Amazon EBS Elastic Volumes feature, then an aggregate can contain up to 8 disks. Learn more about support for Elastic Volumes

General Purpose SSDs (gp3 and gp2)	Provisioned IOPS SSDs (io1)	Throughput Optimized HDDs (st1)
• 100 GiB • 500 GiB • 1 TiB • 2 TiB • 4 TiB • 6 TiB • 8 TiB • 16 TiB	• 100 GiB • 500 GiB • 1 TiB • 2 TiB • 4 TiB • 6 TiB • 8 TiB • 16 TiB	• 500 GiB • 1 TiB • 2 TiB • 4 TiB • 6 TiB • 8 TiB • 16 TiB

Supported EC2 compute

Each Cloud Volumes ONTAP license supports different EC2 instance types. For your convenience, the table below shows the vCPU, RAM, and bandwidth for each supported instance type. You should refer to AWS for the latest and complete details about EC2 instance types.

The bandwidths shown in the table below match the documented AWS limits for each instance type. These limits don't completely align with what Cloud Volumes ONTAP can provide. For the expected performance, refer to NetApp Technical Report 4383: Performance Characterization of Cloud Volumes ONTAP in Amazon Web Services with Application Workloads.

License	Supported instance	vCPU	RAM	Flash Cache [1]	Network bandwidth (Gbps)	EBS bandwidth (Mbps)	High write speed [2]
Explore or any other license	m5.xlarge	4	16	Not supported	Up to 10	Up to 4,750	Supported (single node only)
Standard or any other license	r5.xlarge	4	32	Not supported	Up to 10	Up to 4,750	Supported (single node only)
	m5a.2xlarge	8	32	Not supported	Up to 10	Up to 2,880	Supported
	m5.2xlarge	8	32	Not supported	Up to 10	Up to 4,750	Supported

License	Supported instance	vCPU	RAM	Flash Cache [1]	Network bandwidth (Gbps)	EBS bandwidth (Mbps)	High write speed [2]
Premium or any other license	m5n.2xlarge	8	32	Not supported	Up to 25	Up to 4,750	Supported
	r5.2xlarge	8	64	Not supported	Up to 10	Up to 4,750	Supported
	r5d.2xlarge	8	64	Supported	Up to 10	Up to 4,750	Supported
	c5d.4xlarge	16	32	Supported	Up to 10	4,570	Supported
	m5.4xlarge	16	64	Not supported	Up to 10	4,750	Supported
	m5dn.4xlarge	16	64	Supported	Up to 25	4,750	Supported
	m5d.8xlarge	32	128	Supported	10	6,800	Supported
	r5.8xlarge	32	256	Not supported	10	6,800	Supported
	c5.9xlarge	36	72	Not supported	10	9,500	Supported
	c5d.9xlarge	36	72	Supported	10	9,500	Supported
	c5n.9xlarge	36	96	Not supported	50	9,500	Supported
	c5a.12xlarge	48 [4]	96	Not supported	12	4,750	Supported
	c5.18xlarge	48 [4]	144	Not supported	25	19,000	Supported
	c5d.18xlarge	48 [4]	144	Supported	25	19,000	Supported
	m5d.12xlarge	48	192	Supported	12	9,500	Supported
	m5dn.12xlarge	48	192	Supported	50	9,500	Supported
	c5n.18xlarge	48 [4]	192	Not supported	100	19,000	Supported
	m5a.16xlarge	48 [4]	256	Not supported	12	9,500	Supported
	m5.16xlarge	48 [4]	256	Not supported	20	13,600	Supported
	r5.12xlarge [3]	48	384	Not supported	10	9,500	Supported
	m5dn.24xlarge	48 [4]	384	Supported	100	19,000	Supported

1. Some instance types include local NVMe storage, which Cloud Volumes ONTAP uses as *Flash Cache*. Flash Cache speeds access to data through real-time intelligent caching of recently read user data and NetApp metadata. It's effective for random read-intensive workloads, including databases, email, and file services. Compression must be disabled on all volumes to take advantage of the Flash Cache performance improvements. Learn more about Flash Cache.
2. Cloud Volumes ONTAP supports high write speed with most instance types when using an HA pair. High write speed is supported with all instance types when using a single node system. Learn more about choosing a write speed.
3. The r5.12xlarge instance type has a known limitation with supportability. If a node unexpectedly reboots due to a panic, the system might not collect core files used to troubleshoot and root cause the problem. The customer accepts the risks and limited support terms and bears all support responsibility if this condition occurs. This limitation affects newly deployed HA pairs and HA pairs upgraded from 9.8. The limitation does not affect newly deployed single node systems.
4. While these EC2 instance types support more than 48 vCPUs, Cloud Volumes ONTAP supports up to 48 vCPUs.
5. When you choose an EC2 instance type, you can specify whether it is a shared instance or a dedicated instance.
6. Cloud Volumes ONTAP can run on either a Reserved or On-demand EC2 instance. Solutions that use other instance types aren't supported.

Supported regions

For AWS region support, see Cloud Volumes Global Regions.

Supported configurations in Azure

Several Cloud Volumes ONTAP configurations are supported in Azure.

Supported configurations by license

Cloud Volumes ONTAP is available in Azure as a single node system and as a high-availability (HA) pair of nodes for fault tolerance and nondisruptive operations.

Upgrading a single node system to an HA pair is not supported. If you want to switch between a single node system and an HA pair, then you need to deploy a new system and replicate data from the existing system to the new system.

Single node systems

You can choose from the following configurations when deploying Cloud Volumes ONTAP as a single-node system in Azure:

	Freemium	PAYGO Explore	PAYGO Standard	PAYGO Premium	Node-based BYOL	Capacity-based license
Maximum system capacity (disks + object storage)	500 GiB	2 TiB [1]	10 TiB	368 TiB	368 TiB per license	2 PiB
Supported virtual machine types	• DS4_v2 • DS5_v2 • DS13_v2 • DS14_v2 • DS15_v2 • L8s_v2 [2] • E4s_v3 • E8s_v3 • E32s_v3 [3] • E48s_v3 [3] • E64is_v3 [3] • E4ds_v4 [3] • E8ds_v4 [3] • E32ds_v4 [3] • E48ds_v4 [3] • E80ids_v4 [3]	• E4s_v3 • E4ds_v4 [3]	• DS4_v2 • DS13_v2 • E8s_v3 • E8ds_v4 [3]	• DS5_v2 • DS14_v2 • DS15_v2 • E32s_v3 [3] • E48s_v3 [3] • E64is_v3 [3] • E32ds_v4 [3] • E48ds_v4 [3] • E80ids_v4 [3]	• DS4_v2 • DS5_v2 • DS13_v2 • DS14_v2 • DS15_v2 • L8s_v2 [2] • E4s_v3 • E8s_v3 • E32s_v3 [3] • E48s_v3 [3] • E64is_v3 [3] • E4ds_v4 [3] • E8ds_v4 [3] • E32ds_v4 [3] • E48ds_v4 [3] • E80ids_v4 [3]	• DS4_v2 • DS5_v2 • DS13_v2 • DS14_v2 • DS15_v2 • L8s_v2 [2] • E4s_v3 • E8s_v3 • E32s_v3 [3] • E48s_v3 [3] • E64is_v3 [3] • E4ds_v4 [3] • E8ds_v4 [3] • E32ds_v4 [3] • E48ds_v4 [3] • E80ids_v4 [3]
Supported disk types [4]	Standard HDD Managed Disks, Standard SSD Managed Disks, and Premium SSD Managed Disks					

Notes:

1. Data tiering to Azure Blob storage isn't supported with PAYGO Explore.
2. This VM type includes local NVMe storage, which Cloud Volumes ONTAP uses as *Flash Cache*. Flash Cache speeds access to data through real-time intelligent caching of recently read user data and NetApp metadata. It is effective for random read-intensive workloads, including databases, email, and file services. Compression must be disabled on all volumes to take advantage of the Flash Cache performance improvements. Learn more.
3. These VM types use an Ultra SSD for VNVRAM, which provides better write performance.

   If you choose any of these VM types when you deploy a new Cloud Volumes ONTAP system, you can't change to another VM type that *doesn't* use an Ultra SSD for VNVRAM. For example, you can't change from E8ds_v4 to E8s_v3, but you can change from E8ds_v4 to E32ds_v4 because both of those VM types

use Ultra SSDs.

Conversely, if you deployed Cloud Volumes ONTAP using any other VM type, you won't be able to change to a VM type that uses an Ultra SSD for VNVRAM. For example, you can't change from E8s_v3 to E8ds_v4.

4. High write speed is supported with all instance types when using a single node system. You can enable high write speed from Cloud Manager during deployment or any time after. Learn more about choosing a write speed.
5. Enhanced write performance is enabled when using SSDs.
6. For Azure region support, see Cloud Volumes Global Regions.
7. Cloud Volumes ONTAP can run on either a Reserved or On-demand VM instance from your cloud provider. Solutions that use other VM instance types aren't supported.

HA pairs

You can choose from the following configurations when deploying Cloud Volumes ONTAP as an HA pair in Azure.

	Freemium	PAYGO Standard	PAYGO Premium	Node-based BYOL	Capacity-based license
Maximum system capacity (disks + object storage)	500 GiB	10 TiB	368 TiB	368 TiB per license	2 PiB
Supported virtual machine types	• DS4_v2 • DS5_v2 [1] • DS13_v2 • DS14_v2 [1] • DS15_v2 [1] • E8s_v3 • E48s_v3 [1] • E8ds_v4 [1] • E32ds_v4 [1] • E48ds_v4 [1] • E80ids_v4 [1,2]	• DS4_v2 • DS13_v2 • E8ds_v4 [1]	• DS5_v2 [1] • DS14_v2 [1] • DS15_v2 [1] • E8s_v3 • E48s_v3 [1] • E32ds_v4 [1] • E48ds_v4 [1] • E80ids_v4 [1,2]	• DS4_v2 • DS5_v2 [1] • DS13_v2 • DS14_v2 [1] • DS15_v2 [1] • E8s_v3 • E48s_v3 [1] • E8ds_v4 [1] • E32ds_v4 [1] • E48ds_v4 [1] • E80ids_v4 [1,2]	• DS4_v2 • DS5_v2 [1] • DS13_v2 • DS14_v2 [1] • DS15_v2 [1] • E8s_v3 • E48s_v3 [1] • E8ds_v4 [1] • E32ds_v4 [1] • E48ds_v4 [1] • E80ids_v4 [1,2]
Supported disk types	Premium page blobs				

Notes:

1. Cloud Volumes ONTAP supports high write speed with these VM types when using an HA pair. You can enable high write speed from Cloud Manager during deployment or any time after. Learn more about choosing a write speed.

2. This VM is recommended only when Azure maintenance control is needed. It's not recommended for any other use case due to the higher pricing.
3. PAYGO Explore isn't supported with HA pairs in Azure.
4. For Azure region support, see Cloud Volumes Global Regions.
5. Cloud Volumes ONTAP can run on either a Reserved or On-demand VM instance from your cloud provider. Solutions that use other VM instance types aren't supported.

Supported disk sizes

In Azure, an aggregate can contain up to 12 disks that are all the same type and size.

Single node systems

Single node systems use Azure Managed Disks. The following disk sizes are supported:

Premium SSD	Standard SSD	Standard HDD
• 500 GiB • 1 TiB • 2 TiB • 4 TiB • 8 TiB • 16 TiB • 32 TiB	• 100 GiB • 500 GiB • 1 TiB • 2 TiB • 4 TiB • 8 TiB • 16 TiB • 32 TiB	• 100 GiB • 500 GiB • 1 TiB • 2 TiB • 4 TiB • 8 TiB • 16 TiB • 32 TiB

HA pairs

HA pairs use Premium page blobs. The following disk sizes are supported:

- 500 GiB
- 1 TiB
- 2 TiB
- 4 TiB
- 8 TiB

Supported configurations in Google Cloud

Several Cloud Volumes ONTAP configurations are supported in Google Cloud.

Supported configurations by license

Cloud Volumes ONTAP is available in Google Cloud Platform as a single node system and as a high-availability (HA) pair of nodes for fault tolerance and nondisruptive operations.

Upgrading a single node system to an HA pair isn't supported. If you want to switch between a single node

system and an HA pair, then you need to deploy a new system and replicate data from the existing system to the new system.

	Freemium	PAYGO Explore	PAYGO Standard	PAYGO Premium	Node-based BYOL	Capacity-based license
Maximum system capacity (disks + object storage) [1]	500 GB	2 TB [2]	10 TB	368 TB	368 TB per license	2 PiB
Supported machine types [3]	• n1-standard-8 • n1-standard-32 • n2-standard-4 • n2-standard-8 • n2-standard-16 • n2-standard-32	• n2-standard-4	• n1-standard-8 • n2-standard-8	• n1-standard-32 • n2-standard-16 • n2-standard-32	• n1-standard-8 • n1-standard-32 • n2-standard-4 • n2-standard-8 • n2-standard-16 • n2-standard-32	• n1-standard-8 • n1-standard-32 • n2-standard-4 • n2-standard-8 • n2-standard-16 • n2-standard-32
Supported disk types [4]	Zonal persistent disks (SSD, balanced, and standard)					

Notes:

1. Disk limits can prevent you from reaching the maximum system capacity limit by using disks alone. You can reach the capacity limit by tiering inactive data to object storage.

   Learn more about disk limits in Google Cloud.

2. Data tiering to Google Cloud Storage isn't supported with PAYGO Explore.
3. The custom-4-16384 machine type is no longer supported with new Cloud Volumes ONTAP systems.

   If you have an existing system running on this machine type, you can keep using it, but we recommend switching to the n2-standard-4 machine type.

4. Enhanced write performance is enabled when using SSDs.
5. The Cloud Manager interface shows an additional supported machine type for Standard and BYOL: n1-highmem-4. However, this machine type isn't meant for production environments. We've made it available

for a specific lab environment only.

6. For Google Cloud Platform region support, see Cloud Volumes Global Regions.
7. Cloud Volumes ONTAP can run on either a Reserved or On-demand VM instance from your cloud provider. Solutions that use other VM instance types aren't supported.

Supported disk sizes

In Google Cloud, an aggregate can contain up to 6 disks that are all the same type and size. The following disk sizes are supported:

- 100 GB
- 500 GB
- 1 TB
- 2 TB
- 4 TB
- 8 TB
- 16 TB
- 64 TB

Storage limits

Storage limits in AWS

Cloud Volumes ONTAP has storage configuration limits to provide reliable operations. For best performance, do not configure your system at the maximum values.

Maximum system capacity by license

The maximum system capacity for a Cloud Volumes ONTAP system is determined by its license. The maximum system capacity includes disk-based storage plus object storage used for data tiering.

NetApp doesn't support exceeding the system capacity limit. If you reach the licensed capacity limit, Cloud Manager displays an action required message and no longer allows you to add additional disks.

For some configurations, disk limits prevent you from reaching the capacity limit by using disks alone. In those cases, you can reach the capacity limit by tiering inactive data to object storage. Refer to capacity and disk limits below for more details.

License	Maximum system capacity (disks + object storage)
Freemium	500 GiB
PAYGO Explore	2 TiB (data tiering is not supported with Explore)
PAYGO Standard	10 TiB
PAYGO Premium	368 TiB
Node-based license	368 TiB per license
Capacity-based license	2 PiB

For HA, is the license capacity limit per node or for the entire HA pair?

The capacity limit is for the entire HA pair. It is not per node. For example, if you use the Premium license, you can have up to 368 TiB of capacity between both nodes.

For an HA system in AWS, does mirrored data count against the capacity limit?

No, it doesn't. Data in an AWS HA pair is synchronously mirrored between the nodes so that the data is available in the event of failure. For example, if you purchase an 8 TiB disk on node A, Cloud Manager also allocates an 8 TiB disk on node B that is used for mirrored data. While 16 TiB of capacity was provisioned, only 8 TiB counts against the license limit.

Disk and tiering limits by EC2 instance

Cloud Volumes ONTAP uses EBS volumes as disks, with a maximum disk size of 16 TiB. The sections below show disk and tiering limits by EC2 instance family because many EC2 instance types have different disk limits. Disk limits are also different between single node systems and HA pairs.

Note the following:

- c4, m4, and r4 instance types are not supported with new Cloud Volumes ONTAP systems in this release. However, we're still showing disk limits for these instance types because you can upgrade a system to this release when running on one of these instance types.
- The disk limits below are specific to disks that contain user data. The limits do not include the boot disk and root disk.
- You can now purchase multiple node-based licenses for a Cloud Volumes ONTAP BYOL system to allocate more than 368 TiB of capacity. The number of licenses that you can purchase for a single node system or HA pair is unlimited. Be aware that disk limits can prevent you from reaching the capacity limit by using disks alone. You can go beyond the disk limit by tiering inactive data to object storage. Learn how to add additional system licenses to Cloud Volumes ONTAP.

Single node with a Premium license

Instance	Max disks per node	Max system capacity with disks alone	Max system capacity with disks and data tiering
c5, m5, and r5 instances	21 [1]	336 TiB	368 TiB
m5dn.24xlarge	19 [2]	304 TiB	368 TiB
c4, m4, and r4 instances	34	368 TiB	368 TiB

1. 21 data disks is the limit for *new* deployments of Cloud Volumes ONTAP. If you upgrade a system that was created with version 9.7 or earlier, then the system continues to support 22 disks. One less data disk is supported on new systems that use these instance types because of the addition of a core disk starting with the 9.8 release.
2. This instance type has more local NVMe disks than other instance types, which means a smaller number of data disks are supported.

Single node with node-based licensing

Instance	Max disks per node	Max system capacity with one license		Max system capacity with multiple licenses	
		Disks alone	Disks + data tiering	Disks alone	Disks + data tiering
c5, m5, and r5 instances	21 [1]	336 TiB	368 TiB	336 TiB	368 TiB x each license
m5dn.24xlarge	19 [2]	304 TiB	368 TiB	304 TiB	368 TiB x each license
c4, m4, and r4 instances	34	368 TiB	368 TiB	544 TiB	368 TiB x each license

1. 21 data disks is the limit for *new* deployments of Cloud Volumes ONTAP. If you upgrade a system that was created with version 9.7 or earlier, then the system continues to support 22 disks. One less data disk is supported on new systems that use these instance types because of the addition of a core disk starting with the 9.8 release.

2. This instance type has more local NVMe disks than other instance types, which means a smaller number of data disks are supported.

Single node with capacity-based licensing

Instance	Max disks per node	Max system capacity with disks alone	Max system capacity with disks and data tiering
c5, m5, and r5 instances	21	336 TiB	2 PiB
m5dn.24xlarge	19 [1]	304 TiB	2 PiB

1. This instance type has more local NVMe disks than other instance types, which means a smaller number of data disks are supported.

HA pairs with a Premium license

Instance	Max disks per node	Max system capacity with disks alone	Max system capacity with disks and data tiering
c5, m5, and r5 instances	18 [1]	288 TiB	368 TiB
m5dn.24xlarge	16 [2]	256 TiB	368 TiB
c4, m4, and r4 instances	31	368 TiB	368 TiB

1. 18 data disks is the limit for *new* deployments of Cloud Volumes ONTAP. If you upgrade a system that was created with version 9.7 or earlier, then the system continues to support 19 disks. One less data disk is supported on new systems that use these instance types because of the addition of a core disk starting with the 9.8 release.
2. This instance type has more local NVMe disks than other instance types, which means a smaller number of data disks are supported.

HA pairs with node-based licensing

Instance	Max disks per node	Max system capacity with one license		Max system capacity with multiple licenses	
		Disks alone	Disks + data tiering	Disks alone	Disks + data tiering
c5, m5, and r5 instances	18 [1]	288 TiB	368 TiB	288 TiB	368 TiB x each license
m5dn.24xlarge	16 [2]	256 TiB	368 TiB	256 TiB	368 TiB x each license
c4, m4, and r4 instances	31	368 TiB	368 TiB	496 TiB	368 TiB x each license

1. 18 data disks is the limit for *new* deployments of Cloud Volumes ONTAP. If you upgrade a system that was created with version 9.7 or earlier, then the system continues to support 19 disks. One less data disk is supported on new systems that use these instance types because of the addition of a core disk starting

with the 9.8 release.

2. This instance type has more local NVMe disks than other instance types, which means a smaller number of data disks are supported.

HA pairs with capacity-based licensing

Instance	Max disks per node	Max system capacity with disks alone	Max system capacity with disks and data tiering
c5, m5, and r5 instances	18	288 TiB	2 PiB
m5dn.24xlarge	16 [1]	256 TiB	2 PiB

1. This instance type has more local NVMe disks than other instance types, which means a smaller number of data disks are supported.

Aggregate limits

Cloud Volumes ONTAP uses EBS volumes as disks and groups them into *aggregates*. Aggregates provide storage to volumes.

Parameter	Limit
Maximum number of aggregates	Single node: Same as the disk limit HA pairs: 18 in a node [1]
Maximum aggregate size [2]	• 96 TiB of raw capacity • 128 TiB of raw capacity with Elastic Volumes [3]
Disks per aggregate [4]	• 1-6 • 1-8 with Elastic Volumes [3]
Maximum number of RAID groups per aggregate	1

Notes:

1. It's not possible to create 18 aggregates on both nodes in an HA pair because doing so would exceed the data disk limit.
2. The maximum aggregate size is based on the disks that comprise the aggregate. The limit does not include object storage used for data tiering.
3. If you have a configuration that supports the Amazon EBS Elastic Volumes feature, then an aggregate can contain up to 8 disks, which provides up to 128 TiB of capacity. The Amazon EBS Elastic Volumes feature is enabled by default on *new* Cloud Volumes ONTAP 9.11.0 or later systems when using gp3 or io1 disks. Learn more about support for Elastic Volumes
4. All disks in an aggregate must be the same size.

Storage VM limits

Some configurations enable you to create additional storage VMs (SVMs) for Cloud Volumes ONTAP.

Learn how to create additional storage VMs.

License type	Instance family	Storage VM limit
Freemium	c5, m5, and r5	• 24 storage VMs total [1,2]
Capacity-based PAYGO or BYOL [3]	c5, m5, and r5	• 24 storage VMs total [1,2]
Node-based PAYGO	c4, m4, and r4	• 1 storage VM for serving data • 1 storage VM for disaster recovery
	c5, m5, and r5	• 1 storage VM for serving data • 1 storage VM for disaster recovery
Node-based BYOL [4]	c4, m4, and r4	• 1 storage VM for serving data • 1 storage VM for disaster recovery
	c5, m5, and r5	• 24 storage VMs total [1,2]

1. The limit can be lower, depending on the EC2 instance type that you use. The limits per instance are listed in the section below.
2. These 24 storage VMs can serve data or be configured for disaster recovery (DR).
3. For capacity-based licensing, there are no extra licensing costs for additional storage VMs, but there is a 4 TiB minimum capacity charge per storage VM. For example, if you create two storage VMs and each has 2 TiB of provisioned capacity, you'll be charged a total of 8 TiB.
4. For node-based BYOL, an add-on license is required for each additional *data-serving* storage VM beyond the first storage VM that comes with Cloud Volumes ONTAP by default. Contact your account team to obtain a storage VM add-on license.

   Storage VMs that you configure for disaster recovery (DR) don't require an add-on license (they are free of charge), but they do count against the storage VM limit. For example, if you have 12 data-serving storage VMs and 12 storage VMs configured for disaster recovery, then you've reached the limit and can't create any additional storage VMs.

Storage VM limit by EC2 instance type

When you create an additional storage VM, you need to allocate private IP addresses to port e0a. The table below identifies the maximum number of private IPs per interface, as well as the number of IP addresses that are available on port e0a after Cloud Volumes ONTAP has been deployed. The number of available IP addresses directly affects the maximum number of storage VMs for that configuration.

The instances listed below are for the c5, m5, and r5 instance families.

Configuration	Instance type	Max private IPs per interface	IPs remaining after deployment [1]	Max storage VMs without a mgmt LIF [2,3]	Max storage VMs with a mgmt LIF [2,3]
Single node	*.xlarge	15	9	10	5
	*.2xlarge	15	9	10	5
	*.4xlarge	30	24	24	12
	*.8xlarge	30	24	24	12
	*.9xlarge	30	24	24	12
	*.12xlarge	30	24	24	12
	*.16xlarge	50	44	24	12
	*.18xlarge	50	44	24	12
	*.24xlarge	50	44	24	12
HA pair in single AZ	*.xlarge	15	10	11	5
	*.2xlarge	15	10	11	5
	*.4xlarge	30	25	24	12
	*.8xlarge	30	25	24	12
	*.9xlarge	30	25	24	12
	*.12xlarge	30	25	24	12
	*.16xlarge	50	45	24	12
	*.18xlarge	50	45	24	12
	*.24xlarge	50	44	24	12
HA pair in multi AZs	*.xlarge	15	12	13	13
	*.2xlarge	15	12	13	13
	*.4xlarge	30	27	24	24
	*.8xlarge	30	27	24	24
	*.9xlarge	30	27	24	24
	*.12xlarge	30	27	24	24
	*.16xlarge	50	47	24	24
	*.18xlarge	50	47	24	24
	*.24xlarge	50	44	24	12

1. This number indicates how many *remaining* private IP addresses are available on port e0a after Cloud Volumes ONTAP is deployed and set up. For example, a *.2xlarge system supports a maximum of 15 IP addresses per network interface. When an HA pair is deployed in a single AZ, 5 private IP addresses are allocated to port e0a. As a result, an HA pair that uses a *.2xlarge instance type has 10 private IP addresses remaining for additional storage VMs.
2. The number listed in these columns includes the initial storage VM that Cloud Manager creates by default. For example, if 24 is listed in this column, it means that you can create 23 additional storage VMs for a total

of 24.

3. A management LIF for the storage VM is optional. A management LIF provides a connection to management tools like SnapCenter.

   Because it requires a private IP address, it will limit the number of additional storage VMs that you can create. The only exception is an HA pair in multiple AZs. In that case, the IP address for the management LIF is a *floating* IP address so it doesn't count against the *private* IP limit.

File and volume limits

Logical storage	Parameter	Limit
Files	Maximum size	16 TiB
	Maximum per volume	Volume size dependent, up to 2 billion
FlexClone volumes	Hierarchical clone depth [1]	499
FlexVol volumes	Maximum per node	500
	Minimum size	20 MB
	Maximum size	100 TiB
Qtrees	Maximum per FlexVol volume	4,995
Snapshot copies	Maximum per FlexVol volume	1,023

1. Hierarchical clone depth is the maximum depth of a nested hierarchy of FlexClone volumes that can be created from a single FlexVol volume.

iSCSI storage limits

iSCSI storage	Parameter	Limit
LUNs	Maximum per node	1,024
	Maximum number of LUN maps	1,024
	Maximum size	16 TiB
	Maximum per volume	512
igroups	Maximum per node	256
Initiators	Maximum per node	512
	Maximum per igroup	128
iSCSI sessions	Maximum per node	1,024
LIFs	Maximum per port	32
	Maximum per portset	32
Portsets	Maximum per node	256

Storage limits in Azure

Cloud Volumes ONTAP has storage configuration limits to provide reliable operations. For best performance, do not configure your system at the maximum values.

Maximum system capacity by license

The maximum system capacity for a Cloud Volumes ONTAP system is determined by its license. The maximum system capacity includes disk-based storage plus object storage used for data tiering.

NetApp doesn't support exceeding the system capacity limit. If you reach the licensed capacity limit, Cloud Manager displays an action required message and no longer allows you to add additional disks.

License	Maximum system capacity (disks + object storage)
Freemium	500 GiB
PAYGO Explore	2 TiB (data tiering is not supported with Explore)
PAYGO Standard	10 TiB
PAYGO Premium	368 TiB
Node-based license	368 TiB per license
Capacity-based license	2 PiB

For HA, is the license capacity limit per node or for the entire HA pair?

The capacity limit is for the entire HA pair. It is not per node. For example, if you use the Premium license, you can have up to 368 TiB of capacity between both nodes.

Disk and tiering limits by VM size

The disk limits below are specific to disks that contain user data. The limits do not include the root disk, core disk, and VNVRAM.

The tables below show the maximum system capacity by VM size with disks alone, and with disks and cold data tiering to object storage.

- Single node systems can use Standard HDD Managed Disks, Standard SSD Managed Disks, and Premium SSD Managed Disks, with up to 32 TiB per disk. The number of supported disks varies by VM size.
- HA systems use Premium page blobs as disks, with up to 8 TiB per page blob. The number of supported disks varies by VM size.

You can purchase multiple node-based licenses for a Cloud Volumes ONTAP BYOL system to allocate more than 368 TiB of capacity. The number of licenses that you can purchase for a single node system or HA pair is unlimited. Be aware that disk limits can prevent you from reaching the capacity limit by using disks alone. You can go beyond the disk limit by tiering inactive data to object storage. Learn how to add additional system licenses to Cloud Volumes ONTAP.

Single node with a Premium license

VM size	Max data disks per node	Max system capacity with disks alone	Max system capacity with disks and data tiering
DS5_v2	61	368 TiB	368 TiB
DS14_v2	61	368 TiB	368 TiB
DS15_v2	61	368 TiB	368 TiB
E32s_v3	29	368 TiB	368 TiB
E48s_v3	29	368 TiB	368 TiB
E64is_v3	29	368 TiB	368 TiB
E32ds_v4	29	368 TiB	368 TiB
E48ds_v4	29	368 TiB	368 TiB
E80ids_v4	61	368 TiB	368 TiB

Single node with node-based licensing

For some VM types, you'll need several BYOL licenses to reach the max system capacity listed below. For example, you'd need 6 BYOL licenses to reach 1.95 PiB with DS5_v2.

VM size	Max data disks per node	Max system capacity with one license		Max system capacity with multiple licenses	
		Disks alone	Disks + data tiering	Disks alone	Disks + data tiering
DS4_v2	29	368 TiB	368 TiB	928 TiB	368 TiB x each license
DS5_v2	61	368 TiB	368 TiB	1.95 PiB	368 TiB x each license
DS13_v2	29	368 TiB	368 TiB	928 TiB	368 TiB x each license
DS14_v2	61	368 TiB	368 TiB	1.95 PiB	368 TiB x each license

VM size	Max data disks per node	Max system capacity with one license		Max system capacity with multiple licenses	
DS15_v2	61	368 TiB	368 TiB	1.95 PiB	368 TiB x each license
L8s_v2	13	368 TiB	368 TiB	416 TiB	368 TiB x each license
E4s_v3	5	160 TiB	368 TiB	160 TiB	368 TiB x each license
E8s_v3	13	368 TiB	368 TiB	416 TiB	368 TiB x each license
E32s_v3	29	368 TiB	368 TiB	928 TiB	368 TiB x each license
E48s_v3	29	368 TiB	368 TiB	928 TiB	368 TiB x each license
E64is_v3	29	368 TiB	368 TiB	928 TiB	368 TiB x each license
E4ds_v4	5	160 TiB	368 TiB	160 TiB	368 TiB x each license
E8ds_v4	13	368 TiB	368 TiB	416 TiB	368 TiB x each license
E32ds_v4	29	368 TiB	368 TiB	928 TiB	368 TiB x each license
E48ds_v4	29	368 TiB	368 TiB	928 TiB	368 TiB x each license
E80ids_v4	61	368 TiB	368 TiB	1.95 PiB	368 TiB x each license

Single node with capacity-based licensing

VM size	Max data disks per node	Max system capacity with disks alone	Max system capacity with disks and data tiering
DS4_v2	29	928 TiB	2 PiB
DS5_v2	61	1.95 PiB	2 PiB
DS13_v2	29	928 TiB	2 PiB
DS14_v2	61	1.95 PiB	2 PiB
DS15_v2	61	1.95 PiB	2 PiB
L8s_v2	13	416 TiB	2 PiB
E4s_v3	5	160 TiB	2 PiB
E8s_v3	13	416 TiB	2 PiB
E32s_v3	29	928 TiB	2 PiB

VM size	Max data disks per node	Max system capacity with disks alone	Max system capacity with disks and data tiering
E48s_v3	29	928 TiB	2 PiB
E64is_v3	29	928 TiB	2 PiB
E4ds_v4	5	160 TiB	2 PiB
E8ds_v4	13	416 TiB	2 PiB
E32ds_v4	29	928 TiB	2 PiB
E48ds_v4	29	928 TiB	2 PiB
E80ids_v4	61	1.95 PiB	2 PiB

HA pairs with a Premium license

VM size	Max data disks for an HA pair	Max system capacity with disks alone	Max system capacity with disks and data tiering
DS5_v2	61	368 TiB	368 TiB
DS14_v2	61	368 TiB	368 TiB
DS15_v2	61	368 TiB	368 TiB
E8s_v3	13	104 TiB	368 TiB
E48s_v3	29	232 TiB	368 TiB
E32ds_v4	29	232 TiB	368 TiB
E48ds_v4	29	232 TiB	368 TiB
E80ids_v4	61	368 TiB	368 TiB

HA pairs with node-based licensing

VM size	Max data disks for an HA pair	Max system capacity with one license		Max system capacity with multiple licenses	
		Disks alone	Disks + data tiering	Disks alone	Disks + data tiering
DS4_v2	29	232 TiB	368 TiB	232 TiB	368 TiB x each license
DS5_v2	61	368 TiB	368 TiB	488 TiB	368 TiB x each license

VM size	Max data disks for an HA pair	Max system capacity with one license		Max system capacity with multiple licenses	
DS13_v2	29	232 TiB	368 TiB	232 TiB	368 TiB x each license
DS14_v2	61	368 TiB	368 TiB	488 TiB	368 TiB x each license
DS15_v2	61	368 TiB	368 TiB	488 TiB	368 TiB x each license
E8s_v3	13	104 TiB	368 TiB	104 TiB	368 TiB x each license
E48s_v3	29	232 TiB	368 TiB	232 TiB	368 TiB x each license
E8ds_v4	13	104 TiB	368 TiB	104 TiB	368 TiB x each license
E32ds_v4	29	232 TiB	368 TiB	232 TiB	368 TiB x each license
E48ds_v4	29	232 TiB	368 TiB	232 TiB	368 TiB x each license
E80ids_v4	61	368 TiB	368 TiB	488 TiB	368 TiB x each license

HA pairs with capacity-based licensing

VM size	Max data disks for an HA pair	Max system capacity with disks alone	Max system capacity with disks and data tiering
DS4_v2	29	232 TiB	2 PiB
DS5_v2	61	488 TiB	2 PiB
DS13_v2	29	232 TiB	2 PiB
DS14_v2	61	488 TiB	2 PiB
DS15_v2	61	488 TiB	2 PiB
E8s_v3	13	104 TiB	2 PiB
E48s_v3	29	232 TiB	2 PiB
E8ds_v4	13	104 TiB	2 PiB
E32ds_v4	29	232 TiB	2 PiB
E48ds_v4	29	232 TiB	2 PiB
E80ids_v4	61	488 TiB	2 PiB

Aggregate limits

Cloud Volumes ONTAP uses Azure storage as disks and groups them into *aggregates*. Aggregates provide storage to volumes.

Parameter	Limit
Maximum number of aggregates	Same as the disk limit
Maximum aggregate size [1]	384 TiB of raw capacity for single node [2] 352 TiB of raw capacity for single node with PAYGO 96 TiB of raw capacity for HA pairs
Disks per aggregate	1-12 [3]
Maximum number of RAID groups per aggregate	1

Notes:

1. The aggregate capacity limit is based on the disks that comprise the aggregate. The limit does not include object storage used for data tiering.
2. If using node-based licensing, two BYOL licenses are required to reach 384 TiB.
3. All disks in an aggregate must be the same size.

Storage VM limits

Some configurations enable you to create additional storage VMs (SVMs) for Cloud Volumes ONTAP.

These are the tested limits. While it is theoretically possible to configure additional storage VMs, it's not supported.

Learn how to create additional storage VMs.

License type	Storage VM limit
Freemium	24 storage VMs total [1,2]
Capacity-based PAYGO or BYOL [3]	24 storage VMs total [1,2]
Node-based BYOL [4]	24 storage VMs total [1,2]
Node-based PAYGO	• 1 storage VM for serving data • 1 storage VM for disaster recovery

1. These 24 storage VMs can serve data or be configured for disaster recovery (DR).
2. Each storage VM can have up to three LIFs where two are data LIFs and one is an SVM management LIF.
3. For capacity-based licensing, there are no extra licensing costs for additional storage VMs, but there is a 4 TiB minimum capacity charge per storage VM. For example, if you create two storage VMs and each has 2 TiB of provisioned capacity, you'll be charged a total of 8 TiB.

4. For node-based BYOL, an add-on license is required for each additional *data-serving* storage VM beyond the first storage VM that comes with Cloud Volumes ONTAP by default. Contact your account team to obtain a storage VM add-on license.

   Storage VMs that you configure for disaster recovery (DR) don't require an add-on license (they are free of charge), but they do count against the storage VM limit. For example, if you have 12 data-serving storage VMs and 12 storage VMs configured for disaster recovery, then you've reached the limit and can't create any additional storage VMs.

File and volume limits

Logical storage	Parameter	Limit
Files	Maximum size	16 TiB
	Maximum per volume	Volume size dependent, up to 2 billion
FlexClone volumes	Hierarchical clone depth [1]	499
FlexVol volumes	Maximum per node	500
	Minimum size	20 MB
	Maximum size	100 TiB
Qtrees	Maximum per FlexVol volume	4,995
Snapshot copies	Maximum per FlexVol volume	1,023

1. Hierarchical clone depth is the maximum depth of a nested hierarchy of FlexClone volumes that can be created from a single FlexVol volume.

iSCSI storage limits

iSCSI storage	Parameter	Limit
LUNs	Maximum per node	1,024
	Maximum number of LUN maps	1,024
	Maximum size	16 TiB
	Maximum per volume	512
igroups	Maximum per node	256
Initiators	Maximum per node	512
	Maximum per igroup	128
iSCSI sessions	Maximum per node	1,024
LIFs	Maximum per port	32
	Maximum per portset	32
Portsets	Maximum per node	256

Storage limits in Google Cloud

Cloud Volumes ONTAP has storage configuration limits to provide reliable operations. For best performance, do not configure your system at the maximum values.

Maximum system capacity by license

The maximum system capacity for a Cloud Volumes ONTAP system is determined by its license. The maximum system capacity includes disk-based storage plus object storage used for data tiering.

NetApp doesn't support exceeding the system capacity limit. If you reach the licensed capacity limit, Cloud Manager displays an action required message and no longer allows you to add additional disks.

For some configurations, disk limits prevent you from reaching the capacity limit by using disks alone. You can reach the capacity limit by tiering inactive data to object storage. Refer to the disk limits below for more details.

License	Maximum system capacity (disks + object storage)
Freemium	500 GB
PAYGO Explore	2 TB (data tiering is not supported with Explore)
PAYGO Standard	10 TB
PAYGO Premium	368 TB
Node-based license	368 TB per license
Capacity-based license	2 PiB

For an HA pair, is the licensed capacity limit per node or for the entire HA pair?

The capacity limit is for the entire HA pair. It is not per node. For example, if you use the Premium license, you can have up to 368 TB of capacity between both nodes.

For an HA pair, does mirrored data count against the licensed capacity limit?

No, it doesn't. Data in an HA pair is synchronously mirrored between the nodes so that the data is available in the event of failure in Google Cloud. For example, if you purchase an 8 TB disk on node A, Cloud Manager also allocates an 8 TB disk on node B that is used for mirrored data. While 16 TB of capacity was provisioned, only 8 TB counts against the license limit.

Disk and tiering limits

The table below shows the maximum system capacity with disks alone, and with disks and cold data tiering to object storage. The disk limits are specific to disks that contain user data. The limits do not include the boot disk and root disk.

Parameter	Limit
Maximum data disks	• 124 for single node systems • 123 per node for HA pairs
Maximum disk size	64 TB
Maximum system capacity with disks alone	256 TB [1]
Maximum system capacity with disks and cold data tiering to a Google Cloud Storage bucket	Depends on the license. See the table above.

[1] This limit is defined by virtual machine limits in Google Cloud Platform.

Aggregate limits

Cloud Volumes ONTAP groups Google Cloud Platform disks into *aggregates*. Aggregates provide storage to volumes.

Parameter	Limit
Maximum number of data aggregates [1]	• 99 for single node • 64 for an entire HA pair
Maximum aggregate size	256 TB of raw capacity [2]
Disks per aggregate	1-6 [3]
Maximum number of RAID groups per aggregate	1

Notes:

1. The maximum number of data aggregates doesn’t include the root aggregate.
2. The aggregate capacity limit is based on the disks that comprise the aggregate. The limit does not include object storage used for data tiering.
3. All disks in an aggregate must be the same size.

Storage VM limits

Some configurations enable you to create additional storage VMs (SVMs) for Cloud Volumes ONTAP.

These are the tested limits. While it is theoretically possible to configure additional storage VMs, it’s not supported.

Learn how to create additional storage VMs.

License type	Storage VM limit
Freemium	24 storage VMs total [1]
Capacity-based PAYGO or BYOL [2]	24 storage VMs total [1]
Node-based BYOL [3]	24 storage VMs total [1]
Node-based PAYGO	• 1 storage VM for serving data • 1 storage VM for disaster recovery

1. These 24 storage VMs can serve data or be configured for disaster recovery (DR).
2. For capacity-based licensing, there are no extra licensing costs for additional storage VMs, but there is a 4 TiB minimum capacity charge per storage VM. For example, if you create two storage VMs and each has 2 TiB of provisioned capacity, you'll be charged a total of 8 TiB.
3. For node-based BYOL, an add-on license is required for each additional *data-serving* storage VM beyond the first storage VM that comes with Cloud Volumes ONTAP by default. Contact your account team to obtain a storage VM add-on license.

   Storage VMs that you configure for disaster recovery (DR) don't require an add-on license (they are free of charge), but they do count against the storage VM limit. For example, if you have 12 data-serving storage VMs and 12 storage VMs configured for disaster recovery, then you've reached the limit and can't create any additional storage VMs.

Logical storage limits

Logical storage	Parameter	Limit
Files	Maximum size	16 TB
	Maximum per volume	Volume size dependent, up to 2 billion
FlexClone volumes	Hierarchical clone depth [12]	499
FlexVol volumes	Maximum per node	500
	Minimum size	20 MB
	Maximum size	100 TB
Qtrees	Maximum per FlexVol volume	4,995
Snapshot copies	Maximum per FlexVol volume	1,023

1. Hierarchical clone depth is the maximum depth of a nested hierarchy of FlexClone volumes that can be created from a single FlexVol volume.

iSCSI storage limits

iSCSI storage	Parameter	Limit
LUNs	Maximum per node	1,024
	Maximum number of LUN maps	1,024
	Maximum size	16 TB
	Maximum per volume	512
igroups	Maximum per node	256
Initiators	Maximum per node	512
	Maximum per igroup	128
iSCSI sessions	Maximum per node	1,024
LIFs	Maximum per port	1
	Maximum per portset	32
Portsets	Maximum per node	256

Known issues

Known issues identify problems that might prevent you from using this release of the product successfully.

There are no known issues in this release specific to Cloud Volumes ONTAP.

You can find known issues for ONTAP software in the ONTAP Release Notes.

Known limitations

Limitations in all cloud providers

Known limitations identify platforms, devices, or functions that are not supported by this release of the product, or that do not interoperate correctly with it. Review these limitations carefully.

The following limitations apply to Cloud Volumes ONTAP in all cloud providers: AWS, Azure, and Google Cloud.

Maximum concurrent replication operations

The maximum number of concurrent SnapMirror or SnapVault transfers for Cloud Volumes ONTAP is 100 per node, regardless of the instance type or machine type.

Cloud provider snapshots must not be used for your backup and recovery plans

You shouldn't use your cloud provider's snapshots as part of your backup and recovery plan for Cloud Volumes ONTAP data. You should always use ONTAP Snapshot copies or third-party backup solutions to back up and restore data hosted on Cloud Volumes ONTAP.

Learn how to use the Cloud Backup service to back up and restore ONTAP data.

ONTAP consistency points in the WAFL file system determine data consistency. Only ONTAP can quiesce the WAFL file system to make a crash-consistent backup.

Support in China regions

Cloud Volumes ONTAP is supported in China regions as follows.

- Cloud Volumes ONTAP 9.6 is supported in AWS China regions.
- Single node systems are supported.
- Licenses purchased directly from NetApp are supported.

All other locations, versions, configurations, and licenses aren't supported.

Cloud Volumes ONTAP supports Reserved and On-demand VM instances

Cloud Volumes ONTAP can run on either a Reserved or On-demand VM instance from your cloud provider. Other types of VM instances aren't supported.

Automatic application resource management solutions shouldn't be used

Automatic application resource management solutions should not manage Cloud Volumes ONTAP systems. Doing so can result in a change to an unsupported configuration. For example, the solution might change Cloud Volumes ONTAP to an unsupported VM instance type.

Software updates must be completed by Cloud Manager

Upgrades of Cloud Volumes ONTAP must be completed from Cloud Manager. You should not upgrade Cloud Volumes ONTAP by using System Manager or the CLI. Doing so can impact system stability.

Cloud Volumes ONTAP deployment must not be modified from your cloud provider's console

Changes to a Cloud Volumes ONTAP configuration from your cloud provider's console results in an unsupported configuration. Any changes to the Cloud Volumes ONTAP resources that Cloud Manager creates and manages can impact system stability and Cloud Manager's ability to manage the system.

Disks and aggregates must be managed from Cloud Manager

All disks and aggregates must be created and deleted directly from Cloud Manager. You should not perform these actions from another management tool. Doing so can impact system stability, hamper the ability to add disks in the future, and potentially generate redundant cloud provider fees.

SnapManager licensing limitation

SnapManager per-server licenses are supported with Cloud Volumes ONTAP. Per-storage system (SnapManager suite) licenses are not supported.

Unsupported ONTAP features

The following features are not supported with Cloud Volumes ONTAP:

- Aggregate-level inline deduplication
- Aggregate-level background deduplication
- Anti-ransomware
- Disk maintenance center
- Disk sanitization
- FabricPool mirroring
- Fibre Channel (FC)
- Flash Pools
- Infinite Volumes
- Interface groups
- Intranode LIF failover
- MetroCluster
- Multi-admin verification

  Enabling multi-admin verification on Cloud Volumes ONTAP will result in an unsupported configuration.

- ONTAP S3 in Google Cloud (the S3 protocol is supported in Azure and AWS)
- RAID4, RAID-DP, RAID-TEC (RAID0 is supported)
- Service Processor

- SnapLock Compliance and Enterprise modes (only Cloud WORM is supported)
- SnapMirror Synchronous
- VLANs

Known limitations in AWS

The following known limitations are specific to Cloud Volumes ONTAP in Amazon Web Services. Be sure to also review Limitations for Cloud Volumes ONTAP in all cloud providers.

AWS Outpost limitations

If you have an AWS Outpost, you can deploy Cloud Volumes ONTAP in that Outpost by selecting the Outpost VPC in the Working Environment wizard. The experience is the same as any other VPC that resides in AWS. Note that you will need to first deploy a Connector in your AWS Outpost.

There are a few limitations to point out:

- Only single node Cloud Volumes ONTAP systems are supported at this time
- The EC2 instances that you can use with Cloud Volumes ONTAP are limited to what's available in your Outpost
- Only General Purpose SSDs (gp2) are supported at this time

Flash Cache limitations

C5D and R5D instance types include local NVMe storage, which Cloud Volumes ONTAP uses as *Flash Cache*. Note the following limitations:

- Compression must be disabled on all volumes to take advantage of the Flash Cache performance improvements.

  You can choose no storage efficiency when creating a volume from Cloud Manager, or you can create a volume and then disable data compression by using the CLI.

- Cache rewarming after a reboot is not supported with Cloud Volumes ONTAP.

False alarms reported by Amazon CloudWatch

Cloud Volumes ONTAP does not release CPUs when idle, so Amazon CloudWatch can report a high CPU warning for the EC2 instance because it sees 100% usage. You can ignore this alarm. The ONTAP statistics command displays the true usage of the CPUs.

Cloud Volumes ONTAP HA pairs do not support immediate storage giveback

After a node reboots, the partner must sync data before it can return the storage. The time that it takes to resync data depends on the amount of data written by clients while the node was down and the data write speed during the time of giveback.

Learn how storage works in a Cloud Volumes ONTAP HA pair running in AWS.

Known limitations in Azure

The following known limitations are specific to Cloud Volumes ONTAP in Microsoft Azure. Be sure to also review Limitations for Cloud Volumes ONTAP in all cloud providers.

Flash Cache limitations

The Standard_L8s_v2 VM type includes local NVMe storage, which Cloud Volumes ONTAP uses as *Flash Cache*. Note the following limitations for Flash Cache:

- Compression must be disabled on all volumes to take advantage of the Flash Cache performance improvements.

  You can choose no storage efficiency when creating a volume from Cloud Manager, or you can create a volume and then disable data compression by using the CLI.

- Cache rewarming after a reboot is not supported with Cloud Volumes ONTAP.

HA limitations

HA pairs aren't supported in some regions.

View the list of supported Azure regions.

Pay-as-you-go not available for CSP partners

If you are a Microsoft Cloud Solution Provider (CSP) partner, you cannot deploy Cloud Volumes ONTAP Explore, Standard, or Premium because pay-as-you-go subscriptions are not available for CSP partners. You must purchase a license and deploy Cloud Volumes ONTAP BYOL.

Known limitations in Google Cloud

The following known limitations are specific to Cloud Volumes ONTAP in Google Cloud Platform. Be sure to also review Limitations for Cloud Volumes ONTAP in all cloud providers.

Limitation with packet mirroring

Packet mirroring must be disabled in the Google Cloud VPC in which you deploy Cloud Volumes ONTAP.

Cloud Volumes ONTAP can't operate properly if packet mirroring is enabled.

Google Private Service Connect limitations

If you leverage Google Private Service Connect within the VPC that you are deploying Cloud Volumes ONTAP into, you will need to implement DNS records that forward traffic to the required Cloud Manager API Endpoints.

Tiering data from Cloud Volumes ONTAP into a Google Cloud Storage bucket is not currently supported with Private Service Connect.

Cloud provider integrations

This page describes how NetApp works with cloud providers to resolve issues that might arise.

Collaborative support best practices

NetApp is committed to provide support to Licensee and will use commercially reasonable efforts to resolve technical support issues for Cloud Volumes ONTAP when reported by the Licensee. NetApp and the applicable cloud provider don’t have any direct support obligations to each other’s licensed software or infrastructure.

NetApp has implemented tools aimed to connect with applicable cloud providers on customer technical issues that may be a result of the applicable cloud provider services. However, the best way to maintain a seamless support flow is for customers to (i) maintain a current support contract with both NetApp and the applicable cloud provider and (ii) coordinate joint escalation meetings with both NetApp and the applicable cloud provider when technical issues arise and the customer needs clarity on which products or services are causing those technical issues.

Azure maintenance events

Microsoft schedules and programmatically announces maintenance events on its Azure virtual machine (VM) infrastructure that may affect Cloud Volumes ONTAP VMs. These events are announced 15 minutes prior to the maintenance window.

Special handling of the maintenance events is supported for Cloud Volumes ONTAP high availability (HA) pairs. To maintain application health, we perform a preventive takeover to prioritize stability, as any loss of connectivity of more than 15 seconds will disable failover capabilities.

When the maintenance window is announced, the partner node of the targeted node will perform a takeover. When the maintenance is complete, a giveback will be initiated. After the giveback, the HA pair is expected to return to a healthy state. If this doesn’t occur, contact NetApp Support for assistance. Note that maintenance events are targeted at one of the VMs in an HA pair at a time, and typically both nodes are targeted in a relatively short period of time.

CIFS/SMB clients that use Cloud Volumes ONTAP non-continuously available CIFS shares will experience a loss of session both when a takeover occurs, and when the aggregate that the session is using is given back to the aggregate’s home node. This is a limitation imposed by the CIFS/SMB protocol itself. Customers may wish to use third-party products to avoid issues that may arise from takeover and giveback. For further assistance, contact NetApp Support.

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- Notice for the Cloud Volumes ONTAP 9.11.1 mediator in AWS
- Notice for the Cloud Volumes ONTAP 9.11.1 mediator in Google Cloud