Introduction to APEX File Storage for Microsoft Azure

Architecture and Performance Guidelines

April 2024

H19985

White Paper

Abstract

This white paper provides an introduction to APEX File Storage for Microsoft Azure, including architecture, supported cluster configurations, and performance considerations.

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Executive summary

Overview

In this white paper, we present an architecture overview of APEX File Storage for Microsoft Azure and delve into the performance considerations of clusters: including cluster size, Azure virtual machine (VM) size, and Azure managed disk type. The paper also showcases the results of performance tests conducted on various example cluster configurations.

Revisions

Date	Part number/ revision	Description
April 2024	H19985	Initial release

We value your feedback

Dell Technologies and the authors of this document welcome your feedback. Contact the Dell Technologies team by email.

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Note: For links to other documentation for this topic, see the PowerScale Info Hub.

Benefits of running OneFS in the cloud

Dell PowerScale OneFS is a highly scalable and flexible file system designed to meet the demanding storage needs of data-intensive workloads. It serves as the underlying software platform that powers Dell PowerScale appliance nodes, enabling them to function as a unified distributed file system. APEX File Storage for Microsoft Azure introduces the OneFS distributed file system software into the public cloud, enabling users to enjoy the same management experience in the cloud as with their on-premises PowerScale appliance.

By leveraging APEX File Storage for Microsoft Azure, you can effortlessly deploy and manage file storage on Azure without the need for hardware administration. This service provides a flexible and elastic storage infrastructure that can expand or shrink according to your business requirements.

Key features and benefits of APEX File Storage for Microsoft Azure include:

- **Simplified journey to hybrid cloud:** With the increasing adoption of hybrid cloud environments, organizations often face the challenge of seamlessly moving data between on-premises and cloud-based environments. APEX File Storage for Microsoft Azure simplifies this transition by enabling effortless data mobility through native replication and provides a consistent data management platform across both environments.
- **Scalability:** Because the APEX File Storage for Microsoft Azure leverages the OneFS distributed file system, you have the flexibility to begin with a compact OneFS cluster and gradually expand it as your data storage needs increase. The capacity can be dynamically scaled up to a maximum cluster capacity of 5.6 PiB. These features allow you to scale your storage infrastructure as needed, avoiding excessive provisioning, and reducing upfront capital expenses. Once in the cloud, you can take advantage of the enterprise-class features of OneFS. These include: multiprotocol support, CloudPools, Data Reduction and Snapshots, to run your workloads in a manner consistent with your on-premises operations. APEX File Storage for Microsoft Azure can use CloudPools to tier cold or infrequently accessed data to cost-effective cloud storage services such as Azure Blob Storage. CloudPools extends the OneFS namespace to the private and public cloud and allows you to store far more data than the usable cluster capacity.
- **Data management:** APEX File Storage for Microsoft Azure offers powerful data management capabilities which includes: snapshots, data replication, and backup and restore. These features enable you to protect critical data, ensure high availability and streamline data management. The uniformity of OneFS features across both cloud and on-premises environments allows organizations to simplify operations, reduce the complexity of management, and maintain a consistent user experience.
- **Data Resilience:** Ensuring data resilience is critical for businesses to maintain continuity and to safeguard information. APEX File Storage for Microsoft Azure implements erasure coding techniques. This advanced approach optimizes storage efficiency and enhances fault tolerance, enabling the cluster to withstand multiple node failures. By spreading nodes across different racks

using Azure availability set, the cluster ensures that data accessibility is maintained in the event of a rack failure.

- **High performance:** APEX File Storage for Microsoft Azure offers exceptional file storage performance with low-latency access to data, ensuring that you can access data quickly and efficiently.

APEX File Storage for Microsoft Azure architecture and use cases

Architecture

APEX File Storage for Microsoft Azure is a software-defined cloud file storage service that combines the power of the OneFS distributed file system with the flexibility and scalability of cloud infrastructure. It is a fully customer-managed service that is designed to meet the needs of enterprise-scale file workloads running on Azure. The architecture of APEX File Storage for Microsoft Azure is built on the OneFS distributed file system. This architecture uses multiple cluster nodes to establish a single global namespace. Each cluster node operates as an instance of the OneFS software, running on an Azure VM to deliver storage capacity and compute resources. It is worth noting that the network bandwidth limit at the Azure VM level is shared between the cluster internal network and the external network.

APEX File Storage for Microsoft Azure uses cloud-native technologies and leverages the elasticity of cloud infrastructure, so that you can easily scale the storage infrastructure as your business requirements grow. APEX File Storage for Microsoft Azure can dynamically scale storage capacity and performance to meet changing demands by adding additional cluster nodes without disruption, enabling the storage infrastructure to scale in a more cost-effective and efficient manner. To guarantee the durability and resiliency of data, APEX File Storage for Microsoft Azure distributes data across multiple nodes within the cluster. It also uses advanced data protection techniques such as erasure coding and provides features such as SyncIQ to ensure that data is available. Even in the event of one or more node failures, the data remains accessible from the remaining cluster nodes.

Figure 1 shows the technical architecture of APEX File Storage for Microsoft Azure.

- **Availability set and proximity placement group:** APEX File Storage for Microsoft Azure is designed to run in an availability set, and the availability set is associated with a dedicated proximity placement group. In this way, APEX File Storage for Microsoft Azure can have better reliability by ensuring more consistent lower latency on the cluster backend network.
- **Virtual network:** APEX File Storage for Microsoft Azure requires an Azure virtual network to provide network connectivity.
- **OneFS cluster internal subnet:** The cluster nodes communicate with each other through a dedicated internal subnet. The internal subnet must be isolated from VMs that are not in the cluster. At least /27 subnet is needed to scale to a maximum of 18 nodes.
- **OneFS cluster external subnet:** The cluster nodes communicate with clients through the external subnet by using different protocols, such as NFS, SMB, and S3.

- **OneFS cluster internal network interfaces:** Network interfaces are in the internal subnet.
- **OneFS cluster external network interfaces:** Network interfaces are in the external subnet.
- **Network security group:** The network security group applies to the cluster network interfaces, which allows/denies specific traffic to OneFS cluster.
- **Azure VMs:** These VMs serve as cluster nodes running the OneFS file system, backed by Azure managed disks. Each node within the cluster is strategically placed in an availability set and a proximity placement group. This configuration ensures that all nodes reside in separate fault domains, enhancing reliability, and also brings them physically closer together to enable lower network latency between cluster nodes. See the [Azure availability sets overview] and [Azure proximity placement groups] documentation for more details.

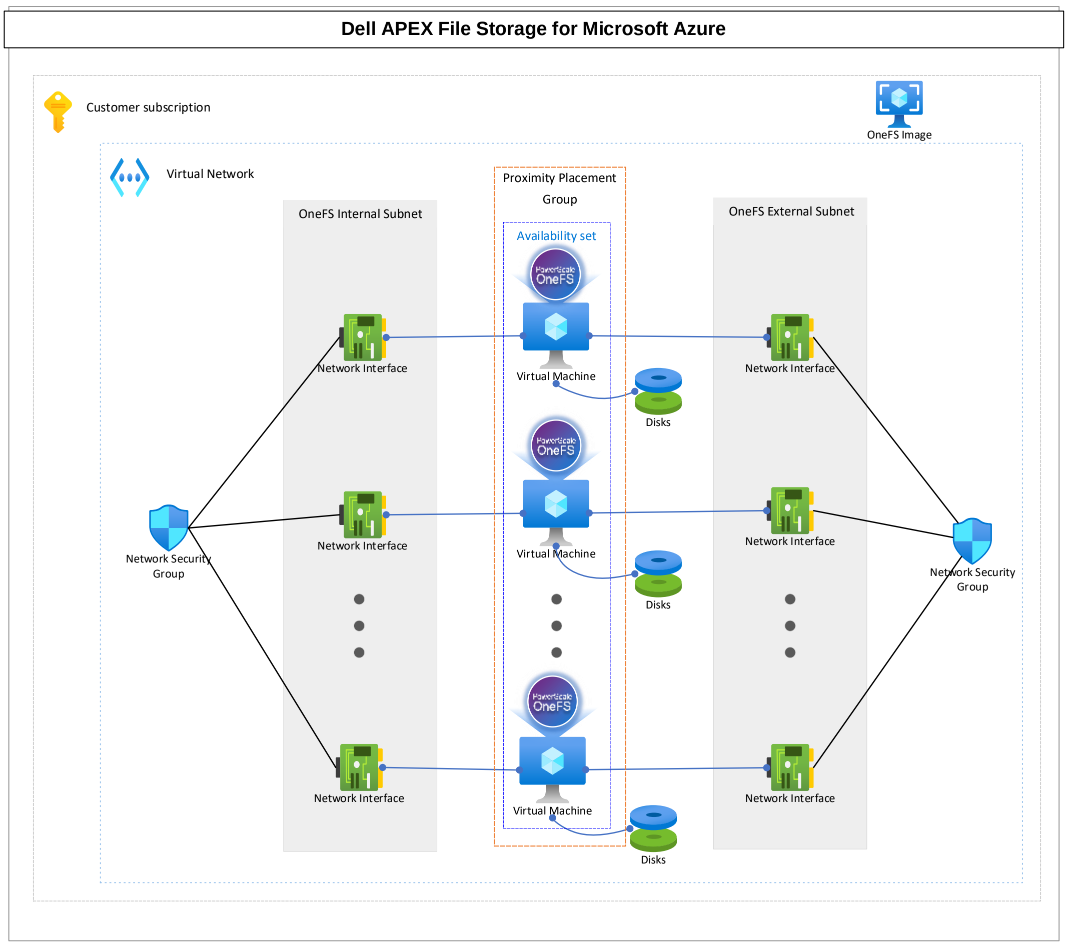

Figure 1. APEX File Storage for Microsoft Azure architecture

Overall, the APEX File Storage for Microsoft Azure offers a powerful and flexible scale-out file storage solution that can help improve data management, optimize costs, and achieve scalability and security in a cloud-based environment.

Use cases

APEX File Storage for Microsoft Azure provides a range of use cases, including data mobility, cloud burst, disaster recovery to cloud, and streamlined management.

Data mobility

APEX File Storage for Microsoft Azure provides data mobility through OneFS SyncIQ. SyncIQ data mobility provides:

- **Snapshots integration:** To provide point-in-time data protection, when a SyncIQ job starts, it automatically generates a snapshot of the dataset stored on-premises and moves them to the cloud for backup and disaster recovery purposes. These snapshots ensure that data is available if an outage or other disruption occurs.
- **Data synchronization:** APEX File Storage for Microsoft Azure provides synchronization capabilities, enabling organizations to keep data synchronized between different Azure cloud regions clusters, or between on-premises clusters and cloud clusters. This synchronization ensures that data is up-to-date and available across multiple locations.
- **Data Migration:** With support for data replication to and from cloud clusters, APEX File Storage for Microsoft Azure enables seamless data migration between different environments. This enhances flexibility and scalability, enabling organizations to optimize their storage and cloud infrastructure.

Cloud burst

APEX File Storage for Microsoft Azure provides a flexible and scalable solution for cloud burst scenarios. Cloud burst refer to a scenario in cloud computing where a sudden and unexpected surge in demand for compute, storage, and network resources occurs. APEX File Storage for Microsoft Azure allows organizations to rapidly allocate additional storage compute and capacity in the cloud, eliminating the requirement for upfront hardware investment. Cloud burst scenarios can arise for various reasons, such as in industry-specific workflows like video rendering in Media and Entertainment, seasonal peaks in demand, unforeseen workload surges, or sudden business growth. Additionally, compute-intensive workloads such as AI/ML and analytics can also be efficiently executed within this environment.

Streamlined management

APEX File Storage for Microsoft Azure provides the same storage management interfaces and data access interfaces as an on-premises PowerScale appliance. This eliminates the need for application refactoring during the migration from on-premises to cloud and minimizes the need to retrain storage administrators.

Supported cluster configurations

When setting up a new cluster, it is important to consider the type of storage configuration that is supported. Different configurations fulfill different requirements, depending on the intended use and the amount of data that needs to be stored. In general, a supported cluster configuration should be reliable, performant and offer enough storage capacity to meet your needs.

For a single cluster of APEX File Storage for Microsoft Azure, all nodes in the cluster must use the same configuration, including Azure VM size, Azure managed disk type, and Azure managed disk size.

Table 1 shows the supported configuration for a OneFS cluster in Azure.

Table 1. Supported configuration for a single cluster

Configuration items	Supported options
Cluster size	4 to 18 nodes
Azure VM size	All nodes in a cluster must use the same VM size. The supported VM sizes are: • Ddv5-series: Standard_D32d_v5 and above • Ddsv5-series: Standard_D32ds_v5 and above • Edv5-series: Standard_E32d_v5 and above • Edsv5-series: Standard_E32ds_v5 and above
Azure managed disk type	All nodes in a cluster muse use the same disk type. The supported disk types are: • Premium SSDs: P20 – P70 • Standard SSDs: E20 – E70 • Standard HDDs: S40 – S70 **Note:** Premium SSDs are only supported with Ddsv5-series and Edsv5-series
Azure managed disk size	All nodes in a cluster muse use the same disk size. The supported disk sizes are: • **0.5 TiB**: P20 or E20 • **1 TiB**: P30 or E30 • **2 TiB**: P40, E40, or S40 • **4 TiB**: P50, E50, or S50 • **8 TiB**: P60, E60, or S60 • **16 TiB**: P70, E70, or S70
Disk count per node	All nodes in a cluster muse use the same disk count. The supported disk counts are: • 5, 6, 10, 12, 15, 18, 20, 24, 25, or 30
Cluster raw capacity	Minimum: 10 TiB, maximum: 5760 TiB
Cluster protection level	Default is +2n. Also supports +2d:1n with additional capacity restrictions. Refer to section OneFS protection level.

Note: all criteria in this table must be met. Therefore, when using **16 TiB** disk size, **not all combinations of cluster size, disk count, and disk size are supported.** For some combinations of cluster size, disk count, and disk size, the total cluster raw capacity may fall outside the maximum supported cluster raw capacity. For example, for an 18-nodes cluster, if each node contains 25 disks, and each disk size is P70 (16 TiB), the final total cluster raw capacity is 7200 TiB which exceeds the maximum supported raw capacity. Therefore, this combination is not supported.

See Appendix A: supported cluster configuration details for all supported combinations.

Data protection

File system journal

The OneFS journal, which stores information about changes to the file system, is designed to enable fast, consistent recoveries after system failures or crashes. The file system replays the journal entries after a node or cluster recovers from an outage.

Each Azure VM node contains local SSD storage, also known as temporary disk. OneFS leverages one of the local SSD as the journal target storage for protecting uncommitted writes to the file system. When a node boots up, it checks its journal and selectively replays transactions to disk where the journaling system deems it necessary.

OneFS protection level

A OneFS cluster is designed to withstand one or more simultaneous component failures while continuing to serve data. To achieve this, OneFS protects files with either erasure code-based protection, using Reed-Solomon error correction (N+M protection), or a mirroring system. Data protection is applied in software at the file level, enabling the system to focus on recovering only those files that are compromised by a failure, rather than having to check and repair an entire file set or volume. OneFS metadata and inodes are always protected by mirroring, rather than Reed-Solomon coding, and with at least the level of protection as the data they reference. For more technical details about OneFS protection levels, refer to OneFS Data Protection.

APEX File Storage for Microsoft Azure is set with a default protection level of +2n, capable of tolerating the failure of up to two drives or two nodes. We have chosen this +2n protection level for APEX File Storage for Microsoft Azure to ensure robust availability and reliability in the cloud environment. While the default setting prioritizes resilience, users have the option to adjust the protection level to +2d:1n for improved storage efficiency. However, it is essential to note that this configuration comes with certain capacity restrictions. The +2d:1n option can tolerate the failure of either two drives or one node.

For clarity on how different protection levels affect storage capacity, Table 2 outlines the maximum cluster raw capacity limits for utilizing the +2d:1n protection level with various Azure managed disk sizes. If these capacity limits are exceeded, users must revert to the default +2n protection level when expanding the cluster to accommodate additional capacity needs. For example, if you have a 14-node cluster with +2d:1n protection level and each node has 15 disks using P50 Azure managed disks, the cluster raw capacity is 840 TiB. If you add more P50 nodes into the cluster, the cluster raw capacity will exceed the limit that +2d:1n allows, as described in Table 2. Therefore, you must change the protection from +2d:1n to +2n.

Refer to Appendix A: supported cluster configuration details for comprehensive details on supported cluster configurations. It includes information about various combinations of cluster node count, disk size, and disk count per node. Additionally, the appendix specifies whether +2d:1n protection level is supported with specific configurations.

Table 2. Cluster raw capacity restriction using +2d:1n

Azure managed disk type	Disk size (TiB)	Min cluster raw capacity (TiB) using +2n or +2d:1n	Max cluster raw capacity (TiB) using +2d:1n	Max cluster raw capacity (TiB) using +2n
P20	0.5	10	270	270
P30	1	20	540	540
P40	2	40	840	1080
P50	4	80	840	2160
P60	8	160	1440	4320
P70	16	320	1440	5760
E20	0.5	10	240	270
E30	1	20	240	540
E40	2	40	240	1080
E50	4	80	240	2160
E60	8	160	800	4320
E70	16	320	1600	5760
S40	2	40	280	1080
S50	4	80	280	2160
S60	8	160	800	4320
S70	16	320	1120	5760

The protection overhead varies with cluster size. Table 3 shows the protection overhead of APEX File Storage for Microsoft Azure with different cluster sizes. File system efficiency increases as the cluster size grows, meanwhile the storage efficiency gap between +2n and +2d:1n is also smaller as cluster size grow. Therefore, if capacity is your primary requirement, opting for +2d:1n in a small cluster can yield a higher usable cluster capacity. Conversely, utilizing +2n in a large cluster ensures storage efficiency while maintaining superior resilience. Usable cluster capacity refers to the amount of storage capacity available for storing data after accounting for protection overhead. Reference Appendix B: cluster raw capacity and usable capacity for the min and max usable capacity using different protection levels.

Table 3. Protection overhead

Cluster size	Requested protection level +2n		Requested protection level +2d:1n	
	Data blocks + protection blocks	Protection overhead	Data blocks + protection blocks	Protection overhead
4 nodes	2+2	50%	6+2	25%
5 nodes	3+2	40%	8+2	20%
6 nodes	4+2	33%	10+2	17%
7 nodes	5+2	29%	12+2	14%
8 nodes	6+2	25%	14+2	13%
9 nodes	7+2	22%	16+2	11%
10 nodes	8+2	20%	16+2	11%

Cluster size	Requested protection level +2n		Requested protection level +2d:1n	
	Data blocks + protection blocks	Protection overhead	Data blocks + protection blocks	Protection overhead
11 nodes	9+2	18%	16+2	11%
12 nodes	10+2	17%	16+2	11%
13 nodes	11+2	15%	16+2	11%
14 nodes	12+2	14%	16+2	11%
15 nodes	13+2	13%	16+2	11%
16 nodes	14+2	13%	16+2	11%
17 nodes	15+2	12%	16+2	11%
18 nodes	16+2	11%	16+2	11%

Note: The final effective capacity of a OneFS cluster depends on the characteristics of the data and on file system features in use. For example, OneFS provides inline data reduction and small file efficiency features to help save storage capacity. Data capacity savings due to inline data reduction and small file efficiency are highly dependent on the data and can vary considerably. This variance means that accurate rates of savings are not predictable without comprehensive analysis of the dataset. The preceding usable cluster capacity estimation is for guidance only when implementing APEX File Storage for Microsoft Azure. For more details about storage efficiency, see the white paper Dell PowerScale OneFS: Data Reduction and Storage Efficiency.

Azure infrastructure considerations

This chapter will cover factors specific to the Azure platform itself. The OneFS software operates on the underlying infrastructure in Azure and the foundational configuration directly impacts the OneFS cluster's performance. To find more performance test details, refer to the Performance section.

Cluster Azure VMs

APEX File Storage for Microsoft Azure supports Ddv5-series, Ddsv5-series, Edv5-series, and Edsv5-series VM types with a minimum of 32 vCPUs. Different Azure VM sizes provide different compute, memory, storage, and network capabilities. Choose a VM size based on the requirements of your workload. Here are some guidelines to consider:

- **Network bandwidth:** In an Azure cloud environment, larger virtual machines receive more bandwidth compared to smaller ones. The allocation of network bandwidth to each virtual machine is measured based on egress traffic across all network interfaces attached to a virtual machine. Ingress traffic is not directly metered or restricted. For example, a Standard_D48ds_v5 OneFS node has max 24,000 Mbps network bandwidth, which is shared by both node’s external and internal interfaces. For details on the maximum network bandwidth of each VM size, refer to Azure documentation Ddv5 and Ddsv5-series and Edv5 and Edsv5-series.
- **Max uncached disk throughput:** the default storage maximum throughput limit that the virtual machine can handle. Refer to Azure documentation for more details.

- **Max burst uncached disk throughput:** leverages the virtual machine-level bursting to achieve higher storage throughput than max uncached disk throughput. When a deployment is planned, it is recommended tosee Appendix C: recommended data disk configuration details for optimal performance fordata disks configuration per node.
- **Virtual machine-level bursting:** OneFS cluster performance can benefit from the Azure VM burst capability to temporarily increase the cluster performance beyond their baseline. Refer to Azure bursting documentation for more details.
- **Disk encryption key management:** Azure managed disks typically use Azure Storage encryption, utilizing server-side encryption (SSE) to safeguard data and ensure compliance with security and organizational requirements. APEX File Storage supports both platform-managed keys and customer-managed keys.

Azure managed disks

APEX File Storage for Microsoft Azure supports Premium SSDs, Standard SSDs, and Standard HDDs. These disk types have different characteristics.

Premium SSDs:

- Performance: Premium SSDs offer high-performance storage with low latency and high IOPS (Input/Output Operations Per Second).
- Reliability: Premium SSDs provide high reliability and endurance, making them ideal for demanding production environments.
- Cost: Premium SSDs are more expensive compared to standard SSDs and HDDs due to their superior performance and reliability.

Standard SSDs:

- Performance: Standard SSDs offer improved performance over traditional HDDs but are generally slower than premium SSDs.
- Reliability: While not as robust as premium SSDs, standard SSDs still offer higher reliability and durability compared to standard HDDs.
- Cost: Standard SSDs are priced lower than premium SSDs but higher than standard HDDs, offering a balance between performance and cost.

Standard HDDs (Hard Disk Drives):

- Performance: Standard HDDs have slower read/write speeds and higher latency compared to SSDs.
- Reliability: Standard HDDs provide lower reliability compared to SSDs.
- Cost: Standard HDDs offer the lowest cost per gigabyte among the three options but provide the lowest performance.

In summary, the choice between Azure premium SSDs, standard SSDs, and standard HDDs depends on the specific requirements of the workload, including performance needs, budget constraints, and storage capacity requirements.

Performance

Test methodology

To understand the performance characteristics of APEX File Storage for Microsoft Azure, a standard benchmark tool was used. It is used for conducting sequential read tests with a request size of 128 KiB and sequential write tests with a request size of 512 KiB, with NFS version 3.

Regarding the sequential read/write tests, here are a few specifics:

- In the tests, the OneFS access pattern "streaming" was applied to the top-level test directory and any child objects of that directory. For more information about OneFS data access patterns, see PowerScale OneFS Best Practices.
- Sequential writes (100% writes) are done to large test files. Each write thread writes to a unique large test file. We used 80 GiB files for sequential writes.
- Sequential reads (100% reads) are done from existing large test files. Each read thread reads from a unique large test file. We used 80 GiB files for sequential reads.

The OneFS inline compression and inline deduplication features were left at their defaults (enabled) during all tests. The benchmark workload specified 0% compressible or deduplicated data blocks. The data reduction ratio for the dataset is 1.0 in the tests.

Note: There is a known issue that the inline deduplication and inline compression feature is not enabled by default at the disk pool level. The first MR (Major Release) will fix it after GA (General Availability). You can also reach out to your sales representative if you need an immediate fix.

In the tests, we used Standard_D48s_v5 clients to generate I/O to the OneFS clusters. The ratio of clients to nodes is 2:1. Each client instance contained 48 vCPU cores and 192 GiB memory, and the network bandwidth was 24 Gbps. For each test, we followed the rule of ensuring that the aggregate bandwidth of data disks is sufficient at the VM level. See Appendix C: recommended data disks configuration details for optimal performance.

All performance tests in this document were performed in the South Central US location.

Considerations

Overall, our performance testing identified several key considerations to address prior to deploying APEX File Storage for Microsoft Azure clusters. These considerations are crucial to ensure that the clusters can effectively meet your organization's performance needs.

This section describes the three key factors that affect performance when designing a OneFS cluster of APEX File Storage for Microsoft Azure. The key factors are:

- Node types
- Node scale-out
- Virtual machine-level bursting

Note: The performance testing is conducted with supported +2d:1n protection level configurations. See Appendix A: supported cluster configuration details for all supported combinations.

Starting with OneFS 9.8.0.0, APEX File Storage for Microsoft Azure supports Ddv5-series VMs, Ddsv5-series VMs, Edv5-series VMs, and Edsv5-series VMs. Table 4 shows two Azure storage throughput limits and the network bandwidth limit at the node level for tests. These three limits will directly impact the maximum sequential read throughput performance.

Table 4. Azure storage throughput limits and network bandwidth limits for tested node types

Node type/VM size	vCPU	Memory (GiB)	Max uncached disk throughput (MBps)	Max burst uncached disk throughput (MBps)	Max network bandwidth (Mbps)
Standard_D32ds_v5	32	128	865	2,000	16,000
Standard_D48ds_v5	48	192	1,315	3,000	24,000
Standard_D64ds_v5	64	256	1,735	3,000	30,000
Standard_E104ids_v5	104	672	4,000	4,000	100,000

When optimizing the performance of a cluster, it is recommended to see Appendix C: recommended data disk configuration details for optimal performance for data disks configuration per node.

Node types

This section describes sequential read and sequential write performance for different node types.

Sequential read throughput

The Figure 2 represents a 128KB sequential read workload for different node types. It indicates that the sequential read performance increases with more powerful (larger VM size) nodes in the cluster.

The max burst uncached disk throughput and max network bandwidth directly impact the maximum sequential read throughput performance.

- **Max burst uncached disk throughput**: For E104ids_v5 node, its sequential read performance is constrained by the node-level storage throughput limit, which is max uncached disk throughput or max burst uncached disk throughput as shown in Table 5.
- **Max network bandwidth**: For most node types (excluding E104ids_v5), their sequential read performance is constrained by their node-level network bandwidth limit as shown in Table 5. The network bandwidth of a node is measured based on egress traffic across all network interfaces. This network bandwidth is shared by both node’s external (front-end) and internal (back-end) interfaces.

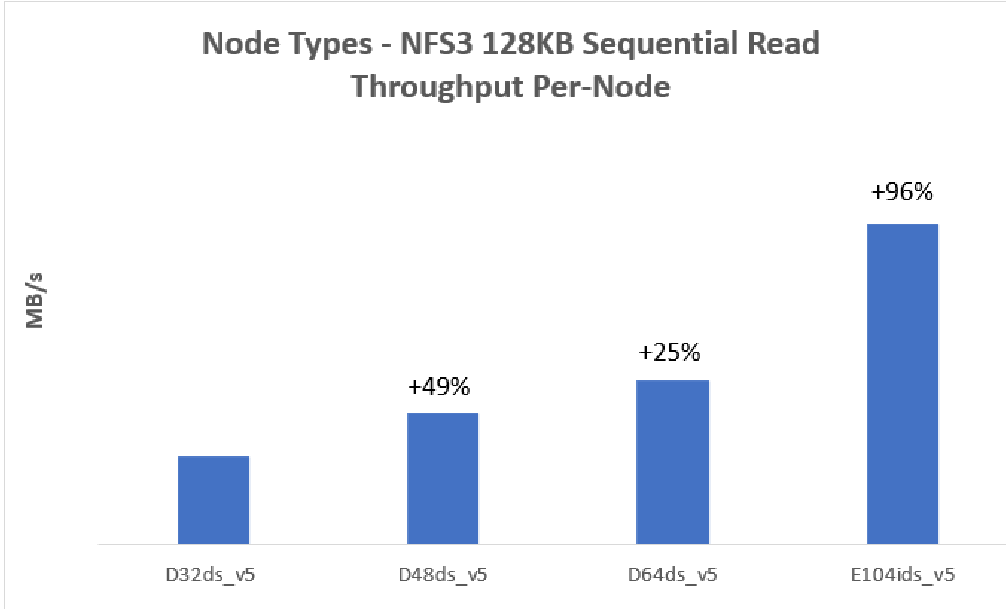

Figure 2. Sequential read throughput for different node types

Note: Each test uses 4-node cluster with 12 data disks per node.

Sequential write throughput

The Figure 3 represents a 512KB sequential write workload for different node types. It indicates that the sequential write performance increases with more powerful (larger VM size) nodes in the cluster.

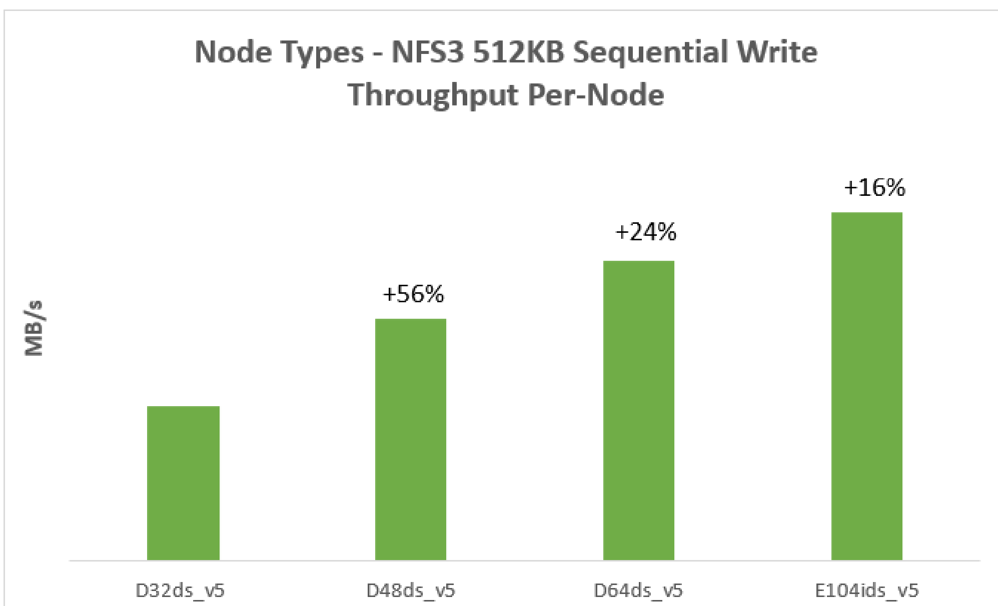

Figure 3. Sequential write throughput for different node types

Note: Each test uses 4-node cluster with 12 data disks per node.

Node scale-out

This section describes sequential read and sequential write performance for node scale-out.

Table 5 shows cluster configurations for node scale-out tests.

Table 5. Cluster configurations for node scale-out tests

Node type	Node count	Data disk type	Data disk count
Standard_D48ds_v5	10	P40	12
Standard_D48ds_v5	14	P40	12
Standard_D48ds_v5	18	P40	12

Note: The performance testing is conducted with supported +2d:1n protection level configurations. See Appendix A: supported cluster configuration details for all supported combinations.

Sequential read throughput

Figure 4 represents a 128KB sequential read workload for node scale-out. It indicates that the sequential read performance increases with more nodes in the cluster.

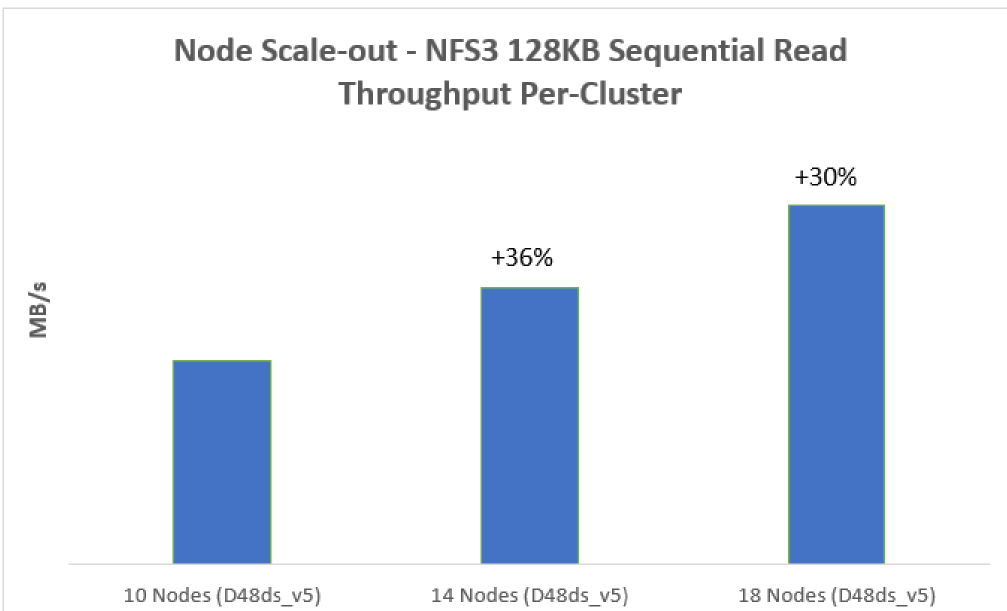

Figure 4. Sequential read performance for node Scale-out

Sequential write throughput

Figure 5 represents a 512KB sequential write workload for node scale-out. It indicates that the sequential write performance increases with more nodes in the cluster.

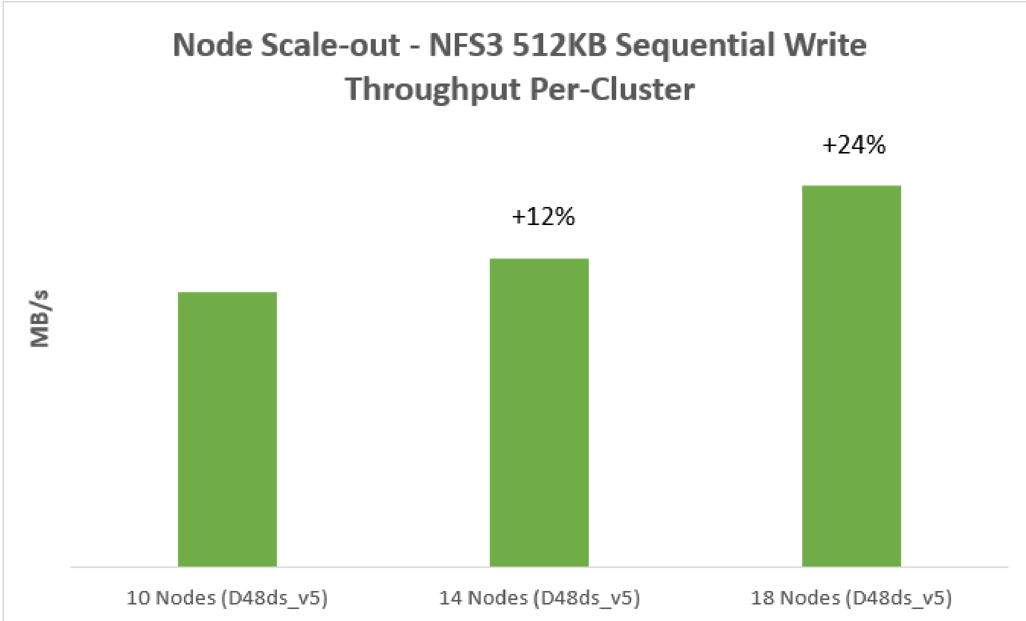

Figure 5. Sequential write performance for node Scale-out

Virtual machine-level bursting

This section describes sequential read performance when leveraging virtual machine-level bursting.

For VMs that support bursting, Azure will start with fully stocked credits for the VM and allow bursting for up to 30 minutes at the maximum burst rate, which is higher than the virtual machine-level's max uncached disk throughput. The VM-level burst credits are restocked whenever throughput falls below the VM-level maximum uncached disk throughput limit. It takes less than a day to fully restock when burst credits are fully depleted. For more information about virtual machine-level bursting, see the [Azure bursting document].

Since sequential writes do not utilize virtual machine-level bursting due to sequential write throughput lower than the virtual machine-level's max uncached disk throughput, virtual machine-level bursting does not affect sequential write performance.

Sequential read throughput

The Figure 6 represents a 128KB sequential read workload with and without VM-level bursting.

- **With VM-level bursting**: The sequential read performance can surpass the VM-level maximum uncached disk throughput limit when utilizing VM-level bursting. With VM-level bursting, Figure 6 shows that a single D32ds_v5 node can exceed the VM-level maximum uncached disk throughput limit. However, the sequential read performance does not reach the VM-level maximum burst uncached disk throughput limit due to constraints imposed by the VM-level network bandwidth limit. This network bandwidth is shared between both the VM's external (front-end) and internal (back-end) interfaces.

- **Without VM-level bursting**: When VM-level burst credits are depleted, the sequential read workload runs without VM-level bursting. The sequential read throughput per node closely aligns with its VM-level maximum uncached disk throughput. Without VM-level bursting. Figure 6 shows that a single D32ds_v5 node read throughput is close to its VM-level maximum uncached disk throughput limit.

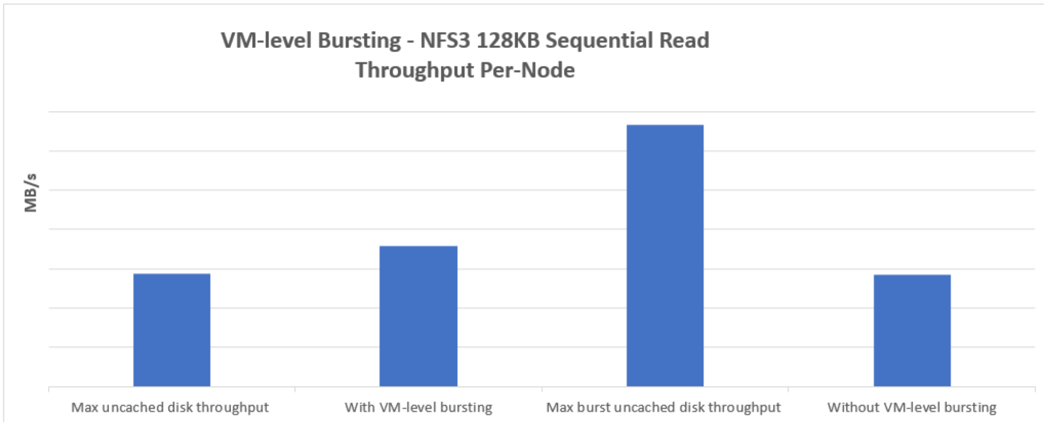

Figure 6. Sequential read performance for with and without VM-level bursting

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Note: This test uses 4 D32ds_v5 nodes cluster with 12 data disks per node.

Disclaimer

Benchmark results depend on workload, specific application requirements and system design and implementation. Relative system performance varies based on these and other factors. These benchmark results should not be used as a substitute for a specific customer application profiling when critical capacity planning or product evaluation decisions are made. All performance results presented in this report were obtained in a rigorously controlled environment. Results obtained in other operating environments may vary significantly. Dell Technologies does not warrant or represent that a user can or will achieve similar performance results.

APEX File Storage for Microsoft AzureAPEX File Storage for Microsoft AzureAPEX File Storage for Microsoft AzureAPEX File Storage for Microsoft AzureAPEX File Storage for Microsoft Azure

Appendix A: supported cluster configuration details

This appendix lists all supported cluster configuration for different disk types and sizes, it also indicates whether +2d:1n OneFS protection level is supported in the specific configuration. Below is the quick reference link to different disk sizes:

- Disk size 0.5 TiB: Cluster using P20 or E20
- Disk size 1 TiB: Cluster using P30 or E30
- Disk size 2 TiB: Cluster using P40, E40, or S40
- Disk size 4 TiB: Cluster using P50, E50, or S50
- Disk size 8 TiB: Cluster using P60, E60, or S60
- Disk size 16 TiB: Cluster using P70, E70, or S70

Cluster using P20 or E20

The following table shows the available combinations of cluster size, disk count by using 0.5 TiB disk size with P20 or E20.

Table 6. Supported configurations details – P20 or E20

Disk count per node	Node count	Cluster raw capacity (TiB)	Support +2d:1n using P20	Support +2d:1n using E20
5	4	10	Yes	Yes
5	5	12.5	Yes	Yes
5	6	15	Yes	Yes
5	7	17.5	Yes	Yes
5	8	20	Yes	Yes
5	9	22.5	Yes	Yes
5	10	25	Yes	Yes
5	11	27.5	Yes	Yes
5	12	30	Yes	Yes
5	13	32.5	Yes	Yes
5	14	35	Yes	Yes
5	15	37.5	Yes	Yes
5	16	40	Yes	Yes
5	17	42.5	Yes	Yes
5	18	45	Yes	Yes
6	4	12	Yes	Yes
6	5	15	Yes	Yes
6	6	18	Yes	Yes
6	7	21	Yes	Yes
6	8	24	Yes	Yes
6	9	27	Yes	Yes
6	10	30	Yes	Yes
6	11	33	Yes	Yes
6	12	36	Yes	Yes
6	13	39	Yes	Yes
6	14	42	Yes	Yes
6	15	45	Yes	Yes
6	16	48	Yes	Yes
6	17	51	Yes	Yes
6	18	54	Yes	Yes

Disk count per node	Node count	Cluster raw capacity (TiB)	Support +2d:1n using P20	Support +2d:1n using E20
10	4	20	Yes	Yes
10	5	25	Yes	Yes
10	6	30	Yes	Yes
10	7	35	Yes	Yes
10	8	40	Yes	Yes
10	9	45	Yes	Yes
10	10	50	Yes	Yes
10	11	55	Yes	Yes
10	12	60	Yes	Yes
10	13	65	Yes	Yes
10	14	70	Yes	Yes
10	15	75	Yes	Yes
10	16	80	Yes	Yes
10	17	85	Yes	Yes
10	18	90	Yes	Yes
12	4	24	Yes	Yes
12	5	30	Yes	Yes
12	6	36	Yes	Yes
12	7	42	Yes	Yes
12	8	48	Yes	Yes
12	9	54	Yes	Yes
12	10	60	Yes	Yes
12	11	66	Yes	Yes
12	12	72	Yes	Yes
12	13	78	Yes	Yes
12	14	84	Yes	Yes
12	15	90	Yes	Yes
12	16	96	Yes	Yes
12	17	102	Yes	Yes
12	18	108	Yes	Yes
15	4	30	Yes	Yes
15	5	37.5	Yes	Yes
15	6	45	Yes	Yes
15	7	52.5	Yes	Yes
15	8	60	Yes	Yes
15	9	67.5	Yes	Yes
15	10	75	Yes	Yes
15	11	82.5	Yes	Yes
15	12	90	Yes	Yes
15	13	97.5	Yes	Yes
15	14	105	Yes	Yes
15	15	112.5	Yes	Yes
15	16	120	Yes	Yes
15	17	127.5	Yes	Yes
15	18	135	Yes	Yes
18	4	36	Yes	Yes
18	5	45	Yes	Yes
18	6	54	Yes	Yes
18	7	63	Yes	Yes
18	8	72	Yes	Yes
18	9	81	Yes	Yes
18	10	90	Yes	Yes
18	11	99	Yes	Yes

Disk count per node	Node count	Cluster raw capacity (TiB)	Support +2d:1n using P20	Support +2d:1n using E20
18	12	108	Yes	Yes
18	13	117	Yes	Yes
18	14	126	Yes	Yes
18	15	135	Yes	Yes
18	16	144	Yes	Yes
18	17	153	Yes	Yes
18	18	162	Yes	Yes
20	4	40	Yes	Yes
20	5	50	Yes	Yes
20	6	60	Yes	Yes
20	7	70	Yes	Yes
20	8	80	Yes	Yes
20	9	90	Yes	Yes
20	10	100	Yes	Yes
20	11	110	Yes	Yes
20	12	120	Yes	Yes
20	13	130	Yes	Yes
20	14	140	Yes	Yes
20	15	150	Yes	Yes
20	16	160	Yes	Yes
20	17	170	Yes	Yes
20	18	180	Yes	Yes
24	4	48	Yes	Yes
24	5	60	Yes	Yes
24	6	72	Yes	Yes
24	7	84	Yes	Yes
24	8	96	Yes	Yes
24	9	108	Yes	Yes
24	10	120	Yes	Yes
24	11	132	Yes	Yes
24	12	144	Yes	Yes
24	13	156	Yes	Yes
24	14	168	Yes	Yes
24	15	180	Yes	Yes
24	16	192	Yes	Yes
24	17	204	Yes	Yes
24	18	216	Yes	Yes
25	4	50	Yes	Yes
25	5	62.5	Yes	Yes
25	6	75	Yes	Yes
25	7	87.5	Yes	Yes
25	8	100	Yes	Yes
25	9	112.5	Yes	Yes
25	10	125	Yes	Yes
25	11	137.5	Yes	Yes
25	12	150	Yes	Yes
25	13	162.5	Yes	Yes
25	14	175	Yes	Yes
25	15	187.5	Yes	Yes
25	16	200	Yes	Yes
25	17	212.5	Yes	Yes
25	18	225	Yes	Yes

Disk count per node	Node count	Cluster raw capacity (TiB)	Support +2d:1n using P20	Support +2d:1n using E20
30	4	60	Yes	Yes
30	5	75	Yes	Yes
30	6	90	Yes	Yes
30	7	105	Yes	Yes
30	8	120	Yes	Yes
30	9	135	Yes	Yes
30	10	150	Yes	Yes
30	11	165	Yes	Yes
30	12	180	Yes	Yes
30	13	195	Yes	Yes
30	14	210	Yes	Yes
30	15	225	Yes	Yes
30	16	240	Yes	Yes
30	17	255	Yes	No
30	18	270	Yes	No

Cluster using P30 or E30

The following table shows the available combinations of cluster size, disk count by using 1 TiB disk size with P30 or E30.

Table 7. Supported configurations details – P30 or E30

Disk count per node	Node count	Cluster raw capacity (TiB)	Support +2d:1n using P30	Support +2d:1n using E30
5	4	20	Yes	Yes
5	5	25	Yes	Yes
5	6	30	Yes	Yes
5	7	35	Yes	Yes
5	8	40	Yes	Yes
5	9	45	Yes	Yes
5	10	50	Yes	Yes
5	11	55	Yes	Yes
5	12	60	Yes	Yes
5	13	65	Yes	Yes
5	14	70	Yes	Yes
5	15	75	Yes	Yes
5	16	80	Yes	Yes
5	17	85	Yes	Yes
5	18	90	Yes	Yes
6	4	24	Yes	Yes
6	5	30	Yes	Yes
6	6	36	Yes	Yes
6	7	42	Yes	Yes
6	8	48	Yes	Yes
6	9	54	Yes	Yes
6	10	60	Yes	Yes
6	11	66	Yes	Yes
6	12	72	Yes	Yes
6	13	78	Yes	Yes
6	14	84	Yes	Yes
6	15	90	Yes	Yes

Disk count per node	Node count	Cluster raw capacity (TiB)	Support +2d:1n using P30	Support +2d:1n using E30
6	16	96	Yes	Yes
6	17	102	Yes	Yes
6	18	108	Yes	Yes
10	4	40	Yes	Yes
10	5	50	Yes	Yes
10	6	60	Yes	Yes
10	7	70	Yes	Yes
10	8	80	Yes	Yes
10	9	90	Yes	Yes
10	10	100	Yes	Yes
10	11	110	Yes	Yes
10	12	120	Yes	Yes
10	13	130	Yes	Yes
10	14	140	Yes	Yes
10	15	150	Yes	Yes
10	16	160	Yes	Yes
10	17	170	Yes	Yes
10	18	180	Yes	Yes
12	4	48	Yes	Yes
12	5	60	Yes	Yes
12	6	72	Yes	Yes
12	7	84	Yes	Yes
12	8	96	Yes	Yes
12	9	108	Yes	Yes
12	10	120	Yes	Yes
12	11	132	Yes	Yes
12	12	144	Yes	Yes
12	13	156	Yes	Yes
12	14	168	Yes	Yes
12	15	180	Yes	Yes
12	16	192	Yes	Yes
12	17	204	Yes	Yes
12	18	216	Yes	Yes
15	4	60	Yes	Yes
15	5	75	Yes	Yes
15	6	90	Yes	Yes
15	7	105	Yes	Yes
15	8	120	Yes	Yes
15	9	135	Yes	Yes
15	10	150	Yes	Yes
15	11	165	Yes	Yes
15	12	180	Yes	Yes
15	13	195	Yes	Yes
15	14	210	Yes	Yes
15	15	225	Yes	Yes
15	16	240	Yes	Yes
15	17	255	Yes	No
15	18	270	Yes	No
18	4	72	Yes	Yes
18	5	90	Yes	Yes
18	6	108	Yes	Yes
18	7	126	Yes	Yes

Disk count per node	Node count	Cluster raw capacity (TiB)	Support +2d:1n using P30	Support +2d:1n using E30
18	8	144	Yes	Yes
18	9	162	Yes	Yes
18	10	180	Yes	Yes
18	11	198	Yes	Yes
18	12	216	Yes	Yes
18	13	234	Yes	Yes
18	14	252	Yes	No
18	15	270	Yes	No
18	16	288	Yes	No
18	17	306	Yes	No
18	18	324	Yes	No
20	4	80	Yes	Yes
20	5	100	Yes	Yes
20	6	120	Yes	Yes
20	7	140	Yes	Yes
20	8	160	Yes	Yes
20	9	180	Yes	Yes
20	10	200	Yes	Yes
20	11	220	Yes	Yes
20	12	240	Yes	Yes
20	13	260	Yes	No
20	14	280	Yes	No
20	15	300	Yes	No
20	16	320	Yes	No
20	17	340	Yes	No
20	18	360	Yes	No
24	4	96	Yes	Yes
24	5	120	Yes	Yes
24	6	144	Yes	Yes
24	7	168	Yes	Yes
24	8	192	Yes	Yes
24	9	216	Yes	Yes
24	10	240	Yes	Yes
24	11	264	Yes	No
24	12	288	Yes	No
24	13	312	Yes	No
24	14	336	Yes	No
24	15	360	Yes	No
24	16	384	Yes	No
24	17	408	Yes	No
24	18	432	Yes	No
25	4	100	Yes	Yes
25	5	125	Yes	Yes
25	6	150	Yes	Yes
25	7	175	Yes	Yes
25	8	200	Yes	Yes
25	9	225	Yes	Yes
25	10	250	Yes	No
25	11	275	Yes	No
25	12	300	Yes	No
25	13	325	Yes	No
25	14	350	Yes	No
25	15	375	Yes	No

Disk count per node	Node count	Cluster raw capacity (TiB)	Support +2d:1n using P30	Support +2d:1n using E30
25	16	400	Yes	No
25	17	425	Yes	No
25	18	450	Yes	No
30	4	120	Yes	Yes
30	5	150	Yes	Yes
30	6	180	Yes	Yes
30	7	210	Yes	Yes
30	8	240	Yes	Yes
30	9	270	Yes	No
30	10	300	Yes	No
30	11	330	Yes	No
30	12	360	Yes	No
30	13	390	Yes	No
30	14	420	Yes	No
30	15	450	Yes	No
30	16	480	Yes	No
30	17	510	Yes	No
30	18	540	Yes	No

Cluster using P40, E40, or S40

The following table shows the available combinations of cluster size, disk count by using 2 TiB disk size with P40, E40, or S40.

Table 8. Supported configurations details - P40, E40, or S40

Disk count per node	Node count	Cluster raw capacity (TiB)	Support +2d:1n using P40	Support +2d:1n using E40	Support +2d:1n using S40
5	4	80	Yes	Yes	Yes
5	4	40	Yes	Yes	Yes
5	5	50	Yes	Yes	Yes
5	6	60	Yes	Yes	Yes
5	7	70	Yes	Yes	Yes
5	8	80	Yes	Yes	Yes
5	9	90	Yes	Yes	Yes
5	10	100	Yes	Yes	Yes
5	11	110	Yes	Yes	Yes
5	12	120	Yes	Yes	Yes
5	13	130	Yes	Yes	Yes
5	14	140	Yes	Yes	Yes
5	15	150	Yes	Yes	Yes
5	16	160	Yes	Yes	Yes
5	17	170	Yes	Yes	Yes
5	18	180	Yes	Yes	Yes
6	4	48	Yes	Yes	Yes
6	5	60	Yes	Yes	Yes
6	6	72	Yes	Yes	Yes
6	7	84	Yes	Yes	Yes
6	8	96	Yes	Yes	Yes
6	9	108	Yes	Yes	Yes
6	10	120	Yes	Yes	Yes
6	11	132	Yes	Yes	Yes
6	12	144	Yes	Yes	Yes

Disk count per node	Node count	Cluster raw capacity (TiB)	Support +2d:1n using P40	Support +2d:1n using E40	Support +2d:1n using S40
6	13	156	Yes	Yes	Yes
6	14	168	Yes	Yes	Yes
6	15	180	Yes	Yes	Yes
6	16	192	Yes	Yes	Yes
6	17	204	Yes	Yes	Yes
6	18	216	Yes	Yes	Yes
10	4	80	Yes	Yes	Yes
10	5	100	Yes	Yes	Yes
10	6	120	Yes	Yes	Yes
10	7	140	Yes	Yes	Yes
10	8	160	Yes	Yes	Yes
10	9	180	Yes	Yes	Yes
10	10	200	Yes	Yes	Yes
10	11	220	Yes	Yes	Yes
10	12	240	Yes	Yes	Yes
10	13	260	Yes	No	Yes
10	14	280	Yes	No	Yes
10	15	300	Yes	No	No
10	16	320	Yes	No	No
10	17	340	Yes	No	No
10	18	360	Yes	No	No
12	4	96	Yes	Yes	Yes
12	5	120	Yes	Yes	Yes
12	6	144	Yes	Yes	Yes
12	7	168	Yes	Yes	Yes
12	8	192	Yes	Yes	Yes
12	9	216	Yes	Yes	Yes
12	10	240	Yes	Yes	Yes
12	11	264	Yes	No	Yes
12	12	288	Yes	No	No
12	13	312	Yes	No	No
12	14	336	Yes	No	No
12	15	360	Yes	No	No
12	16	384	Yes	No	No
12	17	408	Yes	No	No
12	18	432	Yes	No	No
15	4	120	Yes	Yes	Yes
15	5	150	Yes	Yes	Yes
15	6	180	Yes	Yes	Yes
15	7	210	Yes	Yes	Yes
15	8	240	Yes	Yes	Yes
15	9	270	Yes	No	Yes
15	10	300	Yes	No	No
15	11	330	Yes	No	No
15	12	360	Yes	No	No
15	13	390	Yes	No	No
15	14	420	Yes	No	No
15	15	450	Yes	No	No
15	16	480	Yes	No	No
15	17	510	Yes	No	No
15	18	540	Yes	No	No
18	4	144	Yes	Yes	Yes
18	5	180	Yes	Yes	Yes
18	6	216	Yes	Yes	Yes
18	7	252	Yes	No	Yes

Disk count per node	Node count	Cluster raw capacity (TiB)	Support +2d:1n using P40	Support +2d:1n using E40	Support +2d:1n using S40
18	8	288	Yes	No	No
18	9	324	Yes	No	No
18	10	360	Yes	No	No
18	11	396	Yes	No	No
18	12	432	Yes	No	No
18	13	468	Yes	No	No
18	14	504	Yes	No	No
18	15	540	Yes	No	No
18	16	576	Yes	No	No
18	17	612	Yes	No	No
18	18	648	Yes	No	No
20	4	160	Yes	Yes	Yes
20	5	200	Yes	Yes	Yes
20	6	240	Yes	Yes	Yes
20	7	280	Yes	No	Yes
20	8	320	Yes	No	No
20	9	360	Yes	No	No
20	10	400	Yes	No	No
20	11	440	Yes	No	No
20	12	480	Yes	No	No
20	13	520	Yes	No	No
20	14	560	Yes	No	No
20	15	600	Yes	No	No
20	16	640	Yes	No	No
20	17	680	Yes	No	No
20	18	720	Yes	No	No
24	4	192	Yes	Yes	Yes
24	5	240	Yes	Yes	Yes
24	6	288	Yes	No	No
24	7	336	Yes	No	No
24	8	384	Yes	No	No
24	9	432	Yes	No	No
24	10	480	Yes	No	No
24	11	528	Yes	No	No
24	12	576	Yes	No	No
24	13	624	Yes	No	No
24	14	672	Yes	No	No
24	15	720	Yes	No	No
24	16	768	Yes	No	No
24	17	816	Yes	No	No
24	18	864	No	No	No
25	4	200	Yes	Yes	Yes
25	5	250	Yes	No	Yes
25	6	300	Yes	No	No
25	7	350	Yes	No	No
25	8	400	Yes	No	No
25	9	450	Yes	No	No
25	10	500	Yes	No	No
25	11	550	Yes	No	No
25	12	600	Yes	No	No
25	13	650	Yes	No	No
25	14	700	Yes	No	No
25	15	750	Yes	No	No
25	16	800	Yes	No	No

Disk count per node	Node count	Cluster raw capacity (TiB)	Support +2d:1n using P40	Support +2d:1n using E40	Support +2d:1n using S40
25	17	850	No	No	No
25	18	900	No	No	No
30	4	240	Yes	Yes	Yes
30	5	300	Yes	No	No
30	6	360	Yes	No	No
30	7	420	Yes	No	No
30	8	480	Yes	No	No
30	9	540	Yes	No	No
30	10	600	Yes	No	No
30	11	660	Yes	No	No
30	12	720	Yes	No	No
30	13	780	Yes	No	No
30	14	840	Yes	No	No
30	15	900	No	No	No
30	16	960	No	No	No
30	17	1020	No	No	No
30	18	1080	No	No	No

Cluster using P50, E50, or S50

The following table shows the available combinations of cluster size, disk count by using 4 TiB disk size with P50, E50, or S50.

Table 9. Supported configurations details - P50, E50, or S50

Disk count per node	Node count	Cluster raw capacity (TiB)	Support +2d:1n using P50	Support +2d:1n using E50	Support +2d:1n using S50
5	4	80	Yes	Yes	Yes
5	5	100	Yes	Yes	Yes
5	6	120	Yes	Yes	Yes
5	7	140	Yes	Yes	Yes
5	8	160	Yes	Yes	Yes
5	9	180	Yes	Yes	Yes
5	10	200	Yes	Yes	Yes
5	11	220	Yes	Yes	Yes
5	12	240	Yes	Yes	Yes
5	13	260	Yes	No	Yes
5	14	280	Yes	No	Yes
5	15	300	Yes	No	No
5	16	320	Yes	No	No
5	17	340	Yes	No	No
5	18	360	Yes	No	No
6	4	96	Yes	Yes	Yes
6	5	120	Yes	Yes	Yes
6	6	144	Yes	Yes	Yes
6	7	168	Yes	Yes	Yes
6	8	192	Yes	Yes	Yes
6	9	216	Yes	Yes	Yes
6	10	240	Yes	Yes	Yes
6	11	264	Yes	No	Yes
6	12	288	Yes	No	No
6	13	312	Yes	No	No
6	14	336	Yes	No	No
6	15	360	Yes	No	No
6	16	384	Yes	No	No
6	17	408	Yes	No	No

Disk count per node	Node count	Cluster raw capacity (TiB)	Support +2d:1n using P50	Support +2d:1n using E50	Support +2d:1n using S50
6	18	432	Yes	No	No
10	4	160	Yes	Yes	Yes
10	5	200	Yes	Yes	Yes
10	6	240	Yes	Yes	Yes
10	7	280	Yes	No	Yes
10	8	320	Yes	No	No
10	9	360	Yes	No	No
10	10	400	Yes	No	No
10	11	440	Yes	No	No
10	12	480	Yes	No	No
10	13	520	Yes	No	No
10	14	560	Yes	No	No
10	15	600	Yes	No	No
10	16	640	Yes	No	No
10	17	680	Yes	No	No
10	18	720	Yes	No	No
12	4	192	Yes	Yes	Yes
12	5	240	Yes	Yes	Yes
12	6	288	Yes	No	No
12	7	336	Yes	No	No
12	8	384	Yes	No	No
12	9	432	Yes	No	No
12	10	480	Yes	No	No
12	11	528	Yes	No	No
12	12	576	Yes	No	No
12	13	624	Yes	No	No
12	14	672	Yes	No	No
12	15	720	Yes	No	No
12	16	768	Yes	No	No
12	17	816	Yes	No	No
12	18	864	No	No	No
15	4	240	Yes	Yes	Yes
15	5	300	Yes	No	No
15	6	360	Yes	No	No
15	7	420	Yes	No	No
15	8	480	Yes	No	No
15	9	540	Yes	No	No
15	10	600	Yes	No	No
15	11	660	Yes	No	No
15	12	720	Yes	No	No
15	13	780	Yes	No	No
15	14	840	Yes	No	No
15	15	900	No	No	No
15	16	960	No	No	No
15	17	1020	No	No	No
15	18	1080	No	No	No
18	4	288	Yes	No	No
18	5	360	Yes	No	No
18	6	432	Yes	No	No
18	7	504	Yes	No	No
18	8	576	Yes	No	No
18	9	648	Yes	No	No
18	10	720	Yes	No	No
18	11	792	Yes	No	No

Disk count per node	Node count	Cluster raw capacity (TiB)	Support +2d:1n using P50	Support +2d:1n using E50	Support +2d:1n using S50
18	12	864	No	No	No
18	13	936	No	No	No
18	14	1008	No	No	No
18	15	1080	No	No	No
18	16	1152	No	No	No
18	17	1224	No	No	No
18	18	1296	No	No	No
20	4	320	Yes	No	No
20	5	400	Yes	No	No
20	6	480	Yes	No	No
20	7	560	Yes	No	No
20	8	640	Yes	No	No
20	9	720	Yes	No	No
20	10	800	Yes	No	No
20	11	880	No	No	No
20	12	960	No	No	No
20	13	1040	No	No	No
20	14	1120	No	No	No
20	15	1200	No	No	No
20	16	1280	No	No	No
20	17	1360	No	No	No
20	18	1440	No	No	No
24	4	384	Yes	No	No
24	5	480	Yes	No	No
24	6	576	Yes	No	No
24	7	672	Yes	No	No
24	8	768	Yes	No	No
24	9	864	No	No	No
24	10	960	No	No	No
24	11	1056	No	No	No
24	12	1152	No	No	No
24	13	1248	No	No	No
24	14	1344	No	No	No
24	15	1440	No	No	No
24	16	1536	No	No	No
24	17	1632	No	No	No
24	18	1728	No	No	No
25	4	400	Yes	No	No
25	5	500	Yes	No	No
25	6	600	Yes	No	No
25	7	700	Yes	No	No
25	8	800	Yes	No	No
25	9	900	No	No	No
25	10	1000	No	No	No
25	11	1100	No	No	No
25	12	1200	No	No	No
25	13	1300	No	No	No
25	14	1400	No	No	No
25	15	1500	No	No	No
25	16	1600	No	No	No
25	17	1700	No	No	No
25	18	1800	No	No	No
30	4	480	Yes	No	No
30	5	600	Yes	No	No
30	6	720	Yes	No	No

Disk count per node	Node count	Cluster raw capacity (TiB)	Support +2d:1n using P50	Support +2d:1n using E50	Support +2d:1n using S50
30	7	840	Yes	No	No
30	8	960	No	No	No
30	9	1080	No	No	No
30	10	1200	No	No	No
30	11	1320	No	No	No
30	12	1440	No	No	No
30	13	1560	No	No	No
30	14	1680	No	No	No
30	15	1800	No	No	No
30	16	1920	No	No	No
30	17	2040	No	No	No
30	18	2160	No	No	No

Cluster using P60, E60, or S60

The following table shows the available combinations of cluster size, disk count by using 8 TiB disk size with P60, E60, or S60.

Table 10. Supported configurations details - P60, E60, or S60

Disk count per node	Node count	Cluster raw capacity (TiB)	Support +2d:1n using P60	Support +2d:1n using E60	Support +2d:1n using S60
5	4	160	Yes	Yes	Yes
5	5	200	Yes	Yes	Yes
5	6	240	Yes	Yes	Yes
5	7	280	Yes	Yes	Yes
5	8	320	Yes	Yes	Yes
5	9	360	Yes	Yes	Yes
5	10	400	Yes	Yes	Yes
5	11	440	Yes	Yes	Yes
5	12	480	Yes	Yes	Yes
5	13	520	Yes	Yes	Yes
5	14	560	Yes	Yes	Yes
5	15	600	Yes	Yes	Yes
5	16	640	Yes	Yes	Yes
5	17	680	Yes	Yes	Yes
5	18	720	Yes	Yes	Yes
6	4	192	Yes	Yes	Yes
6	5	240	Yes	Yes	Yes
6	6	288	Yes	Yes	Yes
6	7	336	Yes	Yes	Yes
6	8	384	Yes	Yes	Yes
6	9	432	Yes	Yes	Yes
6	10	480	Yes	Yes	Yes
6	11	528	Yes	Yes	Yes
6	12	576	Yes	Yes	Yes
6	13	624	Yes	Yes	Yes

Disk count per node	Node count	Cluster raw capacity (TiB)	Support +2d:1n using P60	Support +2d:1n using E60	Support +2d:1n using S60
6	14	672	Yes	Yes	Yes
6	15	720	Yes	Yes	Yes
6	16	768	Yes	Yes	Yes
6	17	816	Yes	No	No
6	18	864	Yes	No	No
10	4	320	Yes	Yes	Yes
10	5	400	Yes	Yes	Yes
10	6	480	Yes	Yes	Yes
10	7	560	Yes	Yes	Yes
10	8	640	Yes	Yes	Yes
10	9	720	Yes	Yes	Yes
10	10	800	Yes	Yes	Yes
10	11	880	Yes	No	No
10	12	960	Yes	No	No
10	13	1040	Yes	No	No
10	14	1120	Yes	No	No
10	15	1200	Yes	No	No
10	16	1280	Yes	No	No
10	17	1360	Yes	No	No
10	18	1440	Yes	No	No
12	4	384	Yes	Yes	Yes
12	5	480	Yes	Yes	Yes
12	6	576	Yes	Yes	Yes
12	7	672	Yes	Yes	Yes
12	8	768	Yes	Yes	Yes
12	9	864	Yes	No	No
12	10	960	Yes	No	No
12	11	1056	Yes	No	No
12	12	1152	Yes	No	No
12	13	1248	Yes	No	No
12	14	1344	Yes	No	No
12	15	1440	Yes	No	No
12	16	1536	No	No	No
12	17	1632	No	No	No
12	18	1728	No	No	No
15	4	480	Yes	Yes	Yes
15	5	600	Yes	Yes	Yes
15	6	720	Yes	Yes	Yes
15	7	840	Yes	No	No
15	8	960	Yes	No	No
15	9	1080	Yes	No	No
15	10	1200	Yes	No	No

Disk count per node	Node count	Cluster raw capacity (TiB)	Support +2d:1n using P60	Support +2d:1n using E60	Support +2d:1n using S60
15	11	1320	Yes	No	No
15	12	1440	Yes	No	No
15	13	1560	No	No	No
15	14	1680	No	No	No
15	15	1800	No	No	No
15	16	1920	No	No	No
15	17	2040	No	No	No
15	18	2160	No	No	No
18	4	576	Yes	Yes	Yes
18	5	720	Yes	Yes	Yes
18	6	864	Yes	No	No
18	7	1008	Yes	No	No
18	8	1152	Yes	No	No
18	9	1296	Yes	No	No
18	10	1440	Yes	No	No
18	11	1584	No	No	No
18	12	1728	No	No	No
18	13	1872	No	No	No
18	14	2016	No	No	No
18	15	2160	No	No	No
18	16	2304	No	No	No
18	17	2448	No	No	No
18	18	2592	No	No	No
20	4	640	Yes	Yes	Yes
20	5	800	Yes	Yes	Yes
20	6	960	Yes	No	No
20	7	1120	Yes	No	No
20	8	1280	Yes	No	No
20	9	1440	Yes	No	No
20	10	1600	No	No	No
20	11	1760	No	No	No
20	12	1920	No	No	No
20	13	2080	No	No	No
20	14	2240	No	No	No
20	15	2400	No	No	No
20	16	2560	No	No	No
20	17	2720	No	No	No
20	18	2880	No	No	No
24	4	768	Yes	Yes	Yes
24	5	960	Yes	No	No
24	6	1152	Yes	No	No

Disk count per node	Node count	Cluster raw capacity (TiB)	Support +2d:1n using P60	Support +2d:1n using E60	Support +2d:1n using S60
24	7	1344	Yes	No	No
24	8	1536	No	No	No
24	9	1728	No	No	No
24	10	1920	No	No	No
24	11	2112	No	No	No
24	12	2304	No	No	No
24	13	2496	No	No	No
24	14	2688	No	No	No
24	15	2880	No	No	No
24	16	3072	No	No	No
24	17	3264	No	No	No
24	18	3456	No	No	No
25	4	800	Yes	Yes	Yes
25	5	1000	Yes	No	No
25	6	1200	Yes	No	No
25	7	1400	Yes	No	No
25	8	1600	No	No	No
25	9	1800	No	No	No
25	10	2000	No	No	No
25	11	2200	No	No	No
25	12	2400	No	No	No
25	13	2600	No	No	No
25	14	2800	No	No	No
25	15	3000	No	No	No
25	16	3200	No	No	No
25	17	3400	No	No	No
25	18	3600	No	No	No
30	4	960	Yes	No	No
30	5	1200	Yes	No	No
30	6	1440	Yes	No	No
30	7	1680	No	No	No
30	8	1920	No	No	No
30	9	2160	No	No	No
30	10	2400	No	No	No
30	11	2640	No	No	No
30	12	2880	No	No	No
30	13	3120	No	No	No
30	14	3360	No	No	No
30	15	3600	No	No	No
30	16	3840	No	No	No
30	17	4080	No	No	No
30	18	4320	No	No	No

Cluster using P70, E70, or S70

The following table shows the available combinations of cluster size, disk count by using 16 TiB disk size with P70, E70, or S70.

Table 11. Supported configurations details - P70, E70, or S70

Disk count per node	Node count	Cluster raw capacity (TiB)	Support +2d:1n using P70	Support +2d:1n using E70	Support +2d:1n using S70
5	4	320	Yes	Yes	Yes
5	5	400	Yes	Yes	Yes
5	6	480	Yes	Yes	Yes
5	7	560	Yes	Yes	Yes
5	8	640	Yes	Yes	Yes
5	9	720	Yes	Yes	Yes
5	10	800	Yes	Yes	Yes
5	11	880	Yes	Yes	Yes
5	12	960	Yes	Yes	Yes
5	13	1040	Yes	Yes	Yes
5	14	1120	Yes	Yes	Yes
5	15	1200	Yes	Yes	No
5	16	1280	Yes	Yes	No
5	17	1360	Yes	Yes	No
5	18	1440	Yes	Yes	No
6	4	384	Yes	Yes	Yes
6	5	480	Yes	Yes	Yes
6	6	576	Yes	Yes	Yes
6	7	672	Yes	Yes	Yes
6	8	768	Yes	Yes	Yes
6	9	864	Yes	Yes	Yes
6	10	960	Yes	Yes	Yes
6	11	1056	Yes	Yes	Yes
6	12	1152	Yes	Yes	No
6	13	1248	Yes	Yes	No
6	14	1344	Yes	Yes	No
6	15	1440	Yes	Yes	No
6	16	1536	No	Yes	No
6	17	1632	No	No	No
6	18	1728	No	No	No
10	4	640	Yes	Yes	Yes
10	5	800	Yes	Yes	Yes
10	6	960	Yes	Yes	Yes
10	7	1120	Yes	Yes	Yes
10	8	1280	Yes	Yes	No
10	9	1440	Yes	Yes	No
10	10	1600	No	Yes	No

Disk count per node	Node count	Cluster raw capacity (TiB)	Support +2d:1n using P70	Support +2d:1n using E70	Support +2d:1n using S70
10	11	1760	No	No	No
10	12	1920	No	No	No
10	13	2080	No	No	No
10	14	2240	No	No	No
10	15	2400	No	No	No
10	16	2560	No	No	No
10	17	2720	No	No	No
10	18	2880	No	No	No
12	4	768	Yes	Yes	Yes
12	5	960	Yes	Yes	Yes
12	6	1152	Yes	Yes	No
12	7	1344	Yes	Yes	No
12	8	1536	No	Yes	No
12	9	1728	No	No	No
12	10	1920	No	No	No
12	11	2112	No	No	No
12	12	2304	No	No	No
12	13	2496	No	No	No
12	14	2688	No	No	No
12	15	2880	No	No	No
12	16	3072	No	No	No
12	17	3264	No	No	No
12	18	3456	No	No	No
15	4	960	Yes	Yes	Yes
15	5	1200	Yes	Yes	No
15	6	1440	Yes	Yes	No
15	7	1680	No	No	No
15	8	1920	No	No	No
15	9	2160	No	No	No
15	10	2400	No	No	No
15	11	2640	No	No	No
15	12	2880	No	No	No
15	13	3120	No	No	No
15	14	3360	No	No	No
15	15	3600	No	No	No
15	16	3840	No	No	No
15	17	4080	No	No	No
15	18	4320	No	No	No
18	4	1152	Yes	Yes	No
18	5	1440	Yes	Yes	No
18	6	1728	No	No	No
18	7	2016	No	No	No

Disk count per node	Node count	Cluster raw capacity (TiB)	Support +2d:1n using P70	Support +2d:1n using E70	Support +2d:1n using S70
18	8	2304	No	No	No
18	9	2592	No	No	No
18	10	2880	No	No	No
18	11	3168	No	No	No
18	12	3456	No	No	No
18	13	3744	No	No	No
18	14	4032	No	No	No
18	15	4320	No	No	No
18	16	4608	No	No	No
18	17	4896	No	No	No
18	18	5184	No	No	No
20	4	1280	Yes	Yes	No
20	5	1600	No	Yes	No
20	6	1920	No	No	No
20	7	2240	No	No	No
20	8	2560	No	No	No
20	9	2880	No	No	No
20	10	3200	No	No	No
20	11	3520	No	No	No
20	12	3840	No	No	No
20	13	4160	No	No	No
20	14	4480	No	No	No
20	15	4800	No	No	No
20	16	5120	No	No	No
20	17	5440	No	No	No
20	18	5760	No	No	No
24	4	1536	No	Yes	No
24	5	1920	No	No	No
24	6	2304	No	No	No
24	7	2688	No	No	No
24	8	3072	No	No	No
24	9	3456	No	No	No
24	10	3840	No	No	No
24	11	4224	No	No	No
24	12	4608	No	No	No
24	13	4992	No	No	No
24	14	5376	No	No	No
24	15	5760	No	No	No
25	4	1600	No	Yes	No
25	5	2000	No	No	No
25	6	2400	No	No	No

Disk count per node	Node count	Cluster raw capacity (TiB)	Support +2d:1n using P70	Support +2d:1n using E70	Support +2d:1n using S70
25	7	2800	No	No	No
25	8	3200	No	No	No
25	9	3600	No	No	No
25	10	4000	No	No	No
25	11	4400	No	No	No
25	12	4800	No	No	No
25	13	5200	No	No	No
25	14	5600	No	No	No
30	4	1920	No	No	No
30	5	2400	No	No	No
30	6	2880	No	No	No
30	7	3360	No	No	No
30	8	3840	No	No	No
30	9	4320	No	No	No
30	10	4800	No	No	No
30	11	5280	No	No	No
30	12	5760	No	No	No

Appendix B: cluster raw capacity and usable capacity

Below tables show the cluster usable capacity information when using different OneFS protection levels.

Table 12. Raw capacity and usable capacity using +2n

Azure managed disk type	Disk size (TiB)	Min cluster capacity (TiB)		Max cluster capacity (TiB)	
		raw capacity	usable capacity (+2n)	raw capacity	usable capacity (+2n)
P20	0.5	10	5	270	240
P30	1	20	10	540	480
P40	2	40	20	1080	960
P50	4	80	40	2160	1920
P60	8	160	80	4320	3840
P70	16	320	160	5760	4992
E20	0.5	10	5	270	240
E30	1	20	10	540	480
E40	2	40	20	1080	960
E50	4	80	40	2160	1920
E60	8	160	80	4320	3840
E70	16	320	160	5760	4992
S40	2	40	20	1080	960
S50	4	80	40	2160	1920
S60	8	160	80	4320	3840
S70	16	320	160	5760	4992

Table 13. Raw capacity and usable capacity using +2d:1n

Azure managed disk type	Disk size (TiB)	Min cluster capacity (TiB)		Max cluster capacity (TiB)	
		raw capacity	usable capacity (+2d:1n)	raw capacity	usable capacity (+2d:1n)
P20	0.5	10	8	270	240
P30	1	20	15	540	480
P40	2	40	30	840	747
P50	4	80	60	840	747
P60	8	160	120	1440	1280
P70	16	320	240	1440	1280
E20	0.5	10	8	240	213
E30	1	20	15	240	213
E40	2	40	30	240	213
E50	4	80	60	240	213
E60	8	160	120	800	711

Azure managed disk type	Disk size (TiB)	Min cluster capacity (TiB)		Max cluster capacity (TiB)	
		raw capacity	usable capacity (+2d:1n)	raw capacity	usable capacity (+2d:1n)
E70	16	320	240	1600	1422
S40	2	40	30	280	249
S50	4	80	60	280	249
S60	8	160	120	800	711
S70	16	320	240	1120	996

Appendix C: recommended data disk configuration details for optimal performance

This section outlines the recommended details for configuring data disks for optimal performance, including the type and count of data disks for each node in the cluster.

Table 14. The recommended details for Premium SSD data disks

VM sizes/Node types	Data disk size	Recommended data disk count per node
• Standard_D32ds_v5 • Standard_E32ds_v5	P20	10, 12, 15, 18, 20, 24, 25, 30
• Standard_D48ds_v5 • Standard_E48ds_v5	P20	12, 15, 18, 20, 24, 25, 30
• Standard_D64ds_v5 • Standard_E64ds_v5	P20	15, 18, 20, 24, 25, 30
• Standard_D96ds_v5 • Standard_E96ds_v5	P20	18, 20, 24, 25, 30
• Standard_E104ids_v5	P20	30
• Standard_D32ds_v5 • Standard_E32ds_v5	P30	6, 10, 12, 15, 18, 20, 24, 25, 30
• Standard_D48ds_v5 • Standard_E48ds_v5	P30	10, 12, 15, 18, 20, 24, 25, 30
• Standard_D64ds_v5 • Standard_E64ds_v5	P30	12, 15, 18, 20, 24, 25, 30
• Standard_D96ds_v5 • Standard_E96ds_v5	P30	12, 15, 18, 20, 24, 25, 30
• Standard_E104ids_v5	P30	20, 24, 25, 30
• Standard_D32ds_v5 • Standard_E32ds_v5	P40	5, 6, 10, 12, 15, 18, 20, 24, 25, 30
• Standard_D48ds_v5 • Standard_E48ds_v5	P40	10, 12, 15, 18, 20, 24, 25, 30
• Standard_D64ds_v5 • Standard_E64ds_v5	P40	10, 12, 15, 18, 20, 24, 25, 30
• Standard_D96ds_v5 • Standard_E96ds_v5	P40	10, 12, 15, 18, 20, 24, 25, 30
• Standard_E104ids_v5	P40	18, 20, 24, 25, 30
• Standard_D32ds_v5 • Standard_E32ds_v5	P50	5, 6, 10, 12, 15, 18, 20, 24, 25, 30

VM sizes/Node types	Data disk size	Recommended data disk count per node
• Standard_D48ds_v5 • Standard_E48ds_v5	P50	10, 12, 15, 18, 20, 24, 25, 30
• Standard_D64ds_v5 • Standard_E64ds_v5	P50	10, 12, 15, 18, 20, 24, 25, 30
• Standard_D96ds_v5 • Standard_E96ds_v5	P50	10, 12, 15, 18, 20, 24, 25, 30
• Standard_E104ids_v5	P50	18, 20, 24, 25, 30
• Standard_D32ds_v5 • Standard_E32ds_v5	P60	5, 6, 10, 12, 15, 18, 20, 24, 25, 30
• Standard_D48ds_v5 • Standard_E48ds_v5	P60	5, 6, 10, 12, 15, 18, 20, 24, 25, 30
• Standard_D64ds_v5 • Standard_E64ds_v5	P60	5, 6, 10, 12, 15, 18, 20, 24, 25, 30
• Standard_D96ds_v5 • Standard_E96ds_v5	P60	5, 6, 10, 12, 15, 18, 20, 24, 25, 30
• Standard_E104ids_v5	P60	10, 12, 15, 18, 20, 24, 25, 30
• Standard_D32ds_v5 • Standard_E32ds_v5	P70	5, 6, 10, 12, 15, 18, 20
• Standard_D48ds_v5 • Standard_E48ds_v5	P70	5, 6, 10, 12, 15, 18, 20
• Standard_D64ds_v5 • Standard_E64ds_v5	P70	5, 6, 10, 12, 15, 18, 20
• Standard_D96ds_v5 • Standard_E96ds_v5	P70	5, 6, 10, 12, 15, 18, 20
• Standard_E104ids_v5	P70	6, 10, 12, 15, 18, 20

Table 15. The recommended details for Standard SSD data disks

VM sizes/Node types	Data disk Size	Recommended data disk count per node
• Standard_D32ds_v5 • Standard_D32d_v5 • Standard_E32ds_v5 • Standard_E32d_v5	E20	18, 20, 24, 25, 30

VM sizes/Node types	Data disk Size	Recommended data disk count per node
• Standard_D48ds_v5 • Standard_D48d_v5 • Standard_E48ds_v5 • Standard_E48d_v5	E20	30
• Standard_D64ds_v5 • Standard_D64d_v5 • Standard_E64ds_v5 • Standard_E64d_v5	E20	30
• Standard_D96ds_v5 • Standard_D96d_v5 • Standard_E96ds_v5 • Standard_E96d_v5	E20	30
• Standard_E104ids_v5	E20	30
• Standard_D32ds_v5 • Standard_D32d_v5 • Standard_E32ds_v5 • Standard_E32d_v5	E30	18, 20, 24, 25, 30
• Standard_D48ds_v5 • Standard_D48d_v5 • Standard_E48ds_v5 • Standard_E48d_v5	E30	30
• Standard_D64ds_v5 • Standard_D64d_v5 • Standard_E64ds_v5 • Standard_E64d_v5	E30	30
• Standard_D96ds_v5 • Standard_D96d_v5 • Standard_E96ds_v5 • Standard_E96d_v5	E30	30
• Standard_E104ids_v5	E30	30
• Standard_D32ds_v5 • Standard_D32d_v5 • Standard_E32ds_v5 • Standard_E32d_v5	E40	18, 20, 24, 25, 30

VM sizes/Node types	Data disk Size	Recommended data disk count per node
• Standard_D48ds_v5 • Standard_D48d_v5 • Standard_E48ds_v5 • Standard_E48d_v5	E40	30
• Standard_D64ds_v5 • Standard_D64d_v5 • Standard_E64ds_v5 • Standard_E64d_v5	E40	30
• Standard_D96ds_v5 • Standard_D96d_v5 • Standard_E96ds_v5 • Standard_E96d_v5	E40	30
• Standard_E104ids_v5	E40	30
• Standard_D32ds_v5 • Standard_D32d_v5 • Standard_E32ds_v5 • Standard_E32d_v5	E50	18, 20, 24, 25, 30
• Standard_D48ds_v5 • Standard_D48d_v5 • Standard_E48ds_v5 • Standard_E48d_v5	E50	30
• Standard_D64ds_v5 • Standard_D64d_v5 • Standard_E64ds_v5 • Standard_E64d_v5	E50	30
• Standard_D96ds_v5 • Standard_D96d_v5 • Standard_E96ds_v5 • Standard_E96d_v5	E50	30
• Standard_E104ids_v5	E50	30
• Standard_D32ds_v5 • Standard_D32d_v5 • Standard_E32ds_v5 • Standard_E32d_v5	E60	5, 6, 10, 12, 15, 18, 20, 24, 25, 30
• Standard_D48ds_v5 • Standard_D48d_v5 • Standard_E48ds_v5 • Standard_E48d_v5	E60	5, 6, 10, 12, 15, 18, 20, 24, 25, 30

VM sizes/Node types	Data disk Size	Recommended data disk count per node
• Standard_D64ds_v5 • Standard_D64d_v5 • Standard_E64ds_v5 • Standard_E64d_v5	E60	6, 10, 12, 15, 18, 20, 24, 25, 30
• Standard_D96ds_v5 • Standard_D96d_v5 • Standard_E96ds_v5 • Standard_E96d_v5	E60	6, 10, 12, 15, 18, 20, 24, 25, 30
• Standard_E104ids_v5	E60	10, 12, 15, 18, 20, 24, 25, 30
• Standard_D32ds_v5 • Standard_D32d_v5 • Standard_E32ds_v5 • Standard_E32d_v5	E70	5, 6, 10, 12, 15, 18, 20
• Standard_D48ds_v5 • Standard_D48d_v5 • Standard_E48ds_v5 • Standard_E48d_v5	E70	5, 6, 10, 12, 15, 18, 20
• Standard_D64ds_v5 • Standard_D64d_v5 • Standard_E64ds_v5 • Standard_E64d_v5	E70	5, 6, 10, 12, 15, 18, 20
• Standard_D96ds_v5 • Standard_D96d_v5 • Standard_E96ds_v5 • Standard_E96d_v5	E70	5, 6, 10, 12, 15, 18, 20
• Standard_E104ids_v5	E70	10, 12, 15, 18, 20

Table 16. The recommended details for Standard HDD data disks

VM sizes/Node types	Data disk Size	Recommended data disk count per node
• Standard_D32ds_v5 • Standard_D32d_v5 • Standard_E32ds_v5 • Standard_E32d_v5	S40	18, 20, 24, 25, 30

VM sizes/Node types	Data disk Size	Recommended data disk count per node
• Standard_D48ds_v5 • Standard_D48d_v5 • Standard_E48ds_v5 • Standard_E48d_v5	S40	30
• Standard_D64ds_v5 • Standard_D64d_v5 • Standard_E64ds_v5 • Standard_E64d_v5	S40	30
• Standard_D96ds_v5 • Standard_D96d_v5 • Standard_E96ds_v5 • Standard_E96d_v5	S40	30
• Standard_E104ids_v5	S40	30
• Standard_D32ds_v5 • Standard_D32d_v5 • Standard_E32ds_v5 • Standard_E32d_v5	S50	18, 20, 24, 25, 30
• Standard_D48ds_v5 • Standard_D48d_v5 • Standard_E48ds_v5 • Standard_E48d_v5	S50	30
• Standard_D64ds_v5 • Standard_D64d_v5 • Standard_E64ds_v5 • Standard_E64d_v5	S50	30
• Standard_D96ds_v5 • Standard_D96d_v5 • Standard_E96ds_v5 • Standard_E96d_v5	S50	30
• Standard_E104ids_v5	S50	30
• Standard_D32ds_v5 • Standard_D32d_v5 • Standard_E32ds_v5 • Standard_E32d_v5	S60	5, 6, 10, 12, 15, 18, 20, 24, 25, 30
• Standard_D48ds_v5 • Standard_D48d_v5 • Standard_E48ds_v5 • Standard_E48d_v5	S60	6, 10, 12, 15, 18, 20, 24, 25, 30

VM sizes/Node types	Data disk Size	Recommended data disk count per node
• Standard_D64ds_v5 • Standard_D64d_v5 • Standard_E64ds_v5 • Standard_E64d_v5	S60	10, 12, 15, 18, 20, 24, 25, 30
• Standard_D96ds_v5 • Standard_D96d_v5 • Standard_E96ds_v5 • Standard_E96d_v5	S60	10, 12, 15, 18, 20, 24, 25, 30
• Standard_E104ids_v5	S60	15, 18, 20, 24, 25, 30
• Standard_D32ds_v5 • Standard_D32d_v5 • Standard_E32ds_v5 • Standard_E32d_v5	S70	5, 6, 10, 12, 15, 18, 20
• Standard_D48ds_v5 • Standard_D48d_v5 • Standard_E48ds_v5 • Standard_E48d_v5	S70	5, 6, 10, 12, 15, 18, 20
• Standard_D64ds_v5 • Standard_D64d_v5 • Standard_E64ds_v5 • Standard_E64d_v5	S70	5, 6, 10, 12, 15, 18, 20
• Standard_D96ds_v5 • Standard_D96d_v5 • Standard_E96ds_v5 • Standard_E96d_v5	S70	5, 6, 10, 12, 15, 18, 20
• Standard_E104ids_v5	S70	10, 12, 15, 18, 20

References

Dell Technologies documentation

The following resources provide information related to this document. Access to documents depends on your login credentials. If you do not have access to a document, contact your Dell Technologies representative.

- APEX File Storage for Microsoft Azure product page
- APEX File Storage for Microsoft Azure Deployment Guide
- PowerScale OneFS Technical Overview—Data protection

Azure documentation

The following Azure documentation provides additional information related to this document:

- Ddv5 and Ddsv5-series
- Edv5 and Edsv5-series
- Azure managed disk types