Dell PowerStore: File Capabilities

May 2024

H18155.8

White Paper

Abstract

This document describes the features, functionality, and protocols supported by the Dell PowerStore file architecture.

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Contents

Executive summary

Overview

Dell PowerStore offers a native file solution that is designed for the modern data center. The file system architecture is highly scalable, efficient, performance-focused, and flexible. PowerStore also includes a rich supporting feature set, enabling the ability to support a wide array of use cases such as departmental shares or home directories. These file capabilities are integrated, so no extra hardware, software, or licenses are required. File management, monitoring, and provisioning capabilities are handled through the simple and intuitive HTML5-based PowerStore Manager.

Audience

This document is intended for IT administrators, storage architects, partners, and Dell Technologies employees. This audience also includes any individuals who may evaluate, acquire, manage, operate, or design a Dell networked storage environment using PowerStore systems.

Revisions

Date	Part number/ revision	Description
April 2020	H18155	Initial release: PowerStoreOS 1.0
July 2020	H18155.1	Minor updates
September 2020	H18155.2	PowerStoreOS 1.0.2 updates
April 2021	H18155.3	PowerStoreOS 2.0 updates
November 2021	H18155.4	Minor updates; template update
July 2022	H18155.5	PowerStoreOS 3.0 updates
May 2023	H18155.6	PowerStoreOS 3.5 updates: • Added: ▪ Fail-Safe Networking ▪ SMB share permissions • Updated content about snapshots
October 2023	H18155.7	PowerStoreOS 3.6 updates: • Added: ▪ Disaster recovery testing • Updated content about file extension filtering and NAS servers

Date	Part number/ revision	Description
May 2024	H18155.8	PowerStoreOS 4.0 updates: • Added: ▪ Synchronous Replication ▪ Reprotect with discard changes after failover ▪ Asynchronous replication metrics ▪ CAVA enhancements ▪ PowerStore Q model ▪ Native file import from Unity • Removed: PowerStore X content

We value your feedback

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

Author: Wei Chen

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

Introduction

PowerStore overview

PowerStore achieves new levels of operational simplicity and agility. It uses a container-based microservices architecture, advanced storage technologies, and integrated machine learning to unlock the power of your data. PowerStore is a versatile platform with a performance-centric design that delivers multidimensional scale, always-on data reduction, and support for next-generation media.

PowerStore brings the simplicity of public cloud to on-premises infrastructure, streamlining operations with an integrated machine-learning engine and seamless automation. It also offers predictive analytics to easily monitor, analyze, and troubleshoot the environment. PowerStore is highly adaptable, providing the flexibility to host specialized workloads directly on the appliance and modernize infrastructure without disruption. It also offers investment protection through flexible payment solutions and data-in-place upgrades.

PowerStore file capabilities

PowerStore features a native file solution that is highly scalable, efficient, performance-focused, and flexible. This design enables accessing data over file protocols such as Server Message Block (SMB), Network File System (NFS), File Transfer Protocol (FTP), and SSH File Transfer Protocol (SFTP).

PowerStore uses virtualized NAS servers to enable access to file systems, provide data separation, and act as the basis for multitenancy. File systems can be accessed through a wide range of protocols and can take advantage of advanced protocol features. Services such as anti-virus, scheduled snapshots, Network Data Management Protocol (NDMP) backups, and replication ensure the data on the file systems is well protected.

PowerStore file is available natively on PowerStore T and Q model appliances, which are designed as true unified storage systems. There are no extra pieces of software, hardware, or licenses required to enable this functionality. All file management, monitoring, and provisioning capabilities are available in the HTML5-based PowerStore Manager.

Terminology

The following table provides definitions for some of the terms that are used in this document.

Table 1. Terminology

Term	Definition
File system	A storage resource that can be accessed through file sharing protocols such as SMB or NFS.
Network-Attached Storage (NAS) server	A virtualized network-attached storage server that uses the SMB, NFS, FTP, and SFTP protocols to catalog, organize, and transfer files within file system shares and exports. A NAS server, the basis for multitenancy, must be created before you can create file-level storage resources. NAS servers are responsible for the configuration parameters on the set of file systems that it serves.
Network File System (NFS)	An access protocol that enables users to access files and folders on a network. NFS is typically used by Linux and UNIX hosts.

Term	Definition
PowerStore Manager	An HTML5 user interface used to manage PowerStore systems.
PowerStore Q model	Container-based storage system that is running on purpose-built hardware. This storage system supports unified (block and file) workloads or block-optimized workloads. The PowerStore Q model supports Quad-Level Cell (QLC) NVMe SSDs for data storage.
PowerStore T model	Container-based storage system that is running on purpose-built hardware. This storage system supports unified (block and file) workloads or block-optimized workloads. The PowerStore T model supports Triple-Level Cell (TLC) NVMe SSDs for data storage.
Server Message Block (SMB)	An access protocol that allows remote file data access from clients to hosts on a network. SMB is typically used in Microsoft Windows environments.
Snapshot	A point-in-time view of data stored on a storage resource. A user can recover files from a snapshot or restore a storage resource from a snapshot.

Unified appliance

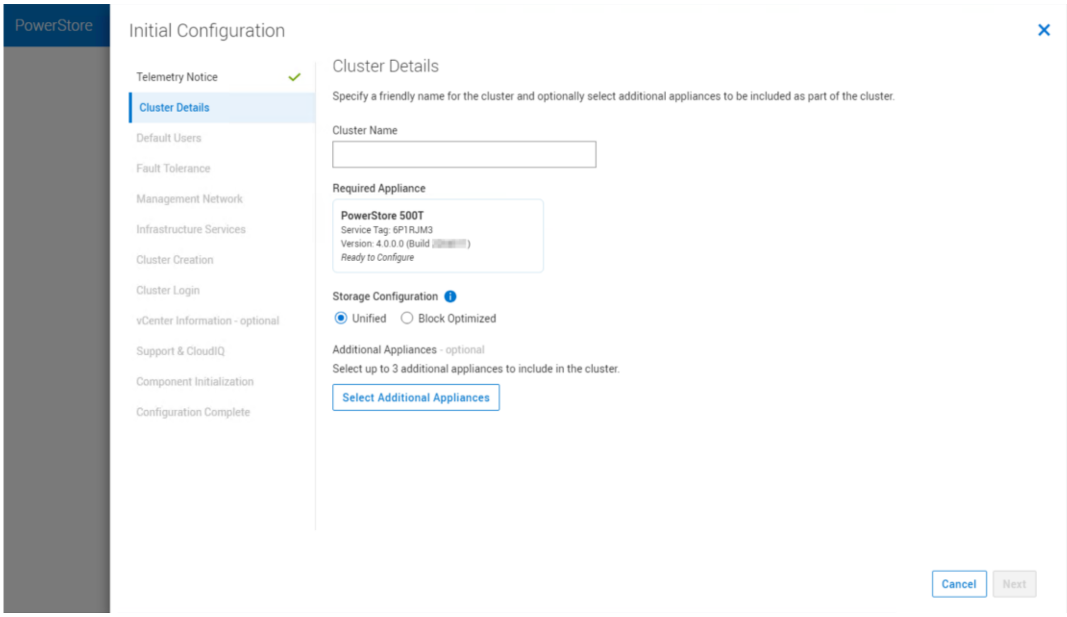
When running through the Initial Configuration Wizard (ICW) on a PowerStore T or Q model appliance, you can choose to configure it either as a unified or block-optimized appliance. Selecting Unified enables file and block functionality while selecting Block Optimized only enables block functionality. This selection determines the resource allocation on the appliance. This selection can only be made during initial configuration and cannot be changed without reinitializing.

To enable file functionality on the appliance, select **Unified**. If there is a chance that a file may be required, it is recommended to choose this option. If a unified configuration is selected, the NAS installation is started automatically after the cluster creation successfully completes.

To complete the NAS installation process, a communication channel between the two nodes is required. Starting with PowerStoreOS 1.0.2, this communication is done through an internal backplane interconnect. Previously, this communication traveled through the first two ports of the 4-port card from one node, through the top-of-rack switches, and through the first two ports of the 4-port card on the second node. If the switches are not properly configured, it results in a NAS installation failure. With PowerStoreOS 1.0.2, the NAS installation completes successfully even if the switches are not configured properly. This behavior allows the administrator to bring the system online and address the switch configuration later.

The PowerStore 500 can be ordered without a 4-port card. However, to support file functionality, the 4-port card must be ordered. On PowerStore 500 systems that do not have a 4-port card installed, the Unified option is disabled and the only option available is Block Optimized. In addition to not supporting file, PowerStore 500 systems without a 4-port card also do not support clustering.

If file functionality is not required, the Block Optimized selection provides slightly higher block IOPS potential. The following figure shows the storage configuration options on a PowerStore T or Q model appliance.



Cluster Details

Specify a friendly name for the cluster and optionally select additional appliances to be included as part of the cluster.

Cluster Name

Required Appliance

PowerStore 500T
Service Tag: 6P1RJM3
Version: 4.0.0.0 (Build [redacted])
Ready to Configure

Storage Configuration

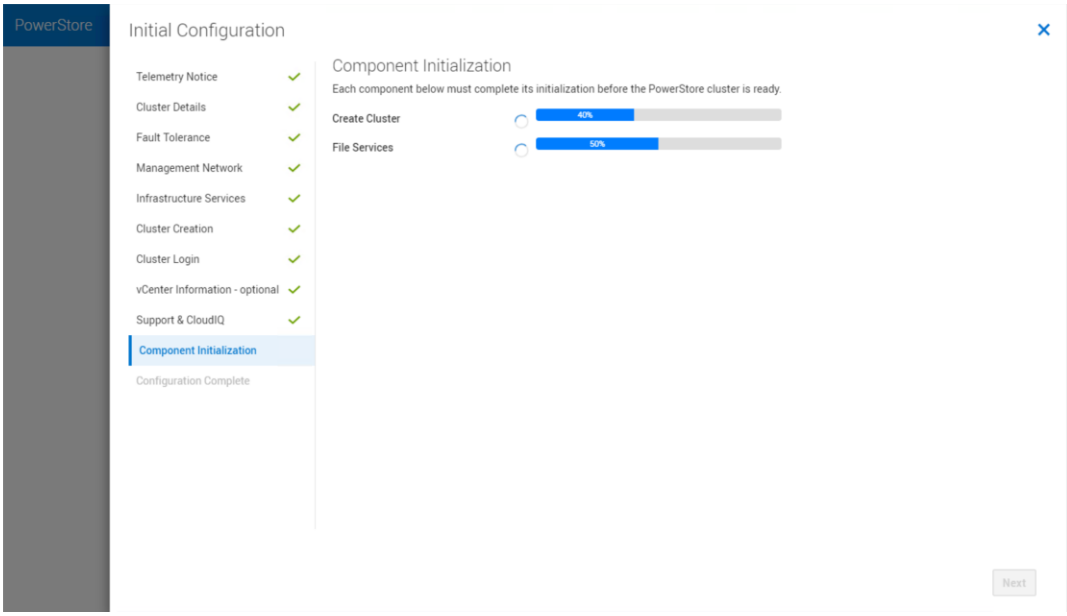
● Unified ○ Block Optimized

Additional Appliances - optional

Select up to 3 additional appliances to include in the cluster.

Figure 1. Storage configuration

After submitting the required data in the ICW, the cluster creation and file installation process begins. Starting with PowerStoreOS 3.0, these operations are split into two separate phases. The first is the core services initialization phase which includes all core services required to make the cluster operational. The second phase consists of non-core and optional services, such as file. If any errors are detected during the non-core services phase, this behavior enables troubleshooting and addressing the issue while maintaining the healthy state of the cluster. Figure 2 shows the create cluster and file services initialization step of the ICW.



Component Initialization

Each component below must complete its initialization before the PowerStore cluster is ready.

Create Cluster 40%

File Services 50%

Figure 2. Create cluster and file services initialization

In a multi-appliance cluster configuration, file functionality is only available on the primary or first appliance in the cluster. The remaining appliances in the cluster are configured as Block-Optimized, and only the capacity on the first appliance can be used for file systems. The capacity on the other appliances within the same cluster can be used for volumes and VMware vSphere Virtual Volumes (vVols), but not for file systems.

Within the first appliance, both nodes are used for file. This configuration creates a fully redundant and active/active architecture where both nodes are used to serve file data. This design enables the ability to load balance across both nodes and ensure high availability in a failover.

NAS servers

Introduction

PowerStore file uses virtualized file servers that are called NAS servers. A NAS server contains the configuration, interfaces, and environmental information used to facilitate access to the file systems. This information includes services such as Domain Name System (DNS), Lightweight Directory Access Protocol (LDAP), Network Information Service (NIS), protocols, anti-virus, NDMP, and so on.

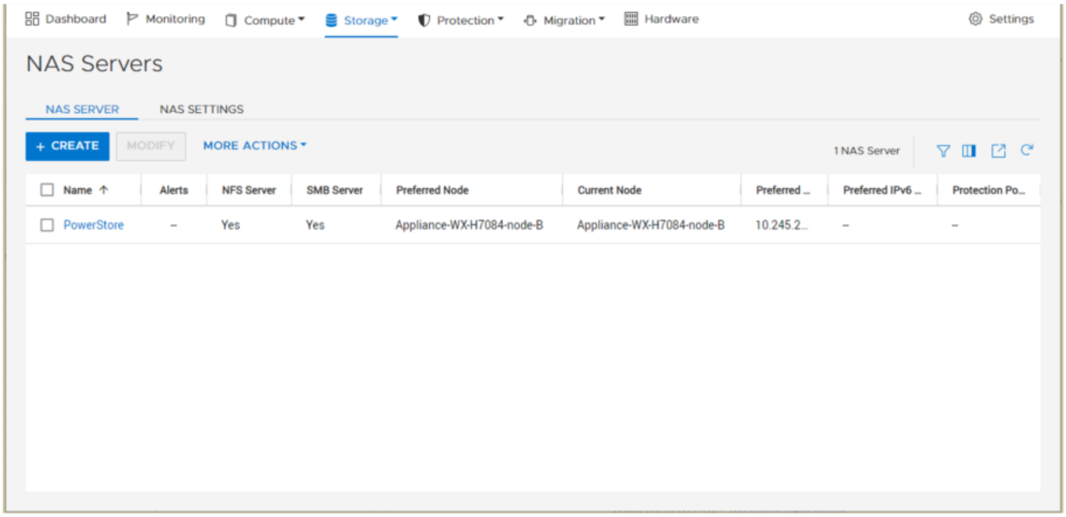
Multitenancy

NAS servers can be used to enforce multitenancy, and are useful when a single system hosts multiple tenants such as service providers. Since each NAS server has its own independent configuration, it can be tailored to the requirements of each tenant without impacting the other NAS servers on the same appliance. Also, each NAS server is logically separated from each other, and clients that have access to one NAS server do not inherently have access to the file systems on the other NAS servers. File systems are assigned to a NAS server upon creation and cannot be moved between NAS servers.

Multi-tenancy can also be enforced on the front-end ports. Each NAS server can have its interface created on a different bond. The ports for these bonds can also be connected to different switches if desired. This enables the network ports to be isolated from each other and dedicated to each tenant. There is no traffic sharing and the full performance capabilities of the port can be made available.

High availability

New NAS servers are automatically assigned on a round-robin basis across the available nodes. The preferred node acts as a marker to indicate the node that the NAS server should be running on, based on this algorithm. Once provisioned, the preferred node for a NAS server never changes. The current node indicates the node that the NAS server is running on. Changing the current node moves the NAS server to a different node, which can be used for load-balancing purposes. When a NAS server is moved to a new node, all file systems on the NAS server are moved along with it. The following figure shows the current and preferred node columns for a NAS server.



Name ↑	Alerts	NFS Server	SMB Server	Preferred Node	Current Node	Preferred ...	Preferred IPv6 ...	Protection Po...
□ PowerStore	–	Yes	Yes	Appliance-WX-H7084-node-B	Appliance-WX-H7084-node-B	10.245.2...	–	–

Figure 3. Current and preferred node

In a PowerStore node failure, the NAS servers automatically fail over to the surviving node. This process generally completes within 30s to avoid host timeouts. Once the failed node is recovered, failing back the NAS servers to return to a balanced configuration is a manual process.

NAS servers are also automatically moved to the peer node and back during the upgrade process. After the upgrade is complete, the NAS servers return to the node they were assigned to at the beginning of the upgrade.

Interfaces

Each NAS server supports up to 50 production and 10 backup interfaces. Production interfaces are used for client connectivity over FTP, SFTP, NFS, and SMB. Backup interfaces support NFS-only access, which can be used for backup purposes.

NAS server interfaces must be created on a bond for high availability purposes. The bond can be either a Link Aggregation or Fail-Safe Network. With a bond, link loss on a single port does not impact connectivity to the NAS server.

Ping from one of the NAS server interfaces can be used for troubleshooting purposes. The system designates one interface as the preferred interface, which is used for outgoing communication to external services. Also, custom host and network routes can be configured on a per-interface basis.

Link Aggregation (LA)

The system configures all NAS server interfaces on the first two bonded ports on the four-port card (bond0), by default. For maximum bandwidth on these ports, configure Virtual Link Trunking interconnect (VLTi) with Link Aggregation Control Protocol (LACP) or equivalent technology on the switch. The following figure shows the embedded module that holds the four-port card.

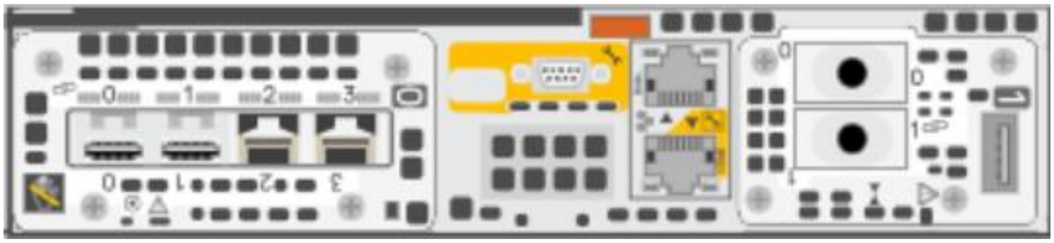
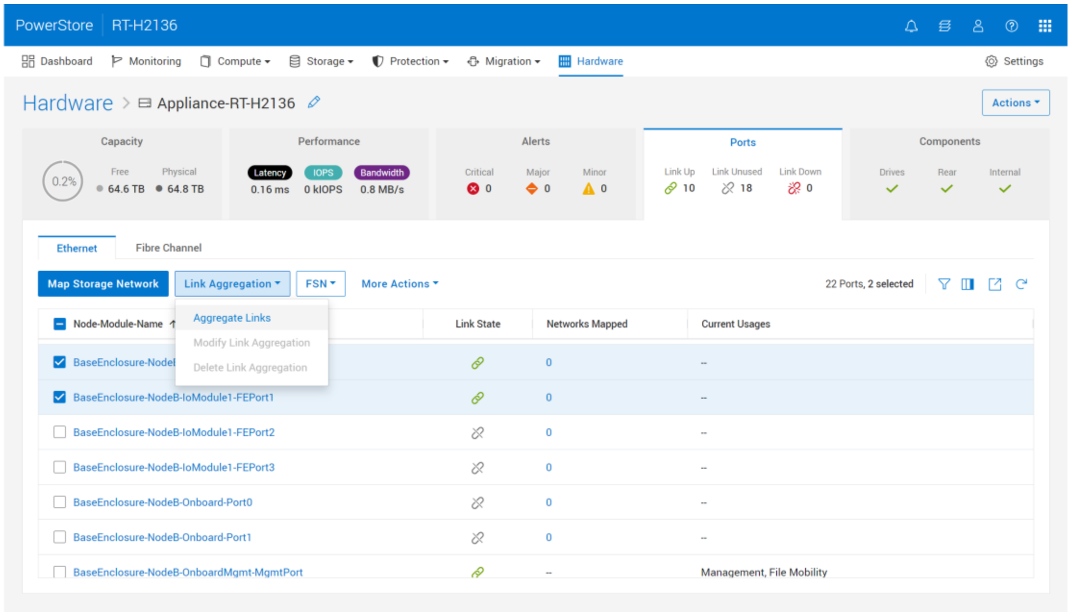


Figure 4. Embedded module with four-port card

Starting with PowerStoreOS 3.0, user-defined LA can be configured for file interfaces, allowing you to create custom bonds on two to four ports. The bonds can span the 4-port card and IO modules, but they must have the same speed, duplex, and MTU settings.

To configure a bond, the switch must be configured properly. The ports that will be part of the bond on node A should be configured into a port channel. The same configuration should be mirrored for the ports on node B. If the switch is not in a consistent configuration with the storage system, PowerStore Manager displays an alert.

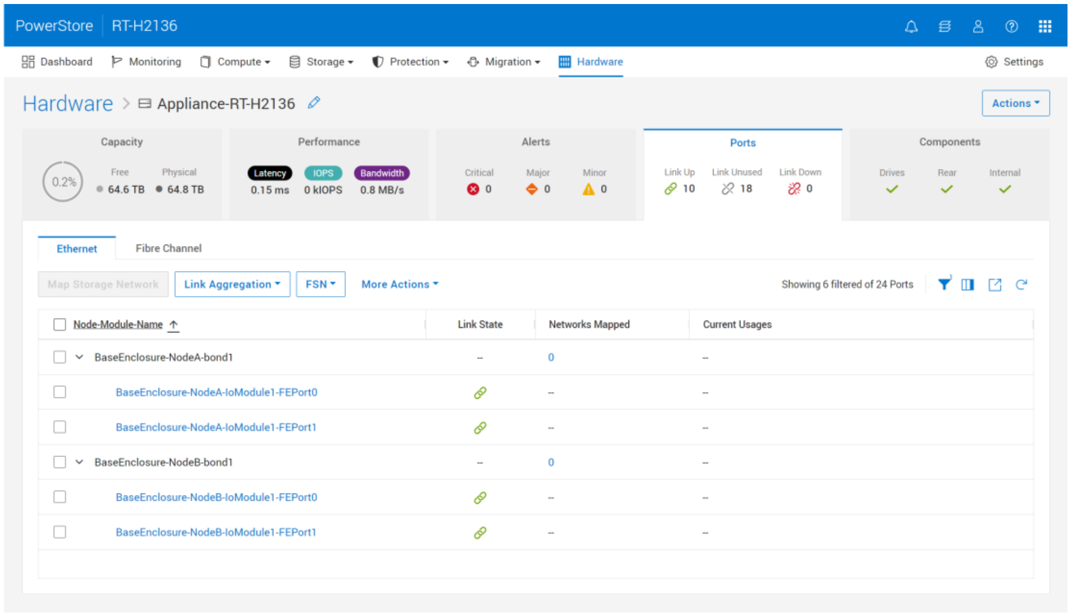
Afterward, in PowerStore Manager, go to **Hardware** > **Ports**. Select the ports on either node A or node B that should be part of the bond, and then click **Link Aggregation** > **Aggregate Link,** as shown in Figure 5**.**



	Node-Module-Name ↑	Link State	Networks Mapped	Current Usages
☑	BaseEnclosure-NodeI	🔗	0	–
☑	BaseEnclosure-NodeB-IoModule1-FEPort1	🔗	0	–
□	BaseEnclosure-NodeB-IoModule1-FEPort2		0	–
□	BaseEnclosure-NodeB-IoModule1-FEPort3		0	–
□	BaseEnclosure-NodeB-Onboard-Port0		0	–
□	BaseEnclosure-NodeB-Onboard-Port1		0	–
□	BaseEnclosure-NodeB-OnboardMgmt-MgmtPort	🔗	–	Management, File Mobility

Figure 5. Aggregate links

Regardless of the node from which the ports were selected, the bond is created on both nodes automatically. A name for the bond is generated automatically and cannot be changed. An optional description can be added to the bond and can be changed at any time. Figure 6 shows the aggregate that was created.

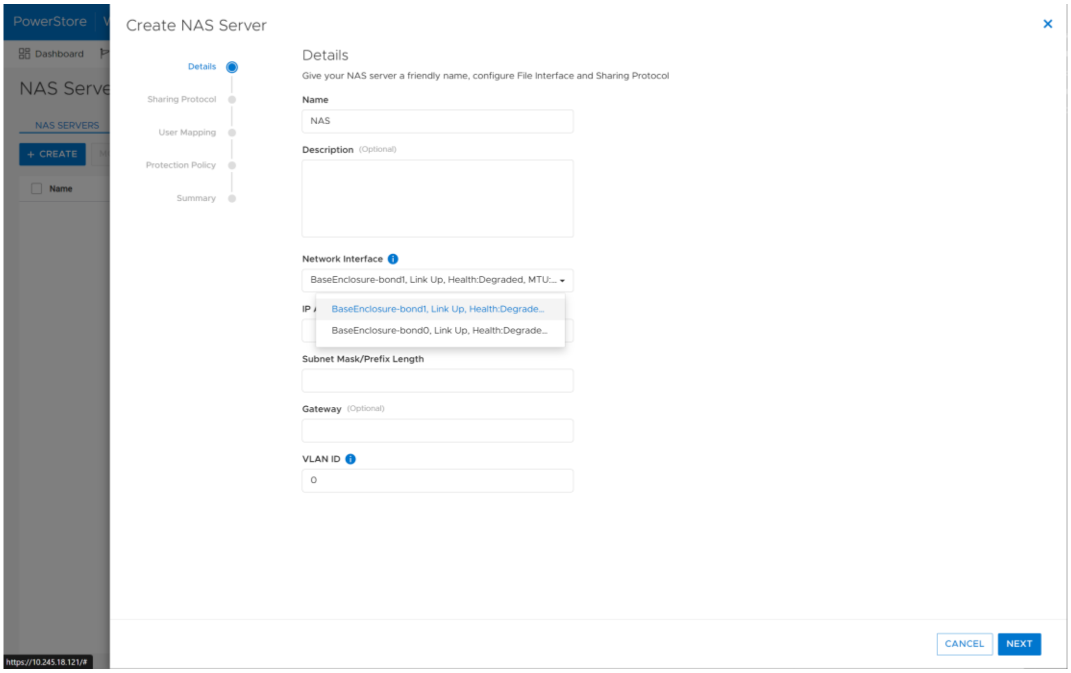


	Node-Module-Name ↑	Link State	Networks Mapped	Current Usages
□	BaseEnclosure-NodeA-bond1	–	0	–
□	BaseEnclosure-NodeA-IoModule1-FEPort0	🔗	–	–
□	BaseEnclosure-NodeA-IoModule1-FEPort1	🔗	–	–
□	BaseEnclosure-NodeB-bond1	–	0	–
□	BaseEnclosure-NodeB-IoModule1-FEPort0	🔗	–	–
□	BaseEnclosure-NodeB-IoModule1-FEPort1	🔗	–	–

Figure 6. Aggregated bond1 on both nodes

Existing bonds can be expanded to add more members to them. To add members, select the bond along with additional individual ports and click **Aggregate Link**. Bonds can also be deleted if they are no longer needed.

After the LA is created, it can be used to create a file interface on a NAS server, as shown in Figure 7.



Create NAS Server

- Details
- Sharing Protocol
- User Mapping
- Protection Policy
- Summary

Details

Give your NAS server a friendly name, configure File Interface and Sharing Protocol

Name: NAS

Description (Optional)

Network Interface: BaseEnclosure-bond1, Link Up, Health:Degraded, MTU:...

- BaseEnclosure-bond1, Link Up, Health:Degrade...
- BaseEnclosure-bond0, Link Up, Health:Degrade...

IP A

Subnet Mask/Prefix Length

Gateway (Optional)

VLAN ID: 0

Figure 7. Selecting a bond for a NAS server interface

Fail-Safe Networking (FSN)

PowerStoreOS 3.5 adds Fail-Safe Networking (FSN) support for file interfaces. FSN is a high-availability feature that enables configuring ports in a primary/backup configuration. Under normal circumstances, the primary ports are designated as active and are used to service I/O. If all primary ports of an FSN go offline, the backup ports automatically become active and continue to service I/O. This feature enables redundancy in case of port, cable, or switch failure. When the primary ports are restored, the system automatically makes the primary ports active again.

FSN can be leveraged to increase resiliency in file networks, especially when Multi-Chassis Link Aggregation Group (MC-LAG) is not configured on the top-of-rack (ToR) switches. MC-LAG enables the ability to create LAs across multiple switches. Without MC-LAG, LAs are limited to a single physical switch. If that switch goes offline, access to the NAS servers on that node becomes unavailable. Configuring FSN across multiple physical switches enables data access to continue even if a switch goes offline.

FSN is designed to be transparent to the switch, which enables it to work with any switch vendor and does not require any switch configuration. The FSN exposes a single MAC address to the network, so it appears as a single link. An FSN can potentially have multiple IP addresses on it if it is used for multiple NAS server interfaces.

An FSN can consist of individual ports, LAs, or a combination of both. When FSN is used with LA, multiple ports can be used as part of the active or backup part of the FSN. Leveraging both FSN and LA together provides high availability as well as load balancing. If the primary side of the FSN uses an LA, all ports of the LA must go down for the backup side to become active. You cannot put the System Bond into an FSN.

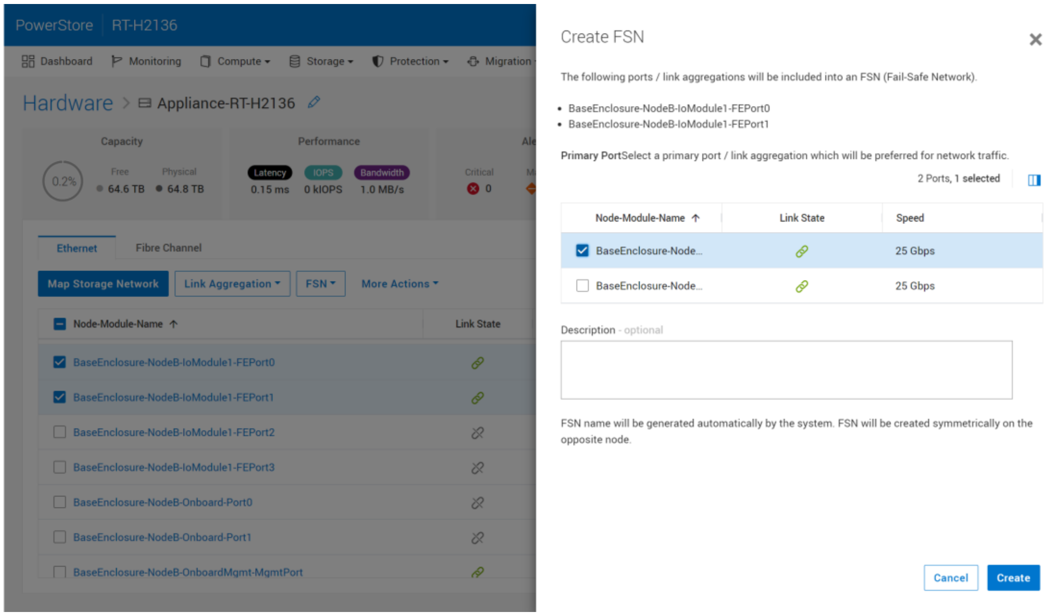
An FSN can be created using different configurations on the primary side and backup side. Members of an FSN can have different speed and duplex settings but must have the same MTU. Ports from different I/O modules on the same node can be used in the FSN.

FSNs created with more ports on one side than on the other are also allowed. However, having a mismatched configuration might have performance implications in failure scenarios.

To create an FSN in PowerStore Manager:

1. Go to **Hardware** > **Appliance** > **Ports**, and select two ports or LAs, or one port and one LA, from the same node.
2. Go to **FSN** > **Create FSN**, and select the port or LA that will be the primary.

   The system automatically designates the other port or LA as the backup. The members and primary link of the FSN cannot be modified after the FSN is created. You can add an optional description, which can be changed at any time.
3. Click **Create** to create the FSN, as shown in Figure 8.



Create FSN

The following ports / link aggregations will be included into an FSN (Fail-Safe Network).

- BaseEnclosure-NodeB-IoModule1-FEPort0
- BaseEnclosure-NodeB-IoModule1-FEPort1

Primary Port Select a primary port / link aggregation which will be preferred for network traffic.

2 Ports, 1 selected

	Node-Module-Name	Link State	Speed
☑	BaseEnclosure-Node...	🔗	25 Gbps
□	BaseEnclosure-Node...	🔗	25 Gbps

Description - optional

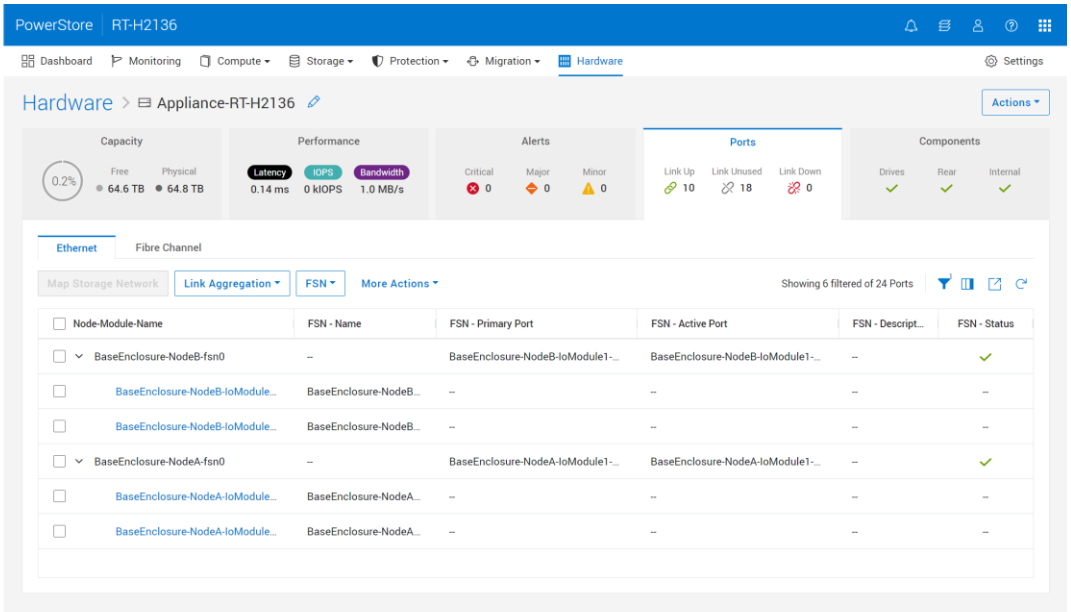
FSN name will be generated automatically by the system. FSN will be created symmetrically on the opposite node.

Figure 8. Create FSN

The FSN is automatically created on both nodes. A name for the FSN is generated automatically and cannot be changed. The FSN naming convention is `BaseEnclosure-Node<A|B>-fsn<#>`, where:

- A or B represents the node.
  - There is a separate FSN device for each node for monitoring purposes.
- # is an incrementing number.
  - The first FSN number is 0.
  - Any gaps in the numbering are filled by the next FSN that is created.

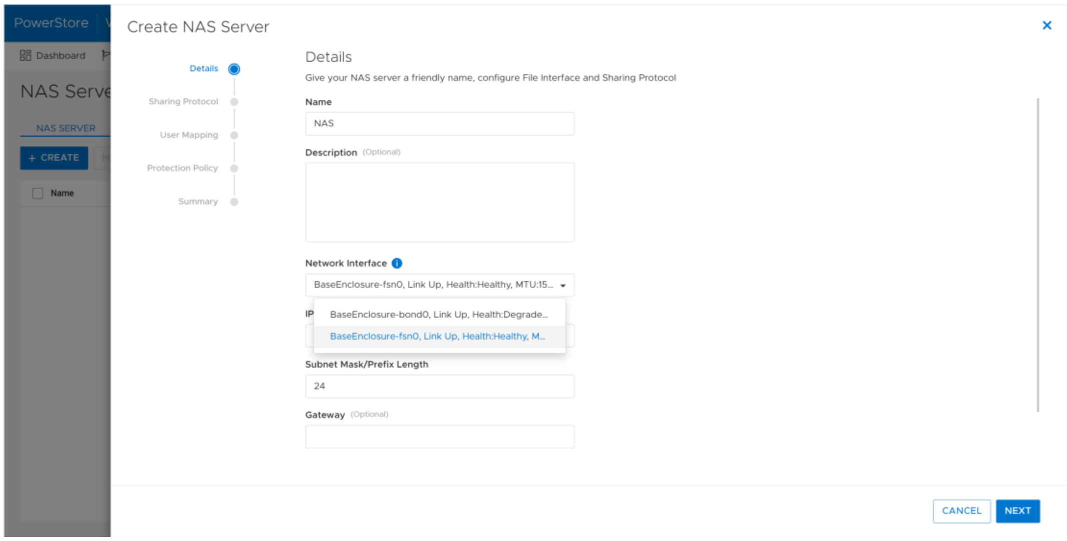
New columns are added to show the FSN details. These columns are hidden by default but can be enabled using the column selector. Figure 9 shows the new FSN columns.



Node-Module-Name	FSN - Name	FSN - Primary Port	FSN - Active Port	FSN - Descript...	FSN - Status
BaseEnclosure-NodeB-fsn0	–	BaseEnclosure-NodeB-IoModule1-...	BaseEnclosure-NodeB-IoModule1-...	–	✓
BaseEnclosure-NodeB-IoModule...	BaseEnclosure-NodeB...	–	–	–	–
BaseEnclosure-NodeB-IoModule...	BaseEnclosure-NodeB...	–	–	–	–
BaseEnclosure-NodeA-fsn0	–	BaseEnclosure-NodeA-IoModule1-...	BaseEnclosure-NodeA-IoModule1-...	–	✓
BaseEnclosure-NodeA-IoModule...	BaseEnclosure-NodeA...	–	–	–	–
BaseEnclosure-NodeA-IoModule...	BaseEnclosure-NodeA...	–	–	–	–

Figure 9. FSN columns

With PowerStoreOS 3.5, NAS server interfaces can be created on any type of bonded ports. The bond can be a LA, FSN, or a combination of both. Creating a NAS server interface on an individual port without a LA or FSN is not allowed due to the lack of redundancy. Figure 10 shows how to create a NAS server interface on an FSN.



Details

Give your NAS server a friendly name, configure File Interface and Sharing Protocol

Name: NAS

Description (Optional)

Network Interface: BaseEnclosure-fsn0, Link Up, Health:Healthy, MTU:15...

- BaseEnclosure-bond0, Link Up, Health:Degrade...
- BaseEnclosure-fsn0, Link Up, Health:Healthy, M...

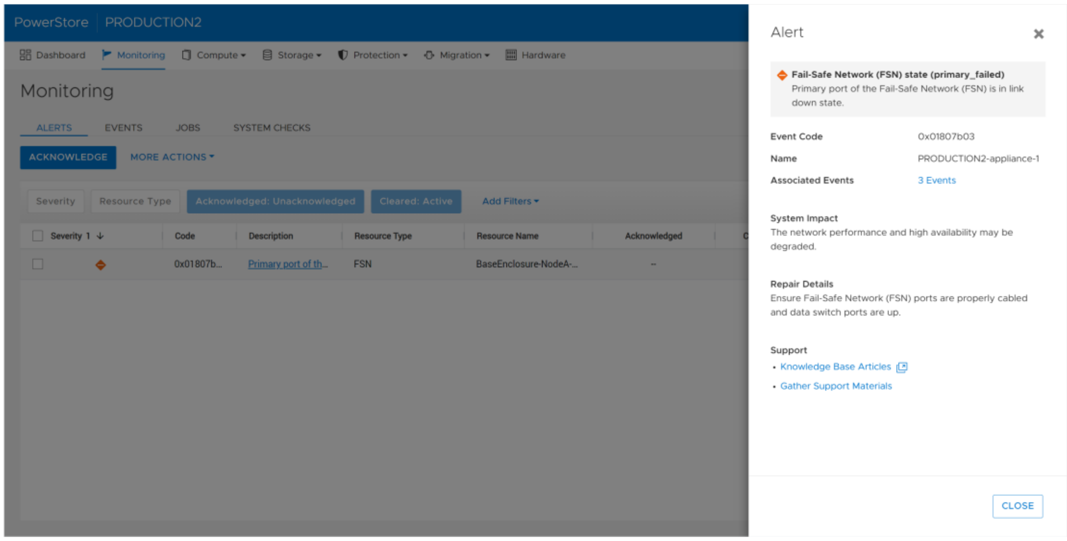
IP

Subnet Mask/Prefix Length: 24

Gateway (Optional)

Figure 10. Create NAS server interface on an FSN

Any changes to the FSN status are captured in the event log. Depending on the potential impact, an alert might be displayed to inform the storage administrator of the status change. For example, if the primary port of the FSN goes down, a major alert is generated, as shown in Figure 11.



Monitoring

Severity 1	Code	Description	Resource Type	Resource Name	Acknowledged
◆	0x01807b...	Primary port of th...	FSN	BaseEnclosure-NodeA-...	--

Alert

Fail-Safe Network (FSN) state (primary_failed)
Primary port of the Fail-Safe Network (FSN) is in link down state.

Event Code	0x01807b03
Name	PRODUCTION2-appliance-1
Associated Events	3 Events

System Impact
The network performance and high availability may be degraded.

Repair Details
Ensure Fail-Safe Network (FSN) ports are properly cabled and data switch ports are up.

Support
- Knowledge Base Articles
- Gather Support Materials

Figure 11. FSN port down alert

VLAN

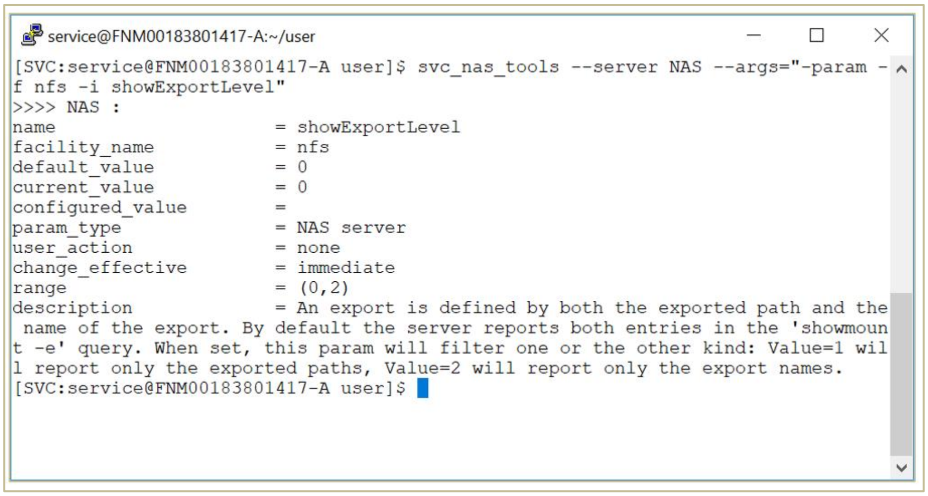
Each NAS server interface can be configured on a specific VLAN. Interfaces that reside on different VLANs can be created, even if they are within the same NAS server. Each IP address must be unique, even if they reside on different VLANs. You cannot create a NAS server interface that resides on the same VLAN as the storage VLAN, which is used for iSCSI and replication connectivity.

NAS server parameters

NAS server parameters are used for controlling the behavior and advanced tuning of file features. Management of parameters is only available in the CLI by the service user using the svc_nas_tools command. All parameter changes are preserved through node reboots and failovers.

When viewing the details or changing a parameter, view the output to see more information about the parameter including the granularity when it takes effect. Some parameters are applied at a NAS server granularity while others are global. The global parameters are applied at the system level by specifying **ALL** instead of a NAS server name. Also, some parameters require a reboot to take effect.

The following figure shows an example of a NAS server parameter.



```
[SVC:service@FNM00183801417-A user]$ svc_nas_tools --server NAS --args="-param -
f nfs -i showExportLevel"
>>>> NAS :
name                     = showExportLevel
facility_name            = nfs
default_value            = 0
current_value            = 0
configured_value         =
param_type               = NAS server
user_action              = none
change_effective         = immediate
range                    = (0,2)
description              = An export is defined by both the exported path and the
 name of the export. By default the server reports both entries in the 'showmoun
t -e' query. When set, this param will filter one or the other kind: Value=1 wil
l report only the exported paths, Value=2 will report only the export names.
[SVC:service@FNM00183801417-A user]$ 
```

Figure 12. NAS server parameters

For more information about the available NAS server parameters and how to configure them, see the *Dell PowerStore Service Scripts Guide* on Dell.com/powerstoredocs.

Protocols

Introduction

PowerStore file supports a wide range of protocols including SMB, NFS, FTP, and SFTP. Since these protocols are enabled at the NAS server level, each NAS server can be customized to allow only the specific protocols that are being used. Each NAS server can be configured to support one or more protocols and these options can be changed at any time.

SMB

PowerStore file supports SMB1 through 3.1.1. SMB3 enhancements such as continuous availability, offload copy, protocol encryption, multichannel, and shared VHDX in Hyper-V are supported on PowerStore.

The SMB option on the NAS server enables or disables SMB connectivity to the file systems. The SMB version that is negotiated depends on the client operating system:

- CIFS: Windows NT 4.0
- SMB1: Windows 2000, Windows XP, Windows Server 2003, and Windows Server 2003 R2
- SMB2: Windows Vista (SP1 or later) and Windows Server 2008
- SMB2.1: Windows 7 and Windows Server 2008 R2
- SMB3.0: Windows 8 and Windows Server 2012
- SMB3.02: Windows 8.1 and Windows Server 2012 R2
- SMB3.1.1: Windows 10 and Windows Server 2016 and Windows Server 2019

Due to the age of the protocol and potential security vulnerabilities, client access using SMB1 is disabled by default. If client access using SMB1 is required, it can be enabled by modifying the `cifs.smb1.disabled` parameter. Using SMB2 at a minimum is recommended as it provides security enhancements and increases efficiency compared to SMB1.

NAS servers use SMB2 to communicate with the domain controllers for operations such as authentication, SID lookups, Group Policies, and so on. If SMB2 is not available, the NAS server attempts to use SMB1 as a backup option. Therefore, any domain controllers that are running older operating systems that only support SMB1 can continue to function.

When enabling SMB support on a NAS server, the SMB server can either be stand-alone or Active Directory domain-joined. Domain-joined NAS servers require DNS to be configured, but this configuration is optional for stand-alone SMB servers. Domain-joined NAS servers are placed in the `CN=Computers` container, by default. When joining an SMB server to the domain, the computer object can be configured to be stored in a different OU location in the advanced settings.

Support for advanced SMB protocol options is also available. Table 2 shows a list of SMB protocol options, where they are configured, and the default setting for each option.

Table 2. SMB options

Protocol option	Level	Default
Sync Writes Enabled	File system	Disabled
Oplocks Enabled	File system	Enabled
Notify on Write Enabled	File system	Disabled
Notify on Access Enabled	File system	Disabled
Continuous Availability	Share	Disabled
Protocol Encryption	Share	Disabled
Access-Based Enumeration	Share	Disabled
Branch Cache Enabled	Share	Disabled
Offline Availability	Share	None
UMASK (Multiprotocol)	Share	022

Sync writes

Synchronous writes enable the storage system to perform immediate synchronous writes for storage operations, regardless of how the SMB protocol performs write operations. Enabling synchronous writes operations allow you to store and access database files (for example, MySQL) on storage system SMB shares. This option guarantees that any write to the share is done synchronously and reduces the chances of data loss or file corruption in various failure scenarios, for example, loss of power. If SMB3 Continuous Availability (CA) is enabled, all write operations are automatically synced to satisfy the requirements for CA. This option can have a big impact on performance. It is not recommended unless you intend to use Windows file systems to provide storage for database applications.

Oplocks

Opportunistic file locks (oplocks) allow SMB clients to buffer file data locally before sending it to a server. SMB clients can then work with files locally and periodically communicate changes to the storage system rather than having to communicate every operation over the network to the storage system. Unless your application handles critical data or has specific requirements that make this mode or operation unfeasible, leaving the oplocks enabled is recommended.

The following oplocks implementations are supported:

- **Level II Oplocks**: Informs a client that multiple clients are currently accessing a file, but no client has yet modified it. A level II oplock lets the client perform read operations and file-attribute fetches by using cached or read-ahead local information. All other file access requests must be sent to the server.
- **Exclusive Oplocks (SMB2 only)**: Informs a client that it is the only client opening the file. An exclusive oplock lets a client perform all file operations. It uses cached or read-ahead information until it closes the file, at which time the server must be updated with any changes that are made to the state of the file (contents and attributes).
- **Batch Oplocks**: Informs a client that it is the only client opening the file. A batch oplock lets a client perform all file operations by using cached or read-ahead information (including opens and closes). The server can keep a file opened for a client even though the local process on the client machine has closed the file. This mechanism curtails the amount of network traffic by letting clients skip the extraneous close and open requests.

This option only applies to client access over SMB1 since oplocks are always enabled for client access over SMB2 and SMB3. However, disabling this option also invalidates the SMB2.1 file and directory lease feature. Leasing serves the same purpose as oplocks, but provides greater flexibility and enhancements, increasing performance and reducing network utilization.

- **Read-caching lease**: Allows caching reads and can be shared by multiple clients.
- **Write-caching lease**: Allows caching writes and is exclusive to only one client.
- **Handle-caching lease**: Allows caching handles and can be shared by multiple clients.

Notify on write or access enabled

This option enables notifications when a file system is written to or accessed. Applications that run on Windows platforms, and use the Win32 API, can register with the SMB server to be notified of file and directory content changes, such as file creation, modify, or rename. For example, this feature can indicate when a display must be refreshed (Windows Explorer) or when the cache must be refreshed (Microsoft Internet Information Server), without having to constantly poll the SMB server.

Continuous availability

Continuous availability is a share-level SMB3 feature. In a client or storage processor failure, CA allows persistent access to file systems without loss of the session state. This ability is useful for critical applications such as Microsoft Hyper-V or SQL, where constant availability to files is of the upmost importance. SMB3 uses persistent handles to enable the NAS server to save specific metadata that is associated to an open handle on disk. In a node failure, applications accessing open file content are not affected if the NAS server and file system failover to the peer node completes within the timeout of the application.

This action results in clients transparently reconnecting to the peer node after the NAS server failover without affecting client access to files.

Continuous availability is also available on the client side, which is independent from storage CA. Client CA transparently preserves access in a node failure within a client application cluster. When a failure of one node in the cluster occurs, the application is moved to the other node and reopens its content on the share from that node using its originally assigned ApplicationID without an interruption in access. The CA option on the share does not need to be enabled to use client CA.

SMB 3.1.1 adds a reliability enhancement for Continuous Availability for Hyper-V Cluster Client Failover by adding an ApplicationInstanceVersion tag in addition to the ApplicationID. The ApplicationInstanceVersion tag is incremented each time that an application is restarted on a new node within the cluster. In situations where network access is lost, but storage access remains available, the application may be restarted on a new node without the cluster knowing due to the lack of network access. The ApplicationInstanceVersion tag enables the storage system to easily identify which node in the cluster is the correct owner of the application. The storage system can safely close any locks that were opened with a lower ApplicationInstanceVersion number, which allows the application to restart without any conflicts.

Protocol encryption

Protocol encryption is a share-level SMB3 feature, which provides in-flight data encryption between SMB3 clients and the NAS server. The client or NAS server encrypts the data before sending it to the destination. It is then decrypted upon reaching its destination, whether that is the NAS server or SMB client. The protocol encryption is enforced at user session level, ensuring the whole SMB traffic is encrypted once the user session is established.

The following setting can be configured in the NAS server registry:

HKEY_LOCAL_MACHINE\System\CurrentControlSet\Services\LanmanServer\Parameters\RejectUnencryptedAccess: Determines if clients that do not support encryption (pre-SMB3.0) have access to the share.

- 1 (default): Returns access denied to pre-SMB3.0 clients that do not support encryption
- 0: Allows pre-SMB3.0 clients to access the share without encryption

SMB 3.1.1 also provides improved security and encryption traffic performance for SMB3 by changing the encryption algorithm from AES-CCM-128 to AES-GCM-128. This change improves performance under certain conditions such as large file transfers. It also improves security against man-in-the-middle attacks.

Access-based enumeration

Access-based enumeration is a share-level option that restricts the display of files and folders based on the access privileges of the user attempting to view them. Without access-based enumeration, all users can view all files and folders within a directory. However, they cannot open or view these files and folders without the appropriate access privileges. When access-based enumeration is enabled on a share, users can only see files or folders for which they have at least read access.

For example, without access-based enumeration, a user could see all files in a directory, regardless of whether they can open them. However, with access-based enumeration, the inaccessible files are hidden from the user view. Administrator users are always able to see all files and folders, even when access-based enumeration is enabled on a share.

BranchCache

BranchCache is a share-level option that allows users to access data that is stored on a remote NAS server locally over the LAN without being required to traverse the WAN to access the NAS server. This ability is useful in a remote or branch office environment, where branch offices are required to access data stored on PowerStore at the main office. BranchCache allows this data to be cached locally at the branch, either by a designated Windows BranchCache server or distributed across Windows clients. This ability can reduce WAN bandwidth that is used by many clients constantly and repeatedly traversing the WAN for the same data.

With BranchCache enabled, the client uses the WAN to retrieve the hash of the file from the NAS server at the main office. The client searches the local file cache to look for a file with a matching hash. If all or some of the data is available locally, either on the designated Windows BranchCache server or another Windows client system, the data is retrieved locally. The data is validated using a hash function to ensure that the file is the same. Any data that is not cached locally is retrieved from the NAS server over the WAN, and then cached locally for future requests. BranchCache works best for data that does not change often, allowing files to be cached for longer periods of time at the branch offices.

Offline availability

Offline availability is a share-level option that allows administrators to determine if and how files and programs in a share are available when offline. This ability allows users to access shares on a server even when they are not connected to the network by storing a version of the share in a local cache on the client system. For offline availability to function, it must be configured on both the share and the individual client systems accessing the share.

SMB shares support four options for offline availability:

- **None (Default)**: No files or programs from the share are available offline. Client systems cannot cache any content from this share for offline access.
- **Manual**: Only files and programs that the users specify are available offline. Nothing is cached without the user requesting it.
- **Programs**: All files and programs that users open from the share are automatically available offline. However, executable files that have been previously cached locally are run from the cached copy rather than the copy on the share, even when the share is available. This option is useful for reducing network traffic and performance overhead.
- **Documents**: All files and programs that users open from the share are automatically available offline. Whenever a user accesses a file or program from a share, that content is automatically cached to be available to that user in offline mode. All files that are opened continue to be cached and available for offline access until the cache becomes full or the user deletes files from the cache.

Cached content continues to sync with the version on the server. Files and programs that have not been opened are not available offline.

DFS

PowerStore also supports the Microsoft Distributed File System (DFS) namespace. This ability enables the administrator to present shares from multiple file systems through a single mapped share. PowerStore SMB servers can be configured as a stand-alone DFS root node or as a leaf node on an Active Directory DFS root. DFS-R (replication) is not supported on PowerStore SMB servers.

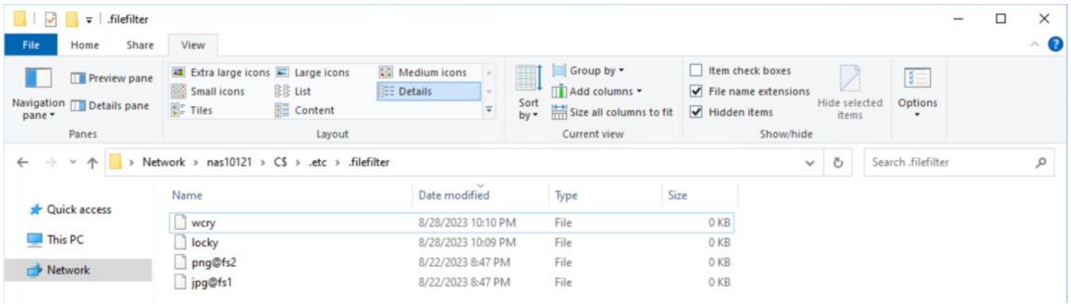
File extension filtering

File extension filtering enables restricting specific file extensions from being stored on an SMB share. Traditionally, this feature has been used to prevent users from storing non-business data on a share. It can also be used to block malicious extensions from being written to a share.

Disallowing known ransomware extensions from being written to the file system can be a simple and effective mechanism to deter or prevent ransomware. File extension filtering can be leveraged in conjunction with other features such as CEPA to implement a ransomware strategy with multiple layers of defense.

To configure file extension filtering, go to the `\\<SMB_Server>\c$\.etc\.filefilter` directory as an administrator. To configure a filter, create an empty file using the naming convention `extension@sharename`. For example, to filter `.wcry` ransomware files on the FS1 share, create a file named `wcry@FS1`. To enable the filter on all shares on the SMB server, create the file with only the extension, such as `wcry`.

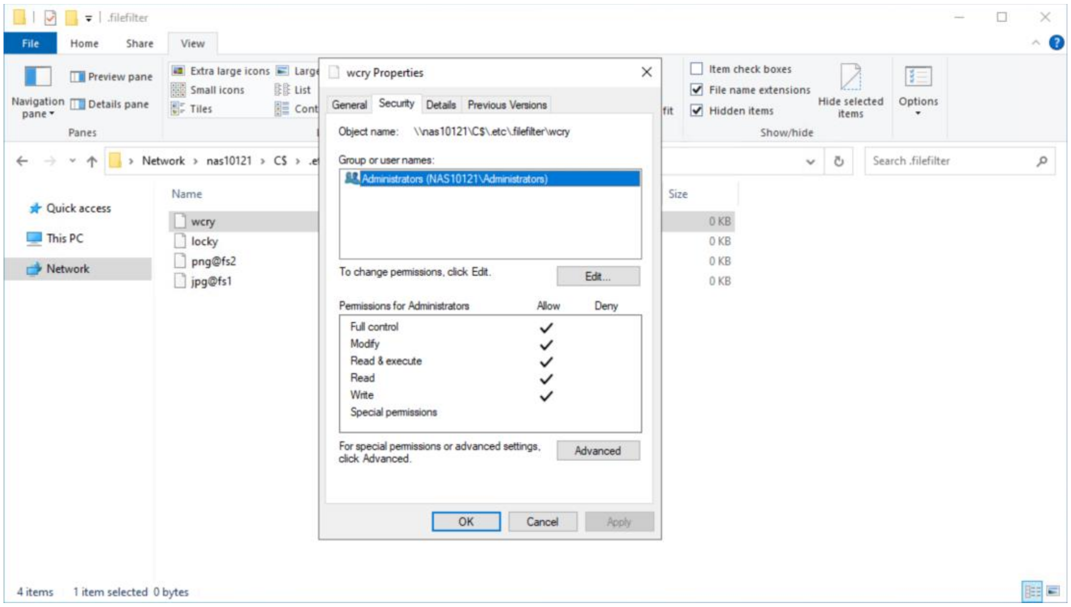
You can configure multiple filters by creating additional files in this directory. For ransomware prevention use cases, create additional filters for other known ransomware extensions. Each SMB server has its own independent file extension filtering configuration so each can be customized with its own configuration. The following figure shows an example of the configuration of the file extension filtering.



Name	Date modified	Type	Size
wcry	8/28/2023 10:10 PM	File	0 KB
locky	8/28/2023 10:09 PM	File	0 KB
png@fs2	8/22/2023 8:47 PM	File	0 KB
jpg@fs1	8/22/2023 8:47 PM	File	0 KB

Figure 13. File extension filtering configuration

After configuring a file extension filter, you can permit exceptions for specific users or groups. This action is done by changing the ACL on the filter file to provide Full Control privileges to the users or groups that should be excluded. For example, if the Administrators group is provided Full Control permissions on the `wcry` filter file, then users in the Administrators group can store `.wcry` files on the share, while others cannot. Exceptions can be configured independently for each file filter being created, as shown in the following figure.



☐ Item check boxes
☑ File name extensions
☑ Hidden items

Name	Size
wcry	0 KB
locky	0 KB
png@fs2	0 KB
jpg@fs1	0 KB

4 items 1 item selected 0 bytes

wcry Properties

Object name: \\nas10121\C$\.etc\.filefilter\wcry

Group or user names:

Administrators (NAS10121\Administrators)

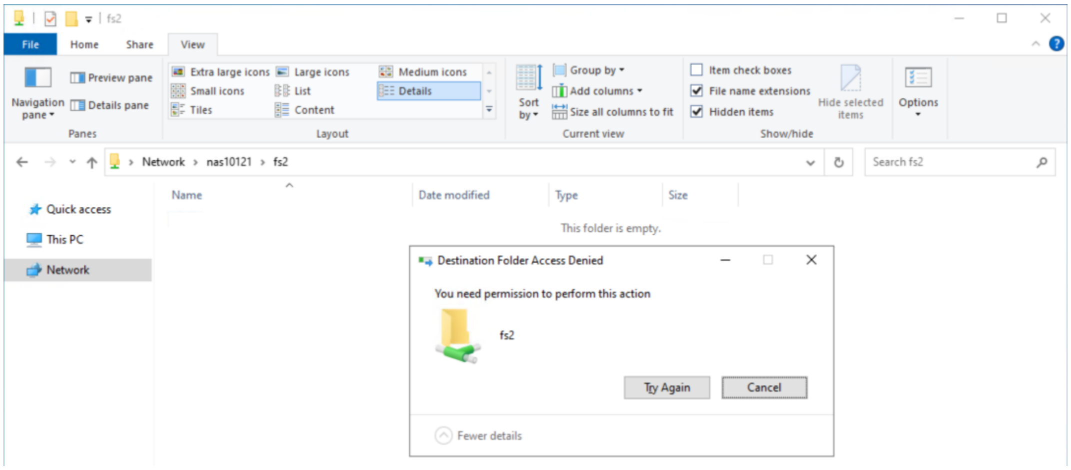
To change permissions, click Edit.

Permissions for Administrators	Allow	Deny
Full control	✓	
Modify	✓	
Read & execute	✓	
Read	✓	
Write	✓	
Special permissions		

For special permissions or advanced settings, click Advanced.

Figure 14. File extension filtering exception

When users attempt to copy a file with a blocked extension, they receive an access denied error, as shown in the following figure.



This folder is empty.

Destination Folder Access Denied

You need permission to perform this action

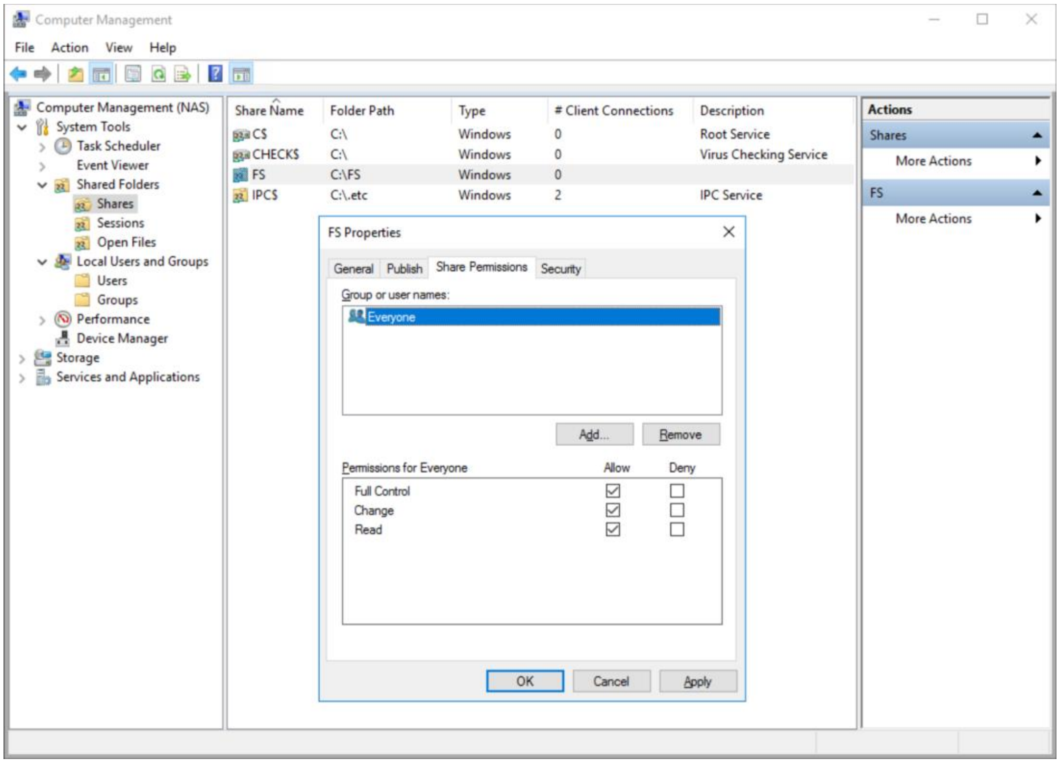
fs2

Figure 15. Access denied due to filtered file

Note that this feature only works on SMB and does not filter file extensions when writing over NFS. Also, users could manually rename file extensions to bypass this filter unless those other extensions are also explicitly blocked. However, malware may not be able to adapt and work around this as easily. Because the list of filtered extensions needs to be checked each time a file is written, having many filters could impact performance.

SMB share permissions

SMB share permissions determine the permissions that are allowed on the root of the share. When a new SMB share is provisioned, the default permissions allow full control for everyone. These permissions can be modified by using Microsoft Management Console (MMC) – Computer Management on a Windows client to connect to the SMB server, as shown in Figure 16. However, this method requires the storage administrator to have access and credentials to a Windows client.



Share Name	Folder Path	Type	# Client Connections	Description
C$	C:\	Windows	0	Root Service
CHECK$	C:\	Windows	0	Virus Checking Service
FS	C:\FS	Windows	0	
IPC$	C:\.etc	Windows	2	IPC Service

Group or user names:
Everyone

Permissions for Everyone	Allow	Deny
Full Control	☑	☐
Change	☑	☐
Read	☑	☐

Figure 16. Microsoft Management Console (MMC) – Computer Management

Starting with PowerStoreOS 3.5, SMB share permissions can also be configured directly from PowerStore Manager or REST API, enabling the storage administrator to set SMB share permissions without relying on external clients, tools, and Windows credentials. Depending on the organizational structure, it might also eliminate the need to engage with the Windows administration team.

This functionality is being added to the existing functionality to increase flexibility for the administrator. The existing functionality remains available and is unchanged. This feature only applies to SMB share-level permissions. Shares for individual files and folders in the share must still be set from within a Windows client.

SMB share permissions are controlled by Access Control Entries (ACEs) and an Access Control List (ACL). Each ACE contains a trustee and its respective permissions. The ACL is a collection of all the ACEs for the SMB share. Each ACE requires the following parameters:

- Trustee Type—Choose a type from the drop-down list.
  - User
  - Group
  - SID
  - Well Known
- Trustee Name—Enter a user or group, depending on the trustee type.

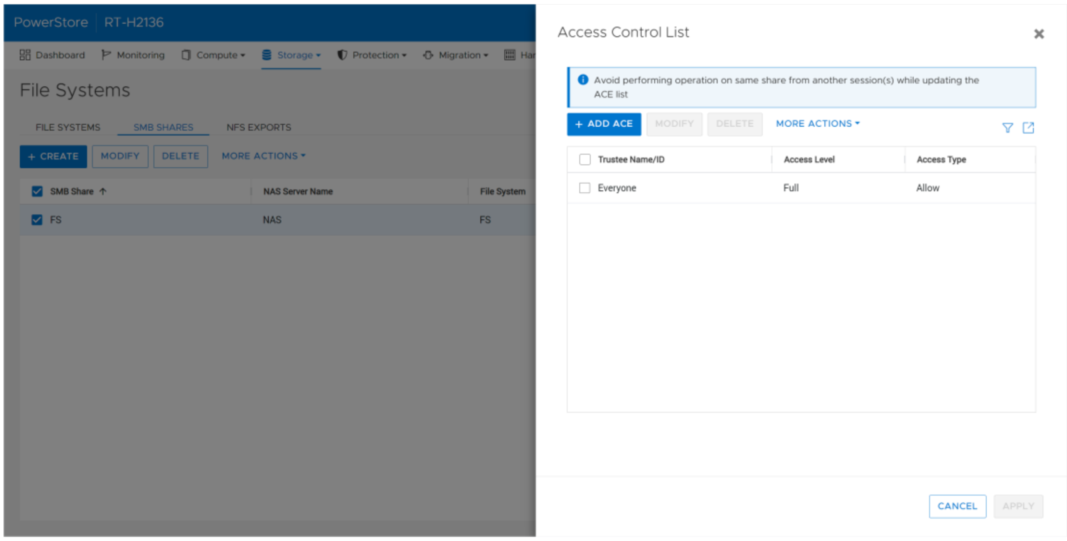
    - Username in DOMAIN\NAME format
    - Group name DOMAIN\NAME format
    - Windows Security Identifier
    - Windows well-known name
- Access Level—Choose an access level for the user or group.
    - Read—Read-only
    - Change—Read, write, and run
    - Full Control—Read, write, run, change permissions, and take ownership
- Access Type—Choose an access type for the user or group.
    - Allow—These permissions are allowed
    - Deny—These permissions are denied

By default, a new share has one ACE:

- Trustee: Everyone
- Access Level: Full
- Access Type: Allow

ACEs in the ACL are applied according to Microsoft Windows rules, meaning that denied permissions are applied first and allowed permissions are applied second. If a conflict occurs, the denial is enforced. For example, if a user belongs to two groups where one group is allowed and the other is denied, access is denied.

To view the ACL for an SMB share, go to **Storage** > **File Systems** > **SMB Shares** > **Select an SMB share** > **More Actions** > **Access Control List**. Figure 17 shows the ACL for an SMB share.



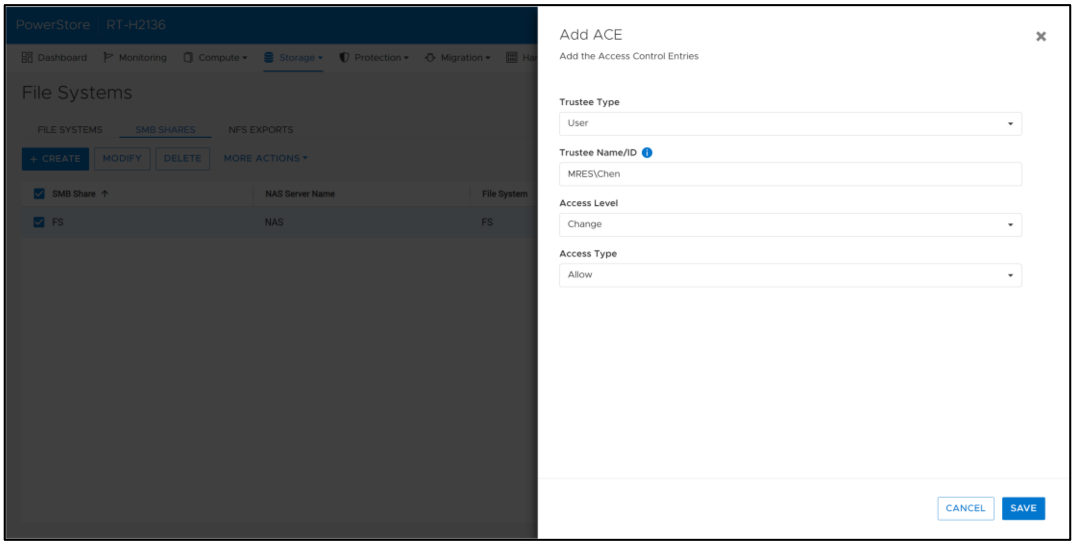
☑ SMB Share ↑	NAS Server Name	File System
☑ FS	NAS	FS

Avoid performing operation on same share from another session(s) while updating the ACE list

□ Trustee Name/ID	Access Level	Access Type
□ Everyone	Full	Allow

Figure 17. SMB share Access Control List

New ACEs can be created by clicking **Add ACE**. Figure 18 shows the fields required to add an ACE. Existing ACEs can be modified and deleted by clicking the respective buttons. Under **More Actions**, clicking **Refresh ACL** refreshes the listing and displays any changes that might have been made elsewhere, such as from MMC. Once all the necessary changes are made, click **Apply** to implement the updates and make them visible from other instances of PowerStore Manager, REST API, and MMC.



☑ SMB Share	NAS Server Name	File System
☑ FS	NAS	FS

Add ACE

Add the Access Control Entries

Trustee Type: User

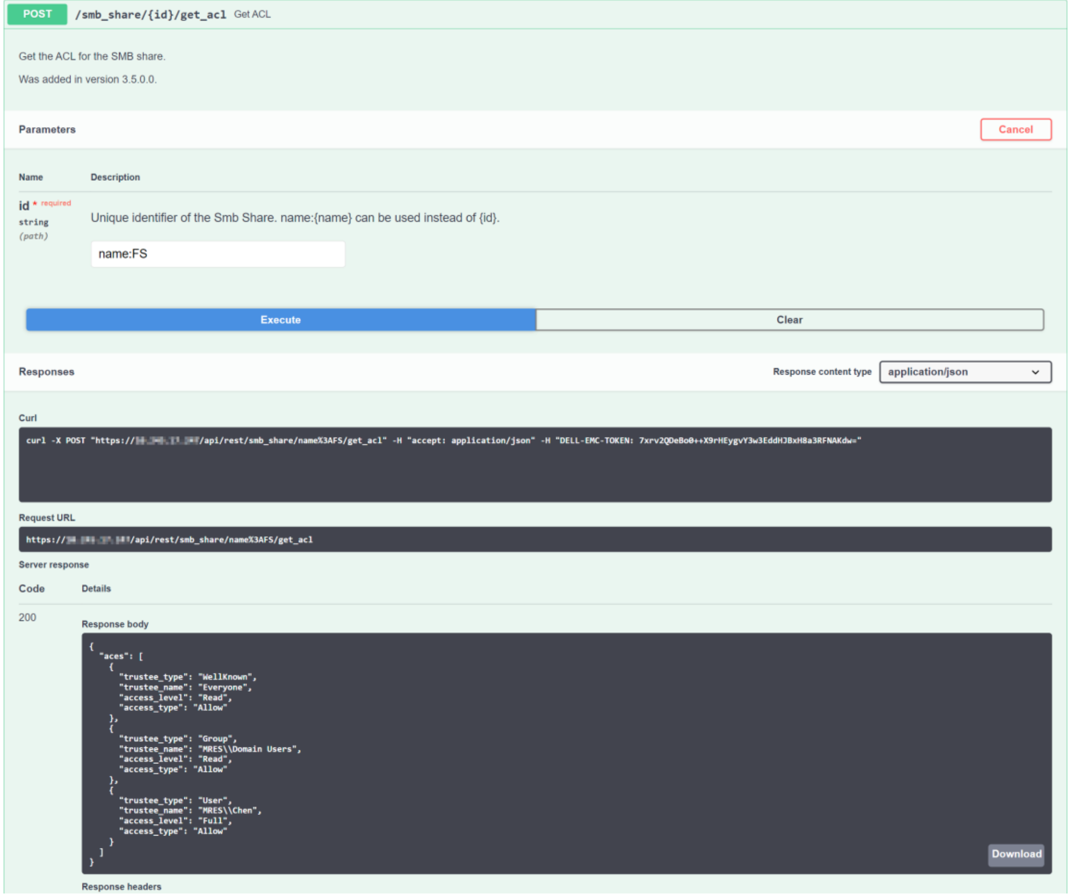
Trustee Name/ID: MRES\Chen

Access Level: Change

Access Type: Allow

Figure 18. Add ACE dialog box

SMB share permissions can also be viewed, added, changed, and removed using REST API. Since REST API uses JSON formatting, certain special characters need to be escaped out using a backslash. Spaces and dashes are commonly used in names and SIDs and do not need to be escaped out. However, the backslash character that is used to identify users and groups needs to be escaped out. This action results in a double backslash in the REST API query body and response, as shown in the SwaggerUI example in Figure 19.



`/smb_share/{id}/get_acl`

Get the ACL for the SMB share.

Was added in version 3.5.0.0.

Unique identifier of the Smb Share. name:{name} can be used instead of {id}.

name:FS

```
curl -X POST "https://[redacted]/api/rest/smb_share/name%3AFS/get_acl" -H "accept: application/json" -H "DELL-EMC-TOKEN: 7xrv2QDeBo0++X9rHEygvY3w3EddHJBxH8a3RFNAKdw="
```

```
https://[redacted]/api/rest/smb_share/name%3AFS/get_acl
```

200

```
{
  "aces": [
    {
      "trustee_type": "WellKnown",
      "trustee_name": "Everyone",
      "access_level": "Read",
      "access_type": "Allow"
    },
    {
      "trustee_type": "Group",
      "trustee_name": "MRES\\Domain Users",
      "access_level": "Read",
      "access_type": "Allow"
    },
    {
      "trustee_type": "User",
      "trustee_name": "MRES\\Chen",
      "access_level": "Full",
      "access_type": "Allow"
    }
  ]
}
```

Figure 19. SwaggerUI Get ACL example

NFS

All PowerStoreOS versions support NFSv3 through NFSv4.1 and Secure NFS. Starting with PowerStoreOS 3.0, basic support for NFSv4.2 in compatibility mode is also available.

Each NAS server has options to enable NFSv3 and NFSv4 independently. Support for advanced NFS protocol options is also available. Table 3 shows a list of NFS protocol options, where they are configured, and the default setting for each option.

Table 3. NFS options

Protocol option	Level	Default
Secure NFS (with Kerberos)	NAS server	Disabled
Minimum Security	Share	Sys
Default Host Access	Share	No Access

NFSv4

NFSv4 is a version of the NFS protocol that differs considerably from previous implementations. Unlike NFSv3, this version is a stateful protocol, meaning that it maintains a session state and does not treat each request as an independent transaction without the need for additional preexisting information. This behavior is like Windows environments with SMB. NFSv4 brings support for several new features including NFS

ACLs that expand on the existing mode-bit-based access control in previous versions of the protocol.

While PowerStore fully supports most of the NFSv4 and v4.1 functionality described in the relevant RFCs, directory delegation and parallel NFS are not supported.

To configure NFSv4, you must first enable NFSv4 on the NAS server, create a file system, and an NFS export. Then, the file system can be mounted on the host using the NFSv4 mount option.

Secure NFS

Traditionally, NFS is not the most secure protocol because it trusts the client to authenticate users, build user credentials, and send the user credentials in clear text over the network. With the introduction of secure NFS, Kerberos can be used to secure data transmissions through user authentication and data signing through encryption. Kerberos is a well-known, strong authentication protocol where a single key distribution center, or KDC, is trusted rather than each individual client. There are three different modes available on PowerStore:

- **Kerberos**: Use Kerberos for authentication only
- **Kerberos With Integrity**: Use Kerberos for authentication and include a hash to ensure data integrity
- **Kerberos With Encryption**: Use Kerberos for authentication, include a hash, and encrypt the data in-flight

To enable secure NFS, the following must be configured:

- DNS must be configured on the NAS server.
- A UNIX Directory Service (UDS) such as NIS, LDAP, or Local Files must be enabled.
- A Kerberos realm must exist.

If an Active Directory domain joined SMB server existed on the NAS server, that Kerberos realm may be leveraged. Otherwise, a custom realm can be configured for use in PowerStore Manager. LDAP over SSL (LDAPS) is used for Secure NFS to avoid weaknesses in the security chain. Although NFSv3 is supported with Secure NFS, it is preferable to use NFSv4 to maximize security.

Minimum security

The minimum security setting determines the type of security that is enforced on the NFS export. The default setting of Sys uses client-provided UNIX UIDs and GIDs for NFS authentication. If Secure NFS is enabled on the NAS server, the Kerberos options become available. For more information about the Secure NFS with Kerberos options, see the preceding section, Secure NFS.

Default host access

The default host access option determines the access permissions for all hosts that attempt to connect to the NFS export. The available options are:

- No Access (Default)

- Read/Write
- Read-Only
- Read/Write, allow Root
- Read-Only, allow Root

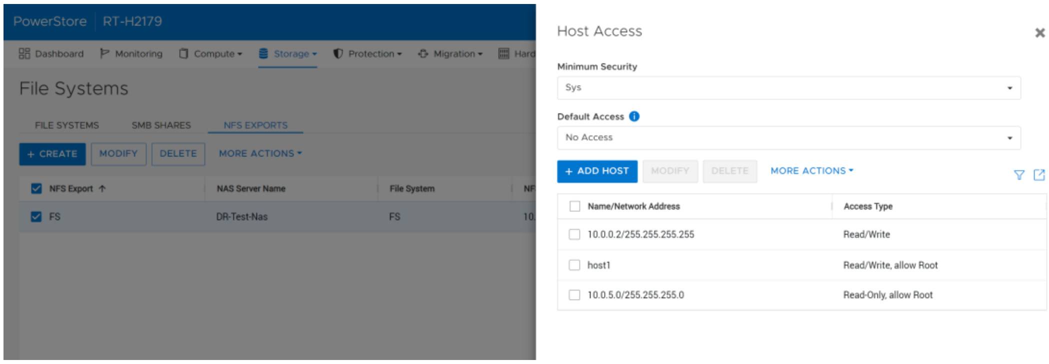
The allow root options are the equivalent to **no_root_squash** on UNIX systems. If the user has root access on the client, they are also granted root access to the NFS export.

For hosts that need different access than the default, they can be configured by adding hostnames, IP addresses, or subnets to the override list with one of the preceding access options. Multiple entries can also be added simultaneously in a comma-separated format. Table 4 shows the supported options when configuring NFS host access.

Table 4. NFS host access

Option	Example	Notes
Hostname	host1.dell.com	Hostname should be defined in the local hosts file, NIS, LDAP, or DNS.
IPv4 or IPv6 Address	10.10.10.10 fd00:c6:a8:1::1	
Subnet	10.10.10.0/255.255.255.0 10.10.10.0/24	IP address/netmask or IP address/prefix
Netgroup	@netgroup	Netgroup should be defined in the local netgroup file or UDS. Netgroup entries should be prefixed with @ to differentiate them from hostnames
DNS Domain	*.dell.com	The DNS server must support reverse lookups and the **ns.switch** parameter should not exclude DNS. Domain entries should be prefixed with * and follow the Linux convention

Host access can also be configured by uploading a CSV file with a list of hosts and their respective access levels. PowerStore Manager provides a template with examples on the formatting and syntax for this file. This template can be downloaded from the system, edited, and then imported. When multiple NFS exports that require the same access configuration are configured, the same file can be imported multiple times and across multiple clusters as well. Once the file is imported, the newly imported hosts are appended to the access list. The following figure shows the host access configuration on an NFS export.



☑ NFS Export	NAS Server Name	File System	NF
☑ FS	DR-Test-Nas	FS	10.

Minimum Security: Sys

Default Access: No Access

□ Name/Network Address	Access Type
□ 10.0.0.2/255.255.255.255	Read/Write
□ host1	Read/Write, allow Root
□ 10.0.5.0/255.255.255.0	Read-Only, allow Root

Figure 20. NFS host access configuration

FTP and SFTP

NAS servers and file systems also support access for FTP and SFTP. SFTP is more secure since, unlike FTP, it does not transmit usernames and passwords in clear text. FTP and SFTP access can be enabled or disabled individually at the NAS server level. Only active mode FTP and SFTP connections are supported.

Administrators can control the types of user accounts that can access files over FTP and SFTP, such as SMB, UNIX, or anonymous users. A home directory restriction option limits access to only the user home directory on the file system. If this option is disabled, a default home directory can be specified. Users that have a home directory that is not defined or accessible are placed in the default home directory instead.

FTP and SFTP can track and record connections and access for the NAS server. The audit logging settings also allow administrators to define the audit log file directory and the maximum size of audit log files.

A welcome message and a message of the day can be displayed when users connect to the FTP or SFTP server. The welcome message is displayed before the client authenticates. The message of the day is only displayed after a client authenticates successfully.

For more granular control over access, FTP and SFTP support defining access control lists. Access can either be allowed or denied for a user-defined list of users, groups, and hosts to restrict FTP or SFTP access to only the necessary users. However, users, groups, or hosts with restricted access to FTP or SFTP can still access the NAS server and file systems over SMB or NFS as allowed by the ACLs or host access configurations for those protocols. Table 5 provides a list of FTP and SFTP protocol options.

Table 5. FTP and SFTP options

Protocol option	Default
Enable FTP	Disabled
Enable SFTP	Disabled
Allow SMB Users Access to the FTP/SFTP server	Enabled
Allow UNIX Users Access to the FTP/SFTP server	Enabled
Allow anonymous Users Access to the FTP server	Disabled
Home Directory Restriction	Enabled

Protocol option	Default
Default Home Directory	/
Enable FTP/SFTP Auditing	Disabled
Directory of Audit Files	/.etc/log
Maximum Size of Audit Files	512 KB
Welcome Message and Message of the Day	Empty
Access Control List	Empty

FTP and SFTP access can be authenticated using the same methods as NFS or SMB. Once authentication is complete, access is then considered to be the same as SMB or NFS for security and permissions purposes. The method of authentication that is used depends on the format that is used for the username. If `domain@user` or `domain\user` is used, SMB authentication is used. For any other single username format, NFS authentication is used. SMB authentication uses the Windows domain controller while NFS authentication uses the UDS or local files.

To use local files for FTP and SFTP access, the `passwd` file must include an encrypted password for the user. This password is only used for FTP and SFTP access. The local `passwd` file uses the same format and syntax as a standard UNIX system, and it can be used to generate the `passwd` file. On a UNIX system, use `useradd <user>` to add a new user and `passwd <user>` to set the password for that user. Then, copy the hashed password from the `/etc/shadow` file, add it to the second field in the `/etc/passwd` file, and upload it to the NAS server.

Multiprotocol

When a NAS server has both the SMB and NFS protocols enabled, multiprotocol access is automatically enabled. Multiprotocol access enables accessing a single file system using the SMB and NFS protocols simultaneously.

Windows and UNIX have inherent differences in how they handle things such as authentication, identification, permissions, locking, and so on. The following table shows some examples of these differences.

Table 6. UNIX and Windows differences

Item	UNIX	Windows
Authentication Provided By	Client or UDS (for Secure NFS)	Domain controller or Local Group Database
Username Length	8 characters	20+ characters
Identifiers	User ID (UID) and Group ID (GID)	Security Identifier (SID)
Group Concept	Simple User/Group Concept	Allows Nested Groups
File/Directory Ownership	Requires User AND Group Owner	Can be owned by a User or Group

Item	UNIX	Windows
Permissions	NFSv3 – Mode Bits NFSv4 – ACLs	ACLs
File Locking	NFSv3 – Advisory NFSv4 – Advisory or Mandatory	Mandatory

Due to these inherent differences in the protocols, some configuration is required to maintain seamless access and enforce security across both protocols.

User mapping

To understand how multiprotocol user mapping works, it is important first to understand how single protocol user mapping works for both SMB and NFS.

- SMB
  - When an SMB user connects to a share, they are identified by their SID.
  - Active Directory is used to resolve their SID to a human-readable username and conversely.

    Example: S-1-5-21-1553607022-1141325308-60145995-1789 ⬄ DELL\Tom
- NFS
  - When an NFS user connects to an export, they are identified by their UID and primary GID.
  - The UNIX Directory Service (UDS) or Local Files are used to resolve their UID to a human-readable username and conversely.

    Example: UID=1000 ⬄ Tom
  - The UNIX Directory Service (UDS) or Local Files are used to resolve their primary GID to a human-readable group name and conversely.

    Example: GID=1000 ⬄ Users

Ultimately, the goal of the multiprotocol-mapping process is to create a mapping between the Windows SID and the UNIX UID. Once the UID is known, it is possible to find its associated primary GID. To accomplish this task, use the usernames to bridge the two protocols together. The following shows an example of a complete multiprotocol mapping between the SID ⬄ UID and primary GID.

- Multiprotocol
  - An SMB user connects to a share and is identified by their SID.
  - Active Directory resolves their SID to a human-readable username.
  - The Windows username is mapped to a UNIX username.
  - UDS or Local Files are used to resolve the UNIX username to their UID.
  - UDS or Local Files are used to resolve the UID primary GID.

    Example: S-1-5-21-155360702… ⬄ DELL\Tom ⬄ Tom ⬄ UID=1000 → GID=1000

In a multiprotocol configuration, the end-to-end mapping between the SID, SMB Name, UNIX Name, UID, and primary GID is crucial. Both Windows and UNIX resolvers must be available to provide their respective mappings, which are joined to create this end-to-end mapping. This mapping provides the ability for a Windows user to be matched to a UNIX user, and conversely, to enforce file security when the other protocol is used for access. This cross-protocol mapping is principally done by matching usernames between the protocols, but each protocol also requires a method to map their respective usernames to their IDs.

If the user mapping is not properly configured, users may be denied access to the file system, obtain access to files that they should not have access to, or be prevented from accessing their own files. This mapping enables the system to identify when the same user is trying to access their files, regardless of the access protocol.

Table 7 shows the components that are involved in the user-mapping process and a short description of their purpose.

Table 7. User-mapping components

Name	Service	Description
Windows resolvers (SMB)	Local Group Database (LGDB) or domain controller (DC)	LGDB is used for local users DC is used to resolve: Windows account name ⇔ SID
UNIX Directory Service (NFS)	LDAP/NIS, Local Files, or Both	Used to resolve: UNIX account name ⇔ UID and primary GID UNIX group name ⇔ GID
Secure Mapping Cache	Secmap Cache	A local cache that contains all the mappings on a NAS server. The following mappings are tracked: SID ⇔ usernames ⇔ UID
ntxmap	NTXMAP	Used for advanced name translations between protocols

SMB mapping – domain users

In a multiprotocol configuration, it is required to join the SMB server to an Active Directory domain for resolving SIDs to and from Windows usernames. When connecting to a multiprotocol file system, domain users go through the user-mapping process to create a mapping from the Windows SID to the UNIX UID and primary GID.

SMB mapping – local users

Because local users on an SMB server are intended for SMB-only access, they are not mapped using this process. Because stand-alone SMB servers only support local users, they would not have the necessary mappings for a proper multiprotocol configuration.

If a local user connects to a multiprotocol file system over SMB, the LGDB is searched and used to resolve the SID to a Windows username. The local user is mapped to a dedicated UID range, starting with 2151678452 as the local Administrator user. The UID then increments with each additional local user.

Due to this mapping, the UID of the local user on the file system is unlikely to match the UID configured on the UNIX client. From the NAS server's perspective, they are being tracked as two different users, which results in the same user having inconsistent permissions across different protocols. Potential workarounds include:

- Manually configure UIDs to ensure that they are consistent with the local SMB server. To manually configure the UIDs, create all the local users on an SMB server, determine the UIDs of the local users, and then configure the UNIX clients to use those UIDs.
- If security is not a concern, using open permissions could be another option. If the files are accessible to everyone, then there is no need to maintain consistent permissions across protocols.

NFS mapping

In a multiprotocol configuration, it is recommended to enable a service for resolving UID and GIDs to and from usernames. The available options are:

- UNIX Directory Service (UDS): LDAP or NIS
- Local files

Although multiprotocol can be used without any of these services, the NAS server would not be able to create the end-to-end mapping described previously. Therefore, when the same user attempts to access files using a different protocol, the user might encounter permissions issues.

For more information about how to configure local files, NIS, or LDAP, see the respective sections in this document.

Secure mapping cache

Secure mapping cache (secmap) is a cache that contains the mappings of users that have previously connected to the NAS server. This mapping includes the SID, username, and UID for each user. Since secmap is a cache, it only stores mappings that are generated by the standard mapping mechanisms. It is not a resolution service and does not generate any mappings of its own.

Once a user mapping is stored in secmap, the NAS server leverages this local cache for future mapping lookups. Only new users connecting to the NAS server must rely on external services to resolve their mappings.

Under normal circumstances, secmap is persistent and does not need to be managed. However, in specific situations, it may be necessary to edit secmap such as when a user UID changes. In this case, the cached entry in secmap is no longer accurate and can be updated or deleted using the `svc_nas_cifssupport` command. If the entry is deleted, the user is treated as a new user the next time they connect, so their new mapping is resolved and stored in secmap.

Ntxmap

Ntxmap is an optional local file that is used to provide name translations between protocols. The multiprotocol user-mapping workflow that is described previously assumes that users have the same usernames across both protocols. However, this consistency in usernames might not be the case in all environments. In environments where usernames are different across protocols, ntxmap is required to translate usernames from one protocol to another. For example, if a user has a Windows account that is named `DELL\Tom` and a UNIX account that is named `Thomas`, the system cannot assume that these accounts are the same user.

In addition to one-to-one mappings, ntxmap can also be used to provide advanced name translations. Ntxmap can be used to convert multiple usernames to a single username. For example, all the users in the Windows ENG domain can be mapped to a single UNIX user named `enguser`. Another option that is available is to provide name conversions. For example, all the UNIX users can be mapped to `DELL\unix-<username>.`

Ntxmap only provides username translations between protocols and does not provide any ID to username mappings. In environments where usernames are always the same and have a one-to-one mapping between protocols, ntxmap is not required.

Automatic mapping for unmapped Windows accounts

Since the PowerStore file system is UNIX-based, all data that is written must be associated with a valid UID and primary GID. NFS users have a UID and primary GID natively available. However, SMB users must have a mapping that converts their native SID to a UID and primary GID. A reverse mapping from UID to SID is not always required because it is only necessary if Windows permissions are enforced (Windows Access Policy).

This feature enables the ability to automatically generate and assign a unique UID to Windows users that do not have a UID mapping. This feature enables access to the share for unmapped users, instead of denying them access. Since each user has a unique UID, UID-based feature such as user quotas can still properly track the consumption of each individual user.

This option is enabled by default on SMB-only and multiprotocol NAS servers. If this feature is enabled, the ability to configure default accounts is disabled. Because the system automatically assigns each UID, use this feature only in environments where the UID of these users is not critical. In environments where administrators want to control the UID assignments, disable this feature. If this feature is disabled and there are no other mapping methods available for unmapped users, the unmapped users are denied access to the share.

This feature generates 32-bit UIDs with the most significant bit set to prevent conflicts with UIDs defined by the administrator in the UDS/local files. The range of UIDs generated by this feature is between 2147483649 (0x80000001) and 2151677951 (0x803FFFFF). The automatic UID is only assigned if the user does not already have a UID configured in the UDS/local files.

If the UDS or local files are updated to configure a UID after the feature has already assigned the UID, the new entry in the UDS or local files is ignored. If you want to use the entry in UDS/local files, you must delete the entry from secmap cache**.**

Default accounts for unmapped users

This feature allows administrators to designate a specific Windows and/or UNIX account to serve as the mapping destination for unmapped users. This feature enables access to the share for unmapped users, instead of denying them access. For example, in an environment where many users only have Windows accounts, a default UNIX user may be designed to allow access for these unmapped users to the multiprotocol file system.

With default accounts enabled, the UID and primary GID of the default UNIX user are used if an unmapped Windows user attempts to access the file system through NFS. Similarly, the credentials of the default Windows user are used when an unmapped UNIX user attempts to access the file system through SMB.

Although multiple users could be writing to the file system as the default user, this user is still considered a single user since they share the same UID. This causes user quota calculations to be inaccurate. Also, the UNIX account may have ownership of files from many different Windows users.

The default UNIX user can be configured as a username or as a numerical UID and primary GID value. If a username is specified, the username must be resolvable to a UID and primary GID through the UDS or local files for the mapping process.

However, configuring the default UNIX user using a numerical UID and primary GID value does not require the user to have an entry in the UDS or local files. This is because all the information needed to create the mapping between the SID to UID and primary GID is available. The specified UID must be in the 32-bit range and follow this format**:** `@uid=<UID>,gid=<GID>@`. For example, if you want to configure a default UNIX user with a UID 1000 and primary GID of 2000, enter `@uid=1000,gid=2000@`.

This option is disabled by default on SMB-only and multiprotocol NAS servers. If this feature is enabled, the ability to enable automatic mapping is disabled. If this feature is disabled and there are no other mapping methods available for unmapped users; they are denied access to the share.

Mapping process

Figure 21 shows the process that is used to resolve a Windows user (SID) to a UNIX user (UID and primary GID). In a multiprotocol configuration, local users on the SMB Server can still be used for SMB-only access, so they are not mapped to a UNIX user.

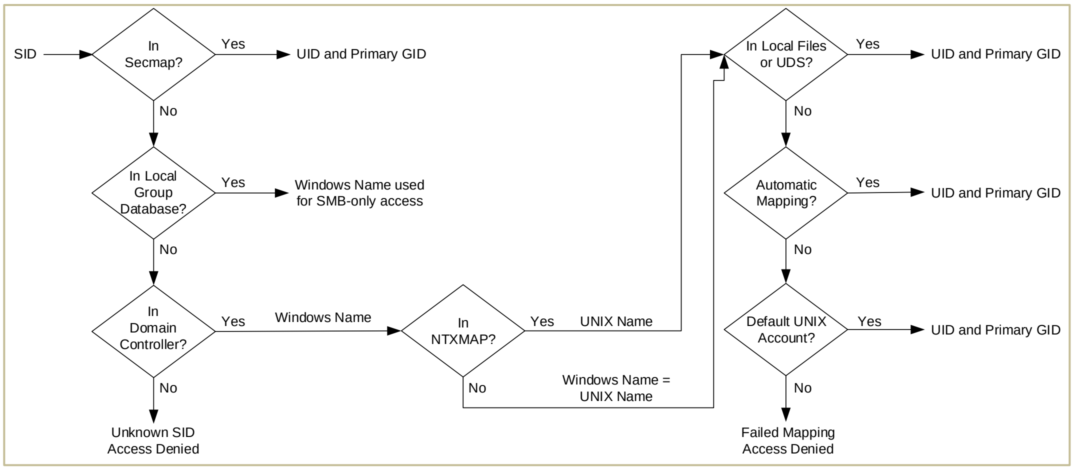


Figure 21. SID to UID and primary GID mapping

1. Secmap is searched for the SID. If the SID is found, the UID and primary GID mapping is resolved.

2. If the SID is not in secmap, the Windows username must be found.
    a. The local group database (LGDB) is searched for the SID to determine if it is a local user. If the SID is found, the name is `SMB_SERVER\USER`. Since it is a local user for SMB-only access, no UNIX mapping is required.
    b. If SID is not found in the LGDB, the DC is searched for the SID. If the SID is found in the domain, the name is `DOMAIN\USER`.
    c. If the SID is not resolvable, access is denied. This failed mapping added to the persistent secmap database.
3. If the default UNIX account is not used, the Windows name is translated to the UNIX name.
    a. If the Windows name is found in NTXMAP, that entry is used as the UNIX name.
    b. If the Windows name is not found in NTXMAP or if NTXMAP is disabled, the Windows name is used as the UNIX name.
4. The local files or UDS is searched for the UNIX name to find the UID and primary GID.
    a. If the UNIX name is found, the UID and primary GID mapping is resolved. This successful mapping is added to the persistent secmap database.
    b. If the UNIX name is not found, but the automatic mapping for unmapped Windows accounts feature is enabled, the UID is automatically assigned. This successful mapping is added to the persistent secmap database.
    c. If the UNIX name is not found, but a default UNIX account is configured, the UID and primary GID are mapped to that of the default UNIX account. This failed mapping added to the persistent secmap database.
    d. If the UNIX name is not resolvable, access is denied. This failed mapping is added to the persistent secmap database.

Mappings that do not result in a permanent UID are considered failed mappings – 2c, 4c, and 4d. Users with failed mappings are added to the secmap database with 4294967294 as their UID. This UID indicates that the mapping process must be retried the next time that the user connects. If a mapping is defined for these users later, they can convert in to successfully mapped users upon connecting. The secmap database is then updated accordingly with the permanent mapping. These users must go through the mapping process each time they connect until they have a permanent mapping defined.

Figure 22 shows the process that is used to resolve a UNIX user (UID) to a Windows user (SID). This process is only needed if the access policy is set to Windows. This process is different compared to the UNIX UID that is always required, regardless of the access policy, since the UID is also used for file ownership and quota management purposes.

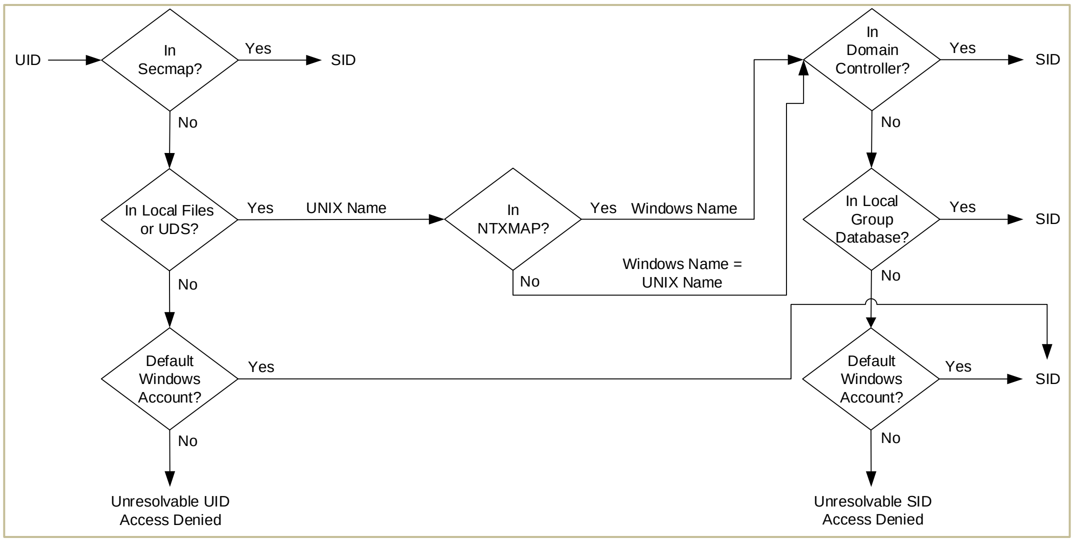


Figure 22. UID to SID mapping

1. Secmap is searched for the UID. If the UID is found, the SID mapping is resolved.
2. If the UID is not in secmap, the UNIX username must be found.
   a. Local files or UDS is searched for the UID. If the UID is found, the UNIX name is determined.
   b. If the UID is not found, but a default Windows account is configured, the UID is mapped to the default Windows account. If it does not exist, the default Windows user is added to the persistent secmap database.
   c. If the UID is not resolvable, access is denied.

3. If the default Windows account is not used, the UNIX name is translated to the Windows name.
   a. If the UNIX name is found in NTXMAP, that entry is used as the Windows name.
   b. If the UNIX name is not found in NTXMAP or if NTXMAP is disabled, the UNIX name is used as the Windows name.

4. The DC or LGDB is searched for the Windows name to find the SID.
   a. The Windows name is searched in the DC. If the Windows name is found, the SID mapping is resolved. This successful mapping is added to the persistent secmap database.
   b. If the Windows name contains a period (.) and the part of the name following the last period (.) matches an SMB server name, the LGDB of that SMB Server is searched. If the Windows name is found, the SID mapping is resolved. This successful mapping is added to the persistent secmap database.
   c. If the Windows name is not found, but a default Windows account is configured, the SID is mapped to that of the default Windows account. If it does not exist, the default Windows user is added to the persistent secmap database.
   d. If the Windows name is not resolvable, access is denied.

Permissions

Security is also handled differently between SMB and NFS. For NFS, the authentication credentials are provided by the client or, for secure NFS, built from the UDS. User rights are determined by the NFSv3 mode bits or NFSv4 ACLs, and the UID/GIDs are used for identification purposes. There are no privileges associated with UNIX security.

For SMB, the credentials are built from the domain controller (DC) and local group database (LGDB) of the SMB server. User rights are determined by the ACL, and the SID is used for identification purposes. Windows security includes privileges such as TakeOwnership**,** Backup**,** and Restore that are granted by the LGDB or group policy object (GPO).

When configuring or managing a multiprotocol NAS environment, there are additional configuration options at the NAS-server and file-system levels that are related to how the permissions are handled between SMB and NFS users that are accessing file system data. These options are shown in Table 8.

Table 8. Multiprotocol permission options

Option	Level	Default
Access policy	File system	Native
UMASK (SMB)	Share	022

Access policy

The access policy is used to define how security is enforced on a multiprotocol file system. The default setting of Native maintains two separate sets of permissions for each file and the protocol that is used to access the file determines which set of permissions are checked. If SMB is used, the ACLs are checked. If NFS is used, the NFSv3 mode bits or NFSv4 ACL are checked.

If the multiprotocol environment is heavily weighted toward users of one type or another, setting the access policy to one of the other values may be desirable. The Windows setting only checks the ACLs and completely ignores the NFSv3 mode bits and NFSv4 ACL while the UNIX policy does the opposite.

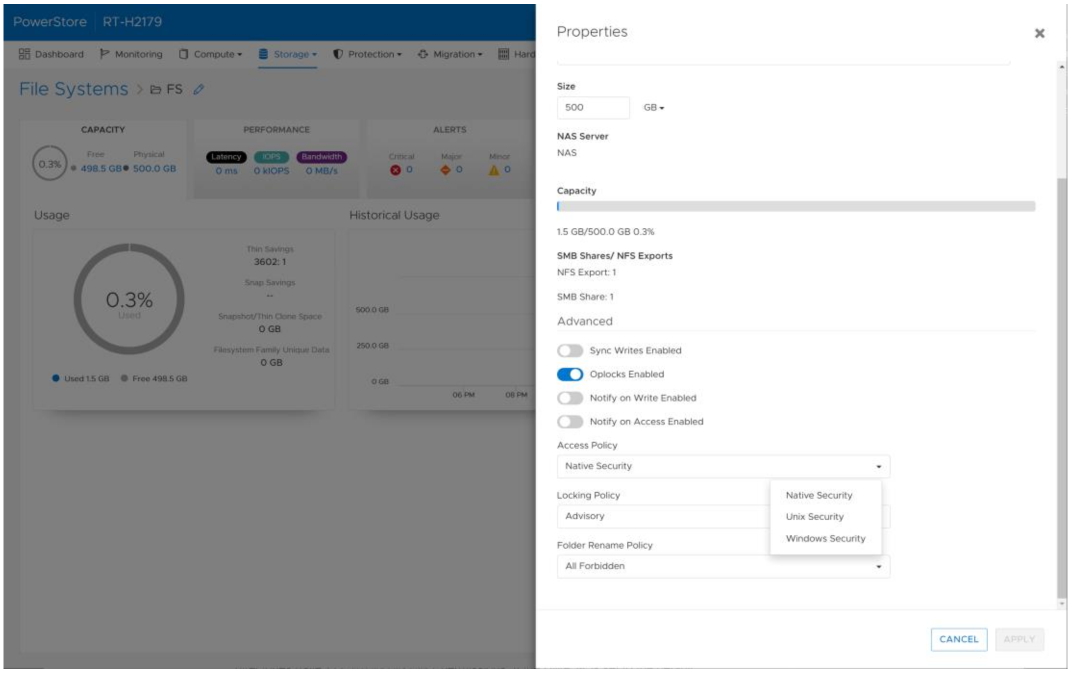
Table 9 describes the available access policies that can be configured at the file system level.

Table 9. Access policy details

Access policy	Description
Native (default)	Manages access for each protocol separately with its own native security Security for NFS shares uses the UNIX mode bits or NFSv4 ACL Security for SMB shares uses the SMB Access Control List (ACL) The two sets of permissions are independent and there is no synchronization between them NFSv3 UNIX mode bits or NFSv4 ACL permission changes are synchronized to each other, but SMB ACL is not changed SMB ACL permission changes do not change the NFSv3 UNIX mode bits or NFSv4 ACL

Access policy	Description
Windows	Uses the SMB ACL for both protocols Upon request for NFS access, the Windows credential that is built from the DC/LGDB is used to check the ACL for permissions NFSv3 UNIX mode bits or NFSv4 ACLs are updated when SMB ACL permissions are changed NFSv3 UNIX mode bits or NFSv4 ACL permission changes are denied
UNIX	Uses the NFSv3 UNIX mode bits or NFSv4 ACL for both protocols Upon request for SMB access, the UNIX credential that is built from the UDS/local files is used to check the NFSv3 mode bits or NFSv4 ACL for permissions SMB ACL permissions are updated when NFSv3 UNIX mode bits or NFSv4 ACLs are changed SMB ACL permission changes are allowed, to avoid causing disruption, but these permissions are not maintained

Figure 23 shows how to configure the access policy on a file system.



Size: 500 GB

NAS Server: NAS

Capacity: 1.5 GB/500.0 GB 0.3%

SMB Shares/ NFS Exports: NFS Export: 1, SMB Share: 1

○ Sync Writes Enabled

● Oplocks Enabled

○ Notify on Write Enabled

○ Notify on Access Enabled

Access Policy: Native Security (Native Security, Unix Security, Windows Security)

Locking Policy: Advisory

Folder Rename Policy: All Forbidden

Figure 23. **Access policy**

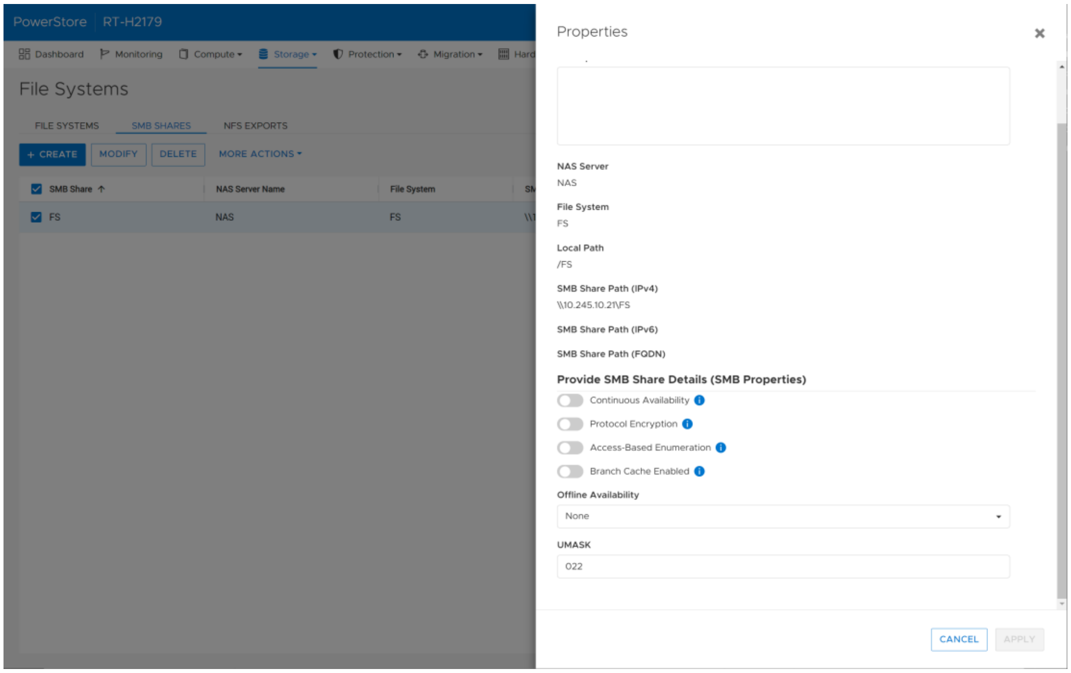
UMASK

For files created on NFS, the SMB ACLs are determined by ACL inheritance. For files created on SMB, the NFSv3 UNIX permissions are determined by the UMASK setting. The UMASK is a bitmask that controls the default UNIX permissions for newly created files and folders. This setting is only applied to new files and folders that are created on SMB on multiprotocol file systems.

The UMASK setting determines which UNIX permissions are excluded for new files and directories. By default, new files have 666 `(-rw-rw-rw-)` permissions while new directories have 777 `(drwxrwxrwx)` permissions. If the UMASK is set to the default value of 022, new files have 644 `(-rw-r--r--)` permissions and new directories have 755 `(drwxr-xr-x)` permissions instead. If NFSv4 ACL inheritance is present on the directory, it takes precedence over the UMASK setting.

This behavior is only used to determine the UNIX permissions when creating files. If permissions are changed on an existing file, the behavior depends on the configured access policy.

Figure 24 shows how to configure the UMASK setting on an SMB share.



SMB Share	NAS Server Name	File System	Sh
☑ FS	NAS	FS	\\\

NAS Server
NAS

File System
FS

Local Path
/FS

SMB Share Path (IPv4)
\\10.245.10.21\FS

SMB Share Path (IPv6)

SMB Share Path (FQDN)

Provide SMB Share Details (SMB Properties)

- ○ Continuous Availability
- ○ Protocol Encryption
- ○ Access-Based Enumeration
- ○ Branch Cache Enabled

Offline Availability
None

UMASK
022

Figure 24. UMASK setting

Multiprotocol policies

The locking and folder rename policies can be configured on multiprotocol file systems. These settings allow the administrator to control the behavior since locking and folder renaming behave differently depending on the protocol.

Locking policy

Range locks allow hosts to lock a byte range of a file. These locks can be shared locks (denies writes) or exclusive locks (denies reads and writes). Each protocol implements either mandatory or advisory locking. For mandatory locks, any I/O to the locked range is denied. For advisory locks, it is the responsibility of the client to check for a lock and even if a lock is detected, it can disregard it and perform I/O anyway. Table 10 shows the locking semantics and mechanisms for NFSv3, NFSv4, and SMB.

Table 10. Locking mechanisms

Protocol	Advisory or mandatory	Mechanism
NFSv3	Advisory	Separate protocol (NLM)
NFSv4	Advisory or mandatory (default)	Embedded in the protocol

Protocol	Advisory or mandatory	Mechanism
SMB	Mandatory	Embedded in the protocol

Due to the differences in the protocol specifications, the locking policy can be configured to control the behavior on multiprotocol file systems. The protocol that is used and the locking policy setting determines whether a lock prevents I/O:

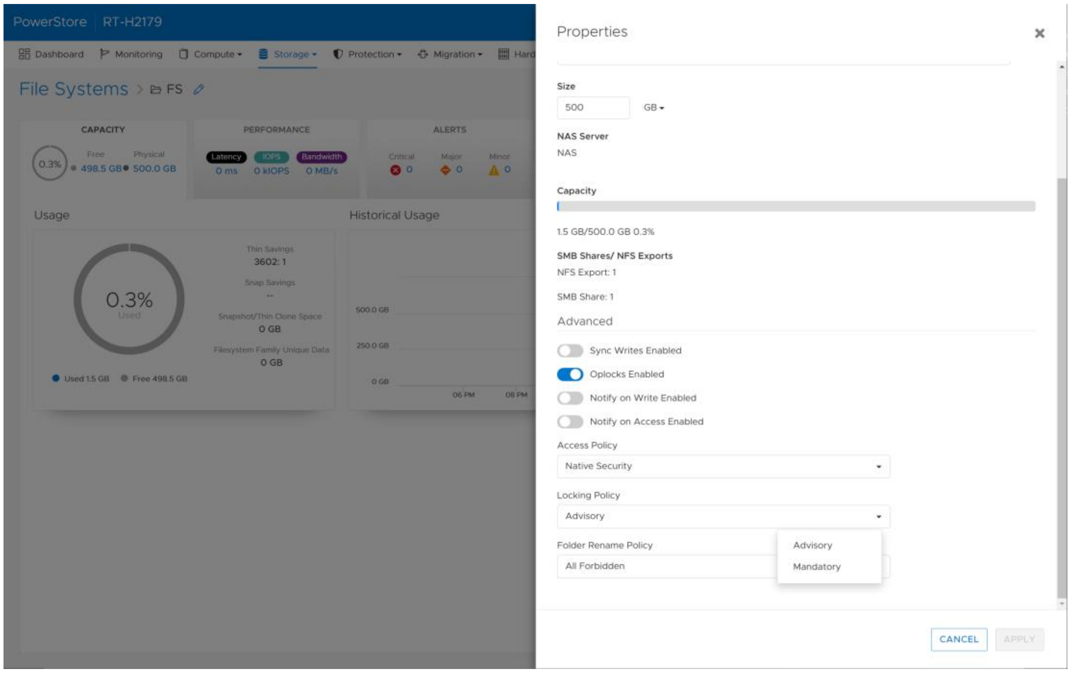
- **Mandatory**: All I/O must honor SMB and NFSv4 range locks. NFSv3 range locks never prevent IO since they are always advisory due to protocol specification.
- **Advisory (default)**: NFSv3/v4/FTP I/O bypasses all range locks. SMB bypasses NFSv4 range locks, but always honors SMB range locks due to protocol specification. Any lock requests continue to report lock conflicts.

Table 11 also shows which locks are honored for each protocol and locking policy setting in a chart format.

Table 11. Honored locks

Protocol	Mandatory (default)	Advisory
NFSv3	SMB + NFSv4	None
NFSv4	SMB + NFSv4	None
FTP	SMB + NFSv4	None
SMB	SMB + NFSv4	SMB

Figure 25 shows how to configure the locking policy on a file system.



Properties

Size: 500 GB

NAS Server: NAS

Capacity: 1.5 GB/500.0 GB 0.3%

SMB Shares/ NFS Exports
NFS Export: 1
SMB Share: 1

Advanced

○ Sync Writes Enabled
● Oplocks Enabled
○ Notify on Write Enabled
○ Notify on Access Enabled

Access Policy: Native Security

Locking Policy: Advisory

Folder Rename Policy: All Forbidden

Figure 25. Locking policy

Folder rename policy

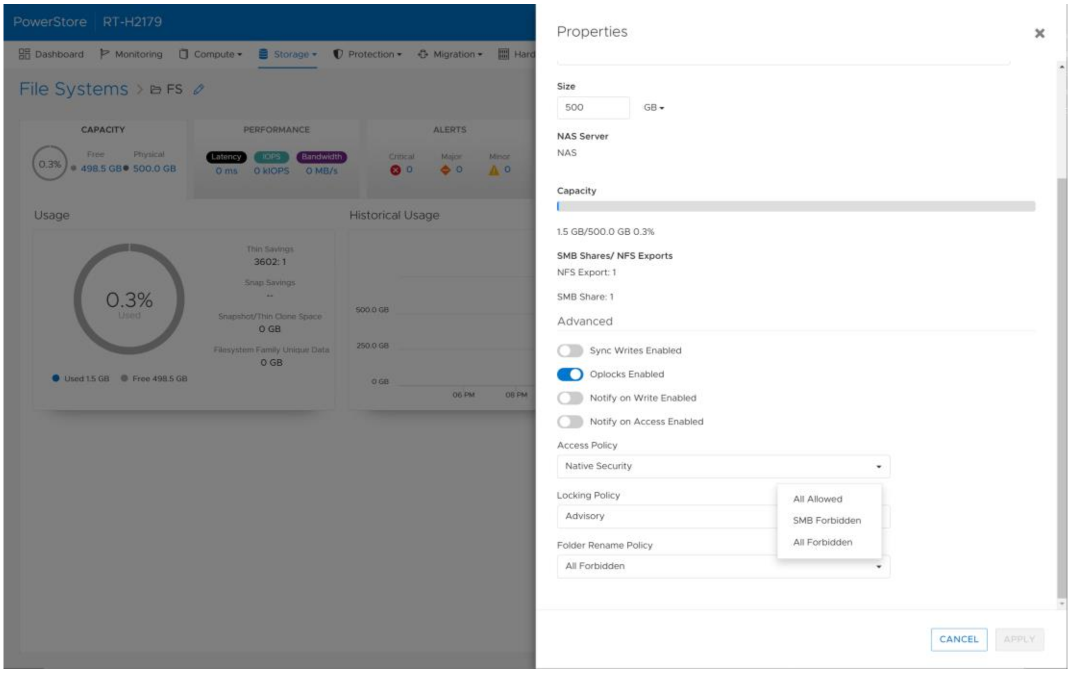
According to the SMB protocol specifications, renaming any directory that is in the path of an open file is prohibited. For example, if `C:\Folder1\Folder2\Folder3\File1.txt` is opened by an SMB client, other clients are prevented from renaming any of the folders in the path leading up to `File1.txt`.

Clients using NFS or FTP do not have the same restriction because SMB opens the entire path while NFS and FTP leverage file handles instead. Due to the differences between protocols, the folder rename policy allows the storage administrator to configure the behavior on multiprotocol file systems. The folder rename policy settings are only invoked when attempting to rename a folder in a path of an open file. Renaming folders that do not have any open files in the path are always allowed.

The folder rename policy can be configured to:

- **All Allowed**: All protocols can rename folders in the path of an open file without restrictions
- **SMB Forbidden**: SMB protocol renames of a folder in the path of an open file are prohibited, but other protocols are allowed
- **All Forbidden (default)**: No protocols can rename folders in the path of an open file

Figure 26 shows how to configure the folder rename policy on a file system.



Properties

Size
500 GB

NAS Server
NAS

Capacity
1.5 GB/500.0 GB 0.3%

SMB Shares/ NFS Exports
NFS Export: 1

SMB Share: 1

Advanced

○ Sync Writes Enabled
● Oplocks Enabled
○ Notify on Write Enabled
○ Notify on Access Enabled

Access Policy
Native Security

Locking Policy
Advisory

Folder Rename Policy
All Forbidden

Figure 26. Folder rename policy

Naming and directory services

PowerStore supports the following naming and directory services:

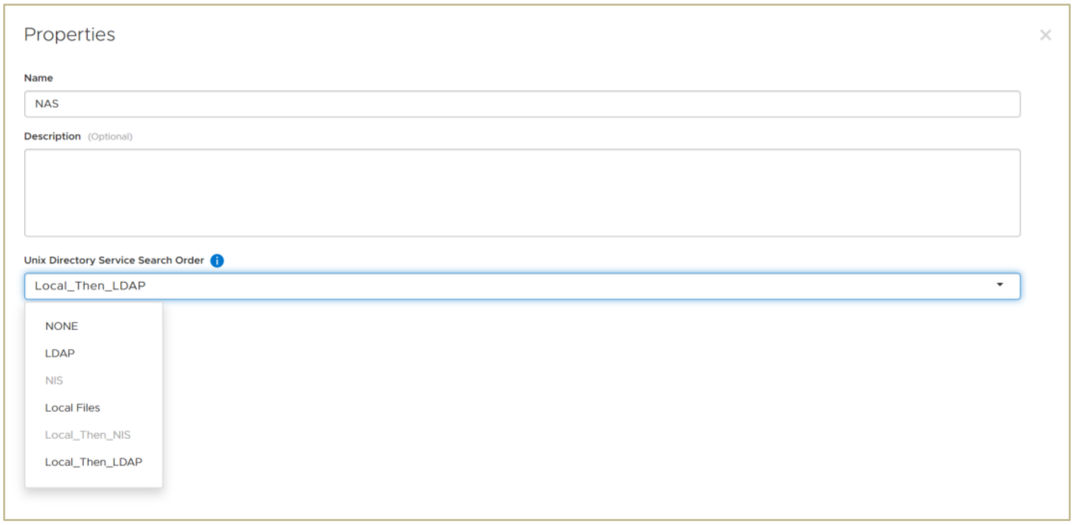
- DNS—A service that is used to provide translations between hostnames and IP addresses
- UDS (LDAP/NIS)—Services that provide a centralized user directory for username and ID resolution
- Local files—Individual files used to provide username and ID resolution

DNS is a commonly used service that relieves the need to remember IP addresses of individual components within the data center. Instead, human-friendly names can be used instead for connectivity and access.

A UDS should be configured if the environment is large and requires consistent UID and GID mappings across multiple NAS servers. The mappings can be managed from the centralized UDS server and propagated outward.

Local `passwd` and group files can be used in smaller environments since mappings are configured by uploading them to the NAS server. These local `passwd` and group files share the same syntax as UNIX environments. Therefore, the same files that are configured on hosts can be leveraged to provide mappings to the NAS server.

Once the UDS or local files are configured, you must specify the service in the UNIX Directory Service Search Order for it to be used. By default, this setting is set to **None** which means that no directory services are searched. It is possible to enable local files in addition to a UDS. If both are configured, there is an option to choose whether the local files, UDS, or both are used. This option can be configured either during NAS server creation or by modifying the NAS server afterwards, as shown in Figure 27.



Properties

Name: NAS

Description (Optional):

Unix Directory Service Search Order: Local_Then_LDAP

Figure 27. UNIX Directory Service Search Order

DNS

DNS is required when configuring domain-joined SMB servers, Secure NFS, and proper multiprotocol configurations. When configuring DNS, provide the following information:

- UDP (default) or TCP protocol

- Domain
- IP address of DNS servers

NAS servers accept between one to three DNS servers. If multiple DNS servers are supplied, they can be moved up or down in the priority list.

LDAP

LDAP can be used for the UDS. LDAP supports anonymous, simple, or Kerberos authentication. There are also options to configure the LDAP schema, enable LDAP secure (using SSL) to encrypt the LDAP traffic, and configure the Certification Authority (CA) certificate for authentication. Table 12 shows the description and syntax for all the LDAP configuration settings.

Table 12. LDAP configuration settings

Setting	Anonymous	Simple (iPlanet or OpenLDAP)	Simple (AD LDAP or IDMU)	Kerberos
Server	LDAP Server IPs or Hostnames			
Port	LDAP Server Port Number - Default: 389 / SSL: 636			
Base DN	Base DN in LDAP notation format. For example, if using svt.lab.com, the Base DN would be DC=svt,DC=lab,DC=com		The Base DN is the same as the Fully Qualified Domain Name. For example, svt.lab.com	Base DN in LDAP notation format. For example, if using svt.lab.com, the Base DN would be DC=svt,DC=lab, DC=com
Profile DN (optional)	Profile DN for the iPlanet or OpenLDAP server			
Bind DN (simple only)		User account in LDAP notation format. For example, cn=administrator,cn=users,dc=svt,dc=lab, dc=com		
Bind DN Password (simple only)		User account password		

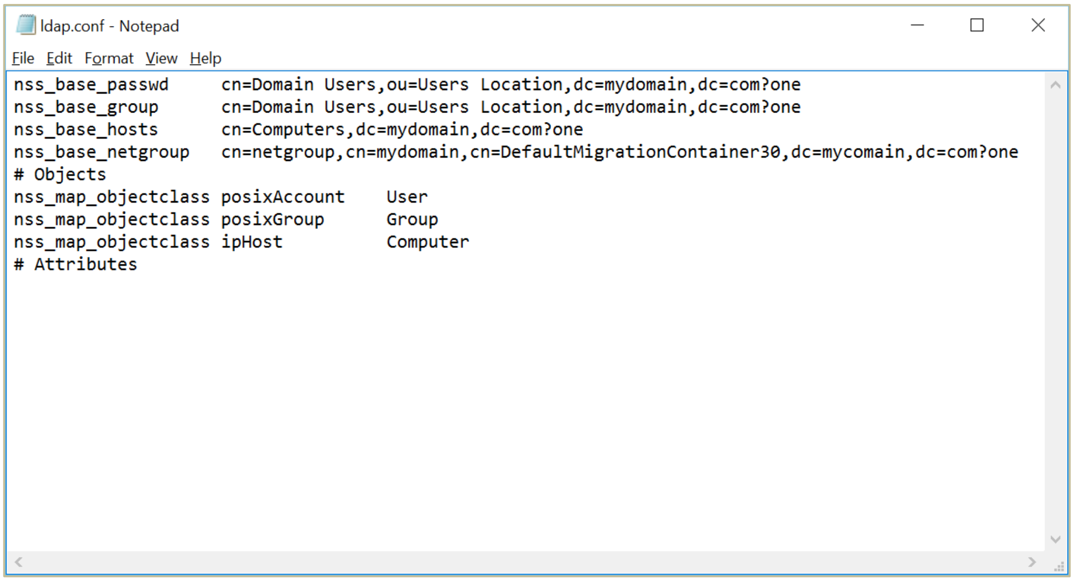
Note: Active Directory is not supported with Anonymous LDAP authentication.

There are two methods for configuring Kerberos:

- **Authenticate to the SMB domain**: Authenticate using the SMB server account or authenticate with other credentials.
- **Configure a custom realm**: Point to any type of Kerberos realm (Windows, MIT, or Heimdal). With this option, the NAS server uses the custom Kerberos realm that is defined in the Kerberos subsection of the NAS server Security tab. AD authentication is not used when you choose this option. If using NFS secure with a custom realm, you must upload a keytab file.

The LDAP configuration must adhere to either the IDMU, RFC 2307, or RFC2307bis schemas. See the RFC for a list of what is required for each schema. You can verify the current schema configuration by using the Retrieve Current Schema link on the LDAP page to retrieve the ldap.conf file, edit it, and upload a new version.

All containers that are specified in the ldap.conf file must point to a location that is valid and exists in the LDAP configuration, including containers that might not be in use, such as netgroup and host. If any entries are removed from this file, the NAS server automatically sets them to a default value based on the Base DN, which may result in lookup issues. Consult with your domain administrator to get the proper values for each container. Figure 28 shows an example of a valid LDAP schema for IDMU.



```
nss_base_passwd     cn=Domain Users,ou=Users Location,dc=mydomain,dc=com?one
nss_base_group      cn=Domain Users,ou=Users Location,dc=mydomain,dc=com?one
nss_base_hosts      cn=Computers,dc=mydomain,dc=com?one
nss_base_netgroup   cn=netgroup,cn=mydomain,cn=DefaultMigrationContainer30,dc=mycomain,dc=com?one
# Objects
nss_map_objectclass posixAccount    User
nss_map_objectclass posixGroup      Group
nss_map_objectclass ipHost          Computer
# Attributes
```

Figure 28. LDAP conf file

NIS

NIS can be used for the UDS. To configure NIS, provide the following information:

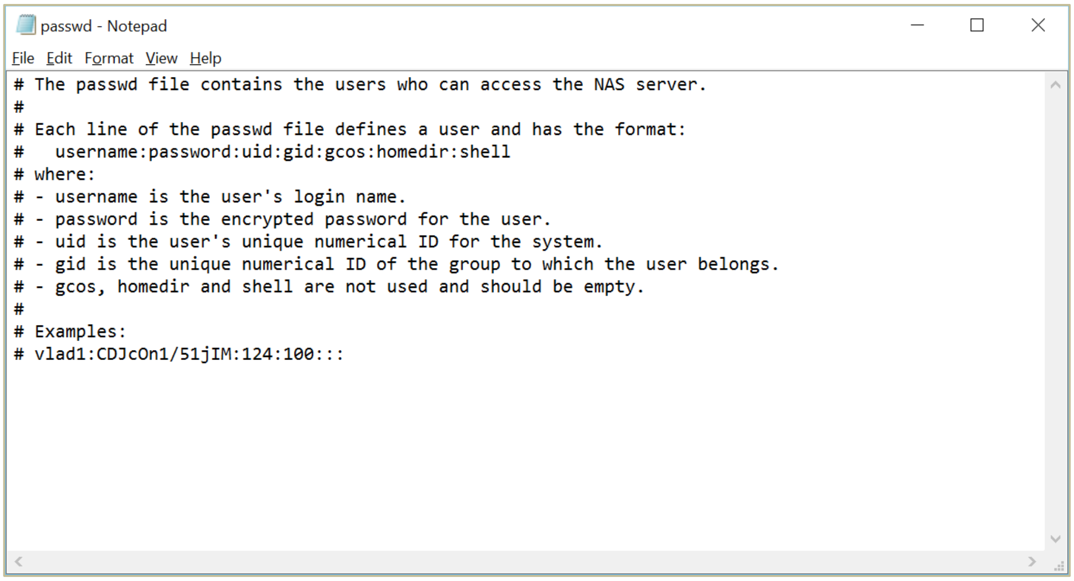
- NIS domain
- IP addresses for NIS servers

If multiple NIS servers are supplied, they can be moved up or down in the priority list.

Local files

Local `passwd` and group files can be used to resolve IDs and usernames. You can download the current version of the local files from the NAS server, which also provides syntax, examples, and additional details. After the files are edited with the user details, they can be uploaded back to the NAS server.

The `passwd` file uses the same format and syntax as UNIX-based operating systems so an existing file from a host could also be leveraged for the NAS server. Figure 29 shows the syntax and an example of the entry in a `passwd` file. The comment, home directory, and shell can be empty since they are not used by the NAS server. The NAS server is only interested in the username, hashed password (used for FTP authentication), UID, and primary GID.



```
# The passwd file contains the users who can access the NAS server.
#
# Each line of the passwd file defines a user and has the format:
#   username:password:uid:gid:gcos:homedir:shell
# where:
# - username is the user's login name.
# - password is the encrypted password for the user.
# - uid is the user's unique numerical ID for the system.
# - gid is the unique numerical ID of the group to which the user belongs.
# - gcos, homedir and shell are not used and should be empty.
#
# Examples:
# vlad1:CDJcOn1/51jIM:124:100:::
```

Figure 29. Local passwd file

File systems

Introduction

PowerStore file leverages a 64-bit file system that is highly scalable, efficient, performant, and flexible. The PowerStore file system is mature and robust, enabling it to be used in many of the traditional NAS use cases.

Scalability

PowerStore file systems can accommodate large amounts of data, directories, and files. Table 13 shows several of the scalability attributes and limits of each file system.

Table 13. File system scalability

File system attribute	Limit
Maximum File System Size	256 TB
Subdirectories per Directory	~10 million
Files per File System	~32 billion
Filenames per Directory	~10 million
ACL IDs	4 million
Timestamp Granularity	1 nanosecond

Storage efficiency

All file systems are thinly provisioned and always have compression and deduplication enabled. With thin file systems, only 1.5 GB is allocated upfront for metadata, regardless of how large the file system is. As capacity is consumed on the file system, additional capacity is allocated on demand. This on-demand allocation continuously happens until the specified file system size is reached and the file system becomes full.

Compression and deduplication help reduce the total cost of ownership and increase the efficiency of the system by reducing the amount of physical capacity that is needed to store the data. Savings are not only limited to the file system itself, but also to its snapshots and thin clones. Compression and deduplication occur in line between the system cache and the backend drives. The compression task is offloaded to a dedicated chip on the node, which frees up CPU cycles.

Performance

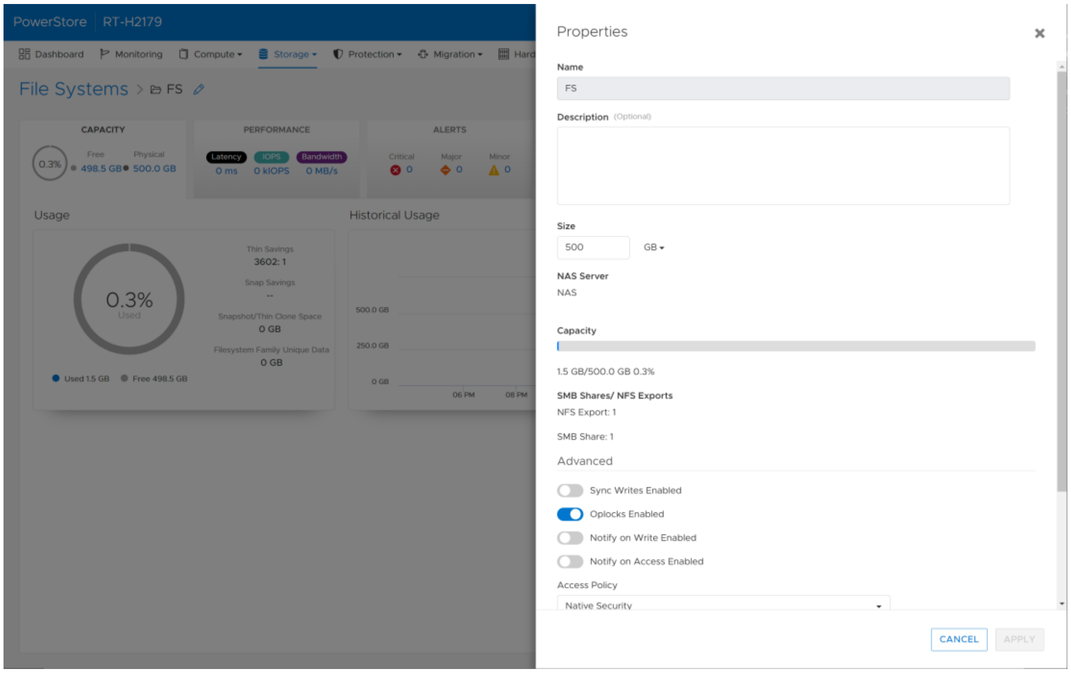
PowerStore file systems are tuned and optimized for high performance across all use cases. In addition, platform components such as Non-Volatile Memory Express (NVMe) drives and high-speed connectivity options enable the system to maintain low response times while servicing large workloads. For more information about performance best practices when configuring file systems, see the *Dell PowerStore: Best Practices Guide*.

Shrink and extend

PowerStore file systems offer increased flexibility by providing the ability to shrink and extend file systems as needed. Shrink and extend operations are used to resize the file system and update the capacity that is seen by the client. Extend operations do not change how much capacity is allocated to the file system. However, shrink operations may be able to reclaim unused space depending on how much capacity is allocated to the file system and the presence of snapshots or thin clones.

If the advertised file system size is too small or full, extending it allows additional data to be written to the file system. If the advertised file system size is too large, shrinking it limits the amount of data that can be written to the file system. For shrink and extend, the minimum value is equal to the used size of the file system and the maximum value is 256 TB. You cannot shrink the file system to less than the used size because the client would then see the file system as more than 100 percent full.

Figure 30 shows the file system properties page in PowerStore Manager, where you can shrink or extend a file system.



Name: FS

Description (Optional):

Size: 500 GB ▾

NAS Server: NAS

Capacity: 1.5 GB/500.0 GB 0.3%

SMB Shares/ NFS Exports: NFS Export: 1; SMB Share: 1

Advanced

○ Sync Writes Enabled
● Oplocks Enabled
○ Notify on Write Enabled
○ Notify on Access Enabled

Access Policy: Native Security ▾

Figure 30. File system shrink and extend

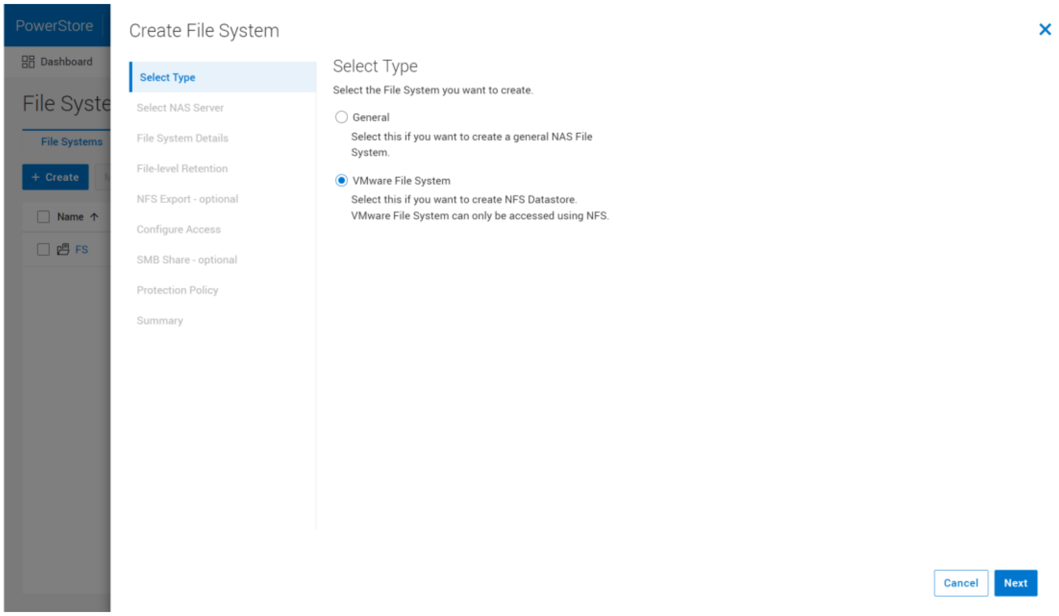
File system types

General file systems

All PowerStore releases support general file systems. General file systems should be used for all file use cases except for VMware NFS datastores.

VMware file systems

Starting with PowerStoreOS 3.0, an option to create a VMware file system is added. VMware file systems are designed and optimized to be used as VMware NFS datastores. VMware file systems support AppSync for VMware NFS, Virtual Storage Integrator (VSI), hardware acceleration, and VM awareness in PowerStore Manager. The file system type selection in the file system provisioning wizard appears in Figure 31.



Select Type

Select the File System you want to create.

○ General

Select this if you want to create a general NAS File System.

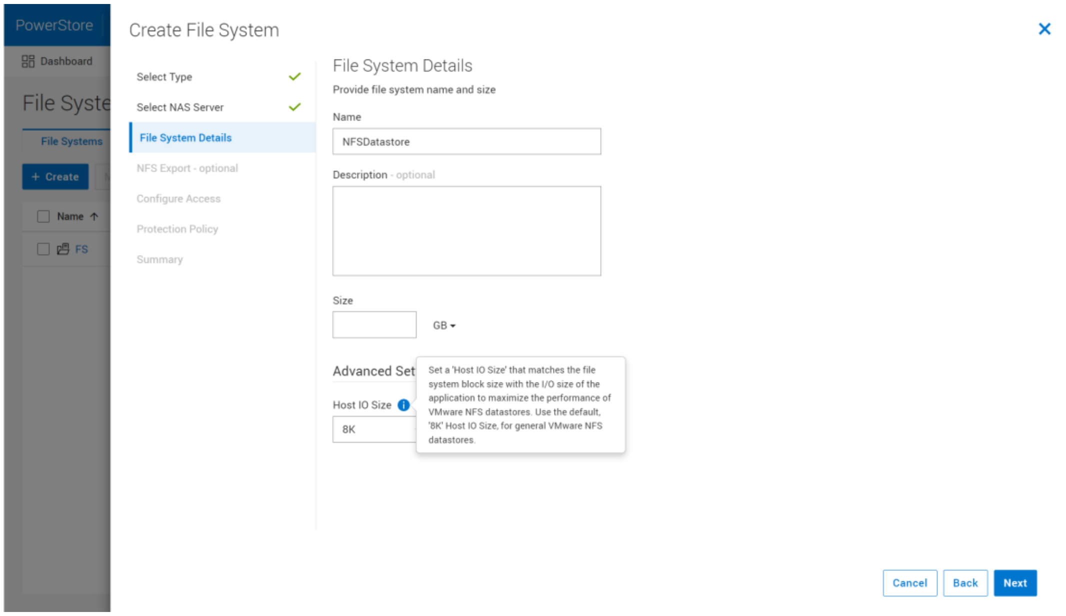
● VMware File System

Select this if you want to create NFS Datastore. VMware File System can only be accessed using NFS.

Figure 31. File system type

Host IO Size

When provisioning a VMware file system, you can configure **Host IO Size**. To maximize performance, configure it to match the application I/O size. The available options are 8K, 16K, 32K, and 64K. For general VMware NFS datastores, use the default setting of 8K. The file system type and host I/O size settings are specified during creation and cannot be changed afterwards.



Create File System

File System Details

Provide file system name and size

Name: NFSDatastore

Description - optional

Size

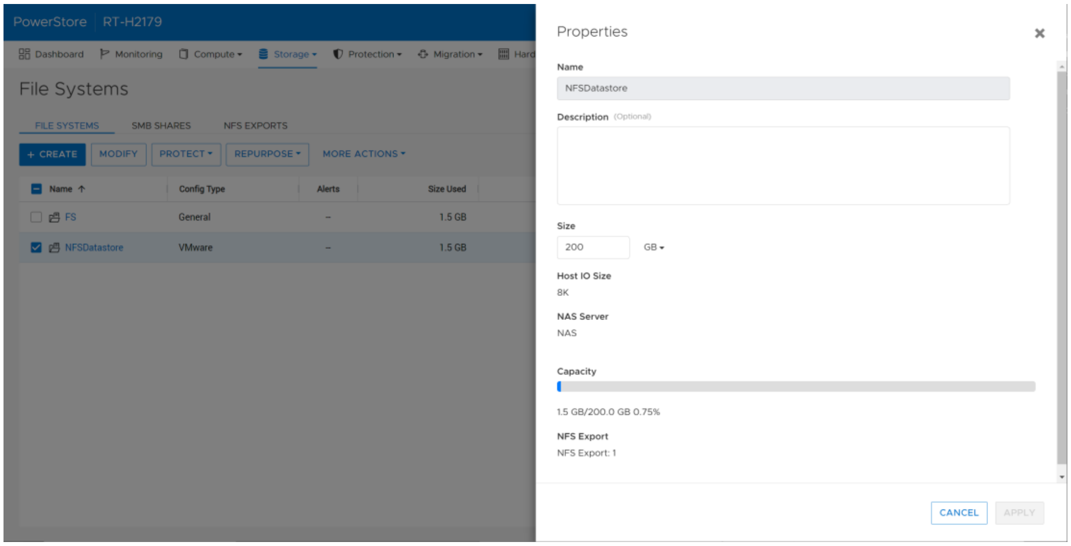
Advanced Set

Host IO Size: 8K

Set a 'Host IO Size' that matches the file system block size with the I/O size of the application to maximize the performance of VMware NFS datastores. Use the default, '8K' Host IO Size, for general VMware NFS datastores.

Figure 32. Host IO size

For existing file systems, you can identify the file system type in PowerStore Manager by going to **Storage** > **File Systems** and reviewing the **Config Type** column. In addition, you can view the configured host I/O size by clicking **Modify**, as shown in Figure 33.



File Systems

Name	Config Type	Alerts	Size Used
□ FS	General	--	1.5 GB
☑ NFSDatastore	VMware	--	1.5 GB

Properties

Name: NFSDatastore

Description (Optional)

Size: 200 GB

Host IO Size: 8K

NAS Server: NAS

Capacity: 1.5 GB/200.0 GB 0.75%

NFS Export: NFS Export: 1

Figure 33. Config Type column

PowerStore monitors the IOs that are sent to a VMware file system over the previous 24-hour period. If more than 50 percent of the IOs are a different size than the configured host IO size, or are not aligned properly, PowerStore Manager displays a warning. If there are less than 86,400 IOs received over the 24-hour period (1 IOPS), this check is skipped.

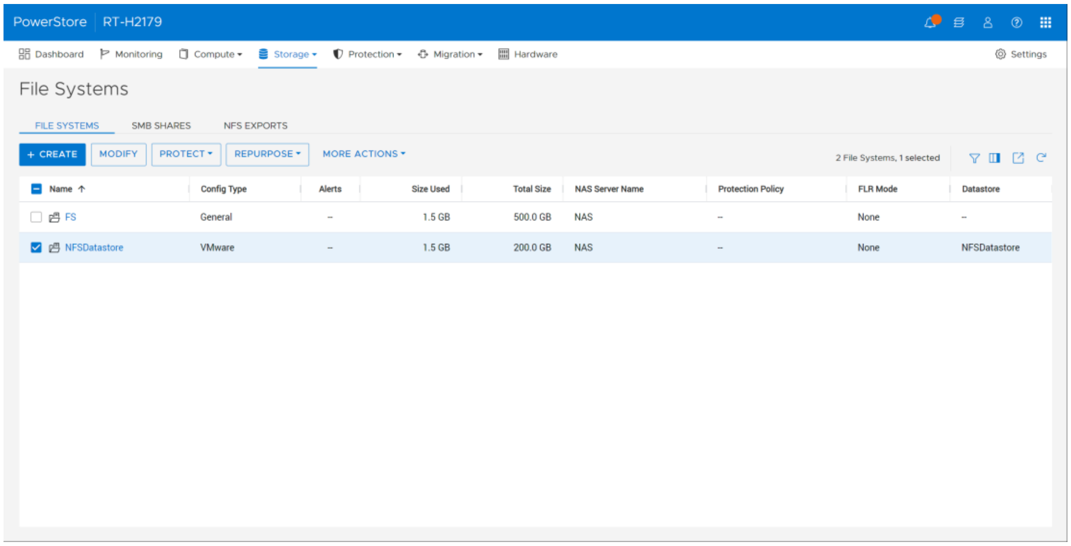
vStorage APIs for Array Integration (VAAI)

VMware file systems support vStorage APIs for Array Integration (VAAI), which are storage primitives that enable offloading storage operations from the host to the storage system. To leverage VAAI, the PowerStore NAS VAAI plug-in must be installed on the ESXi host. The following VAAI primitives are supported:

- Fast File Clone—Enables the creation of virtual machine snapshots to be offloaded to the array
- Full File Clone—Enables the offloading of virtual-disk cloning to the array
- Reserve Space—Enables provisioning virtual disks using the Thick Lazy and Eager Zeroed options over NFS
- Extended Statistics—Provides additional capacity utilization information

VM awareness

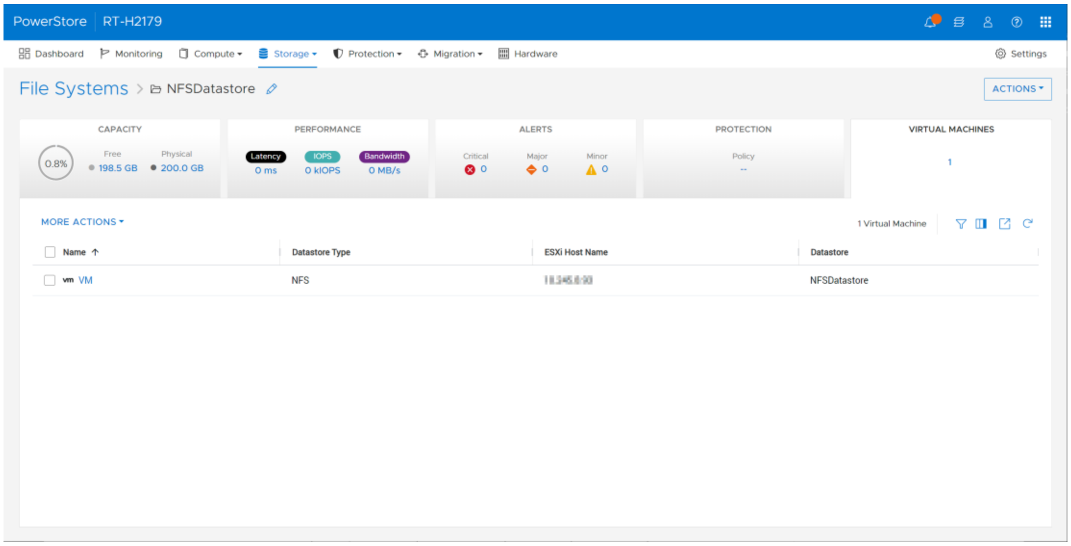
PowerStore Manager provides insight into the VMware environment for VMware file systems. The name of the datastore in vSphere is displayed in PowerStore Manager, enabling administrators to correlate the resources easily, as shown in Figure 34. In PowerStore Manager, go to **Storage** > **File Systems** and enable the **Datastore** column.



Name ↑	Config Type	Alerts	Size Used	Total Size	NAS Server Name	Protection Policy	FLR Mode	Datastore
□ FS	General	–	1.5 GB	500.0 GB	NAS	–	None	–
☑ NFSDatastore	VMware	–	1.5 GB	200.0 GB	NAS	–	None	NFSDatastore

Figure 34. VMware file system and associated datastore

In addition, administrators can view the VMs that are stored on this datastore, as shown in Figure 35. In PowerStore Manager, go to **Storage** > **File Systems** > **file system properties** > **Virtual Machines**.



□ Name ↑	Datastore Type	ESXi Host Name	Datastore
□ vm VM	NFS	[redacted]	NFSDatastore

Figure 35. Virtual machines on a VMware NFS datastore

Performance

VMware file systems are optimized for performance in VMware environments. On VMware file systems, metadata updates occur asynchronously because they are not critical for VMware NFS datastores. This behavior enables improved efficiency and performance on the file system.

VMware file system interoperability

VMware file systems do not support quotas and File-Level Retention (FLR), because these features are not required for VMware NFS datastores.

Supporting file features

Introduction

PowerStore also includes a rich set of supporting file features to ensure that the data is secure, protected, and easily monitored.

Quotas

To regulate file system storage consumption, PowerStore includes quota support to allow administrators to place limits on the amount of space that can be consumed. These simple but flexible quotas can easily be configured through any of the available management interfaces. PowerStore supports user quotas, quota trees, and user quotas on tree quotas. All three types of quotas can co-exist on the same file system and may be used in conjunction to achieve finer grained control over storage usage. Quotas are supported on general file systems. Quotas are not available on VMware file systems because they are not necessary for NFS datastores.

User quotas

User quotas are set at a file system level and limit the amount of space a user can consume on a file system. Quotas are disabled by default but can be enabled in the quota properties page dialog box along with the default user quota settings. The default quota limits are applied automatically to all users who access the file system. However, the default limits can be overridden for specific users by creating a user quota entry in PowerStore Manager.

Because all unspecified users are subject to the default quota settings, there is no ability to delete a user quota. Instead, a user quota can be set to 0 to allow unlimited access. Alternatively, a user quota can be set to inherit the default limits.

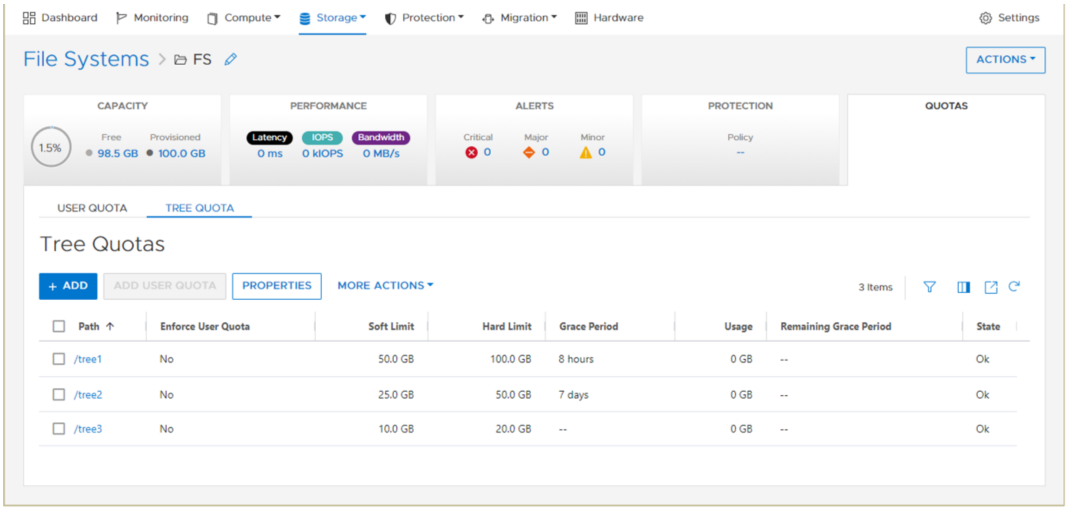
Tree quotas

Quota trees limit the maximum size of a directory on a file system. Unlike user quotas, which are applied and tracked on a user-by-user basis, quota trees are applied to directories within the file system. Quota trees can be applied on new or existing directories.

If an administrator specifies a nonexistent directory when configuring a new quota tree, the directory is automatically created as part of quota configuration. However, an administrator can also specify an existing file system directory with existing data when creating a quota tree. This functionality allows for implementation of quotas on existing file system directory structures after they have already been in production. If a tree quota is deleted, the directory itself remains intact, and all files continue to be available.

Quota trees cannot be nested within a single directory. For example, if a quota tree is created on /directory1, another quota tree cannot be created on /directory1/subdirectory1. However, it is possible to have quota trees on /directory2, /directory3, and so on.

In PowerStoreOS 1.0, the quota grace period setting applies to all user quotas and tree quotas within the file system. Starting with PowerStoreOS 2.0, this setting only applies to user quotas because each tree quota can have its own individual grace period setting. Newly created tree quotas have a default grace period setting of seven days, which can be customized during creation or afterwards. Figure 36 shows a file system containing multiple tree quotas with different grace periods configured.



Tree Quotas

Path ↑	Enforce User Quota	Soft Limit	Hard Limit	Grace Period	Usage	Remaining Grace Period	State
☐ /tree1	No	50.0 GB	100.0 GB	8 hours	0 GB	--	Ok
☐ /tree2	No	25.0 GB	50.0 GB	7 days	0 GB	--	Ok
☐ /tree3	No	10.0 GB	20.0 GB	--	0 GB	--	Ok

Figure 36. Multiple tree quotas with different grace periods

User quotas on tree quotas

When a quota tree is created, it is also possible to create additional user quotas within that specific directory by choosing to enforce user quotas. When multiple limits apply, users are bound by the limit that they reach first. As an example, a single user might be bound by the following limits on a file system:

- File system user quota: 25 GB

  This user has a limit of 25 GB across the entire file system.

- Tree quota (/directory1): 100 GB

  Data from all users in this directory may not exceed 100 GB.

- User quota on tree quota (/directory1): 10 GB

  This user cannot consume more than 10 GB on this directory.

Quota limits

All quotas consist of three major parameters that determine the amount of space that can be consumed on a file system and define the behavior when a limit is being approached or exceeded. These parameters are:

- Soft limit (GB)
- Grace period (time)
- Hard limit (GB)

The soft limit is a capacity threshold that triggers the grace period timer to start. For as long as the soft limit is exceeded, the grace period continues to count down. If the soft limit remains exceeded long enough for the grace period to expire, no new data can be added by the user or to the directory. The grace period has a minimum value of one minute and a maximum value of unlimited. However, if enough data is removed from the file system or directory to reduce the utilization below the soft limit before the grace period expires, data can continue to be written normally. Administrators can also allow users to continue writing data by increasing the value of the soft limit.

A hard limit is also set for each quota configured. Upon reaching a hard limit, no new data can be added to by the user or to the directory. When this happens, the quota must be increased, or data must be removed from the file system before additional data can be written.

Suppose the following user quotas are configured on a file system:

- Soft limit: 20 GB
- Grace period: 1 day
- Hard limit: 25 GB

The user copies data onto the file system, and after some time the user has stored 16 GB of files on the file system. Because the user has not reached their quota limits, the user is still able to add more data to the file system unimpeded. Figure 37 shows a file system under normal operation.

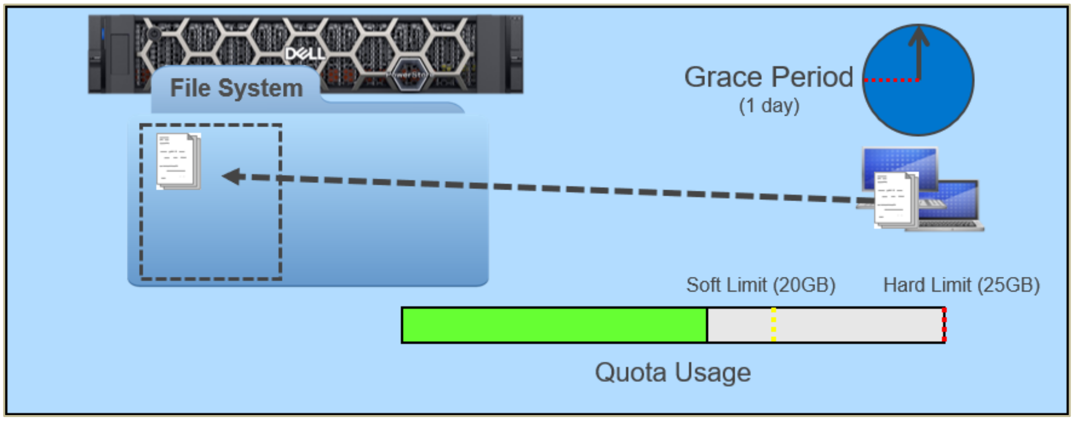


Figure 37. Normal operation

The user then continues to add more data to the file system, crossing the 20 GB soft limit. The user is still able to add additional data to the file system, but the grace period of one day begins. If the user does not remove data from the file system before the expiration of the grace period, the user can no longer add data to the file system. The user must remove enough data for the usage to fall below the soft limit first. Figure 38 shows a user that has crossed the soft limit and reached the end of the grace period.

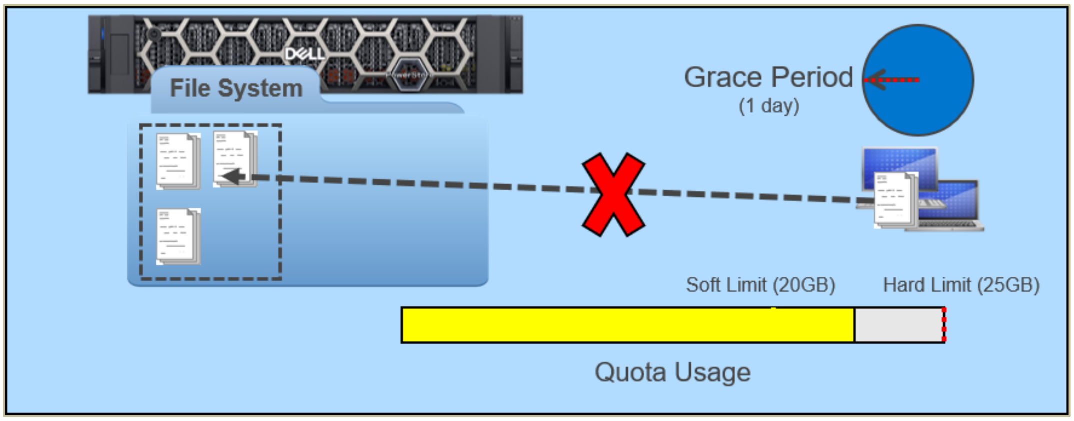


Figure 38. Grace period reached

If the user continues writing to and using additional space from the file system despite passing the soft limit, the user might eventually reach the hard limit. When the hard limit is reached, the user can no longer add data to the file system unless the user first removes some data. Figure 39 shows a user that has crossed the soft limit and reached the hard limit.

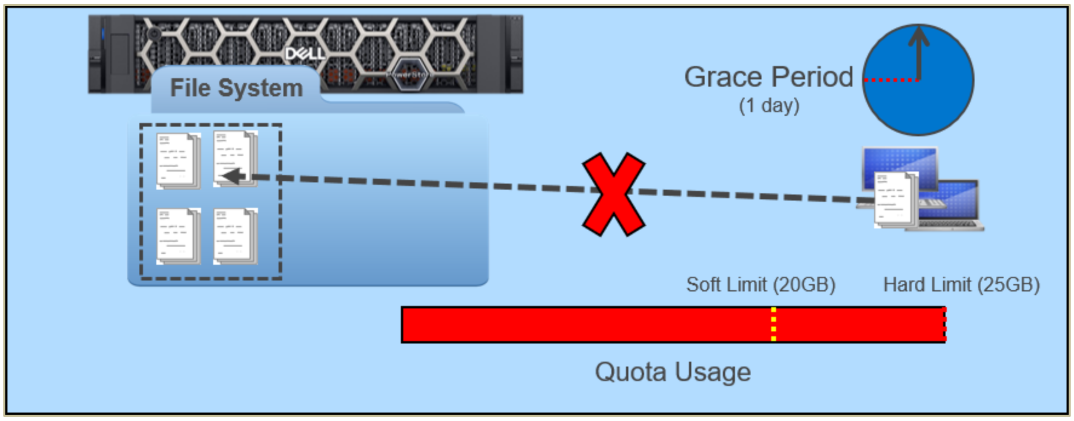


Figure 39. Hard limit reached

Snapshots

PowerStore features pointer-based immutable snapshots, meaning that the data is read-only and can never be modified. These snapshots can be used for restoring individual files or the entire file system back to a previous point in time. Because these snapshots leverage redirect-on-write on technology, no additional capacity is consumed when the snapshot is first created. Capacity only starts to be consumed as data is written to the file system and changes are tracked.

Snapshots can be taken manually or by the integrated scheduler. Manual snapshots can be created at any time on the file system properties page. Scheduled snapshots can be configured by creating a protection policy with one or more snapshot rules and applying the policy to the file system. Starting with PowerStoreOS 3.5, secure snapshots can be taken by a snapshot rule, but secure snapshots are not supported on file systems. If a protection policy containing a secure snapshot rule is applied to a file system, the policy runs and creates standard snapshots instead.

When a snapshot is created, it can be configured to have no automatic deletion or retention until a specific date and time. If retention is set, the snapshot is automatically deleted upon reaching the retention date. This retention setting does not prevent the snapshot from being deleted before the retention date.

All snapshots that are created by a protection policy must have a retention date. The maximum retention date varies depending on how often the snapshots are scheduled. Each file system supports up to 256 snapshots so the combination of the snapshot frequency and retention cannot be configured to exceed this number.

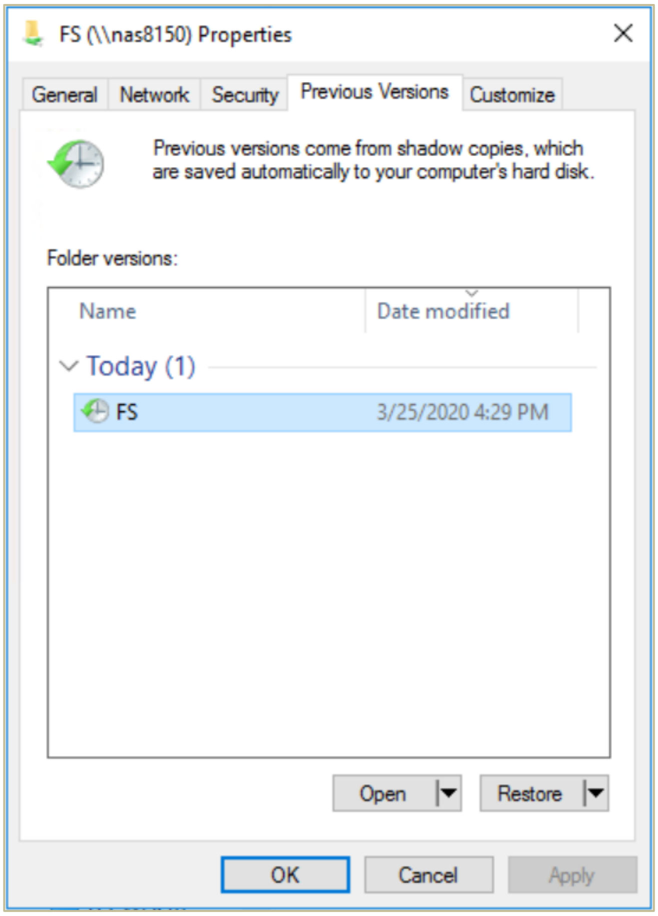
For file snapshots, there are two access types available:

- Protocol (default)—Enables the snapshot to be shared and mounted like a file system
- Snapshot—Makes the snapshot available for self-service restores

Both protocol- and snapshot-type snapshots are read-only. To access the data on a protocol snapshot, a share must be created. Once the share is created, the snapshot can be mounted on the host and accessed as if it were a read-only file system.

Snapshot-type snapshots have integration with Windows and UNIX systems to enable self-service restores. On UNIX systems, users can access snapshot data by going to the

.snapshot directory. On Windows systems, users can access snapshot data using the **Previous Versions** tab, as shown in Figure 40.



Previous versions come from shadow copies, which are saved automatically to your computer's hard disk.

Folder versions:

Name	Date modified
Today (1)	
FS	3/25/2020 4:29 PM

Figure 40. Accessing snapshot data through Previous Versions

Both protocol and snapshot type snapshots can be used for individual file and folder restores by copying the data off the snapshot back to the file system. Also, both types of snapshots can be used to restore the entire file system back to that point in time. When restoring the entire file system, a backup snapshot of the current file system data is taken by default.

Snapshots can be refreshed at any time. Refreshing the snapshot overwrites the contents of the snapshot with the data that is currently on the file system. Refreshing a snapshot only updates the data contents of the snapshot so the snapshot properties do not change.

For more information about snapshots, see the *Dell PowerStore: Snapshots and Thin Clones white paper*.

Replication

Replication is a software feature that synchronizes data to another system at the same site or to a different location. Replicating data helps to provide data redundancy and safeguards against failures or natural disasters at the main production site. Having a remote disaster recovery (DR) site protects against system and site-wide outages. It also provides a remote location that can resume production and minimize downtime due to a disaster. The PowerStore platform offers many data protection solutions that can meet disaster recovery needs in various environments.

Asynchronous Replication

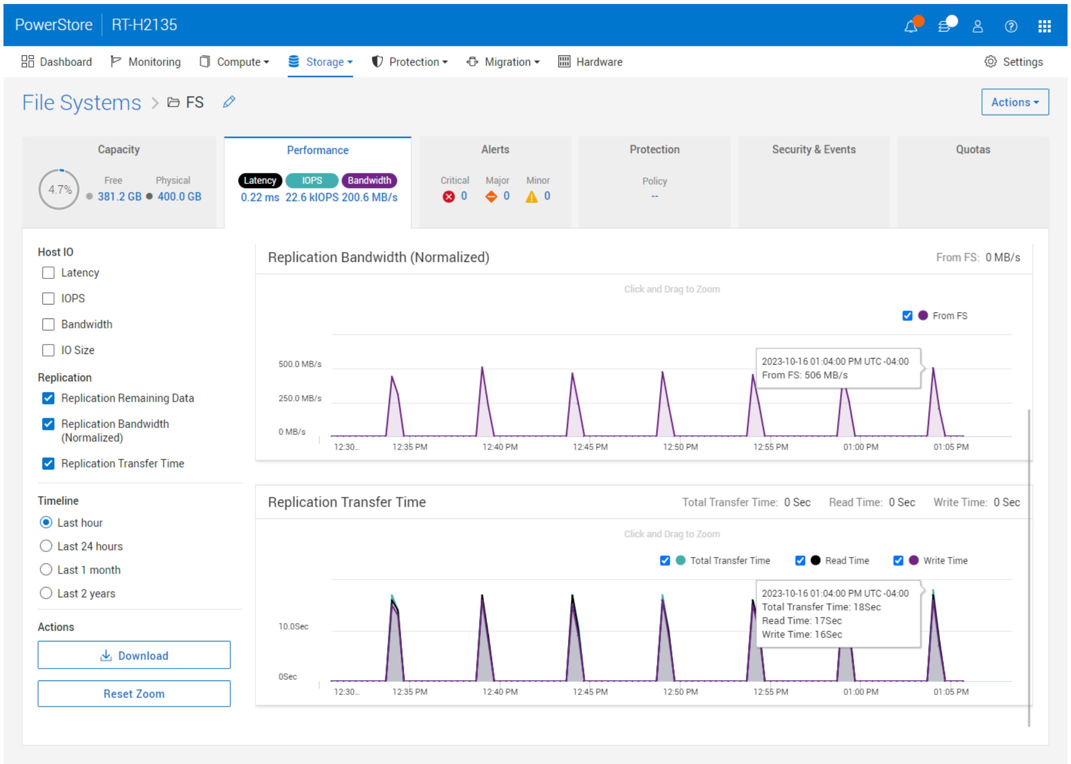
Starting with PowerStoreOS 3.0, asynchronous file replication is available. Asynchronous replication can be used to protect against a storage system outage by creating a copy of data on a remote system at any distance.

The asynchronous replication for PowerStore is designed to have minimal impact on host I/O latency. Host writes are acknowledged when they are saved to the local storage resource, and no additional writes are needed for change tracking. Because write operations are not immediately replicated to a destination resource, all writes are tracked on the source. This data is replicated during the next synchronization.

With protection policies, asynchronous replication uses the concept of a recovery point objective (RPO). The RPO, measured in units of time, is the acceptable amount of data that may be lost due to an outage. This delta of time also affects the amount of data that must be replicated during the next synchronization. It also reflects the amount of potential data loss in a disaster scenario.

Starting with PowerStoreOS 4.0, asynchronous replication metrics can be viewed on the source system through PowerStore Manager, PSTCLI, or REST API. As shown in Figure 41, the following metrics are available at the file system and NAS server levels:

- Replication Remaining Data – The amount of data left to be replicated to the remote system (MB)
- Replication Bandwidth – The replication rate (MB/s)
- Replication Transfer Time – The amount of time needed to copy the data (seconds)
    - Total Transfer Time
    - Read Time
    - Write Time



Host IO
□ Latency
□ IOPS
□ Bandwidth
□ IO Size

Replication
☑ Replication Remaining Data
☑ Replication Bandwidth (Normalized)
☑ Replication Transfer Time

Timeline
● Last hour
○ Last 24 hours
○ Last 1 month
○ Last 2 years

Actions

Figure 41. Asynchronous replication metrics

For more information about file asynchronous replication, see the *Dell PowerStore: Replication Technologies white paper*.

Synchronous Replication

Starting with PowerStoreOS 4.0, synchronous file replication is available. Synchronous replication is a zero RPO solution. This ensures both sites always have consistent copies of the data, eliminating the possibility of data loss.

When using synchronous replication, the write operation behavior changes since it must be committed to both systems in real-time.

5. The write operation is sent to the primary system
6. The primary system replicates the write to the secondary system
7. The secondary system acknowledges receipt of the write
8. The primary system acknowledges the host and completes the write operation

This ensures that both sites always have an identical copy of the data. Since the final host acknowledgement cannot be completed until both systems provide acknowledgement, the latency between the two sites is crucial. It is highly recommended to ensure the sites are within 100 kilometers or 60 miles of each other and has a Round-Trip Time (RTT) of 5ms or less.

Synchronous replication includes performance metrics that show the session bandwidth. This provides information on how much bandwidth is being used to copy data across the link between the two systems.

For more information about file synchronous replication, see the *Dell PowerStore: Replication Technologies white paper*.

Thin clones

File system thin clones

Thin clones are pointer-based copies of the file system that can be written to. They enable file systems to be repurposed for copy data management use cases, such as testing, development, or analytics. Thin clones can be created based on the current file system or any snapshot.

Because they are pointer-based clones, they continue to share blocks with the file system and snapshots. No additional capacity is consumed when the thin clone is first created. Capacity only starts to be consumed as data is written to the file system or thin clone and changes are tracked. Any changes to the data on the thin clone or the file system do not affect each other.

Although blocks are shared, there are no dependencies between objects within the family. For example, a file system that is used as the source for a thin clone can be deleted without impacting the thin clone. When a thin clone is created, it is treated as if it is a file system, which means that thin clones can also be created by using a thin clone as the source.

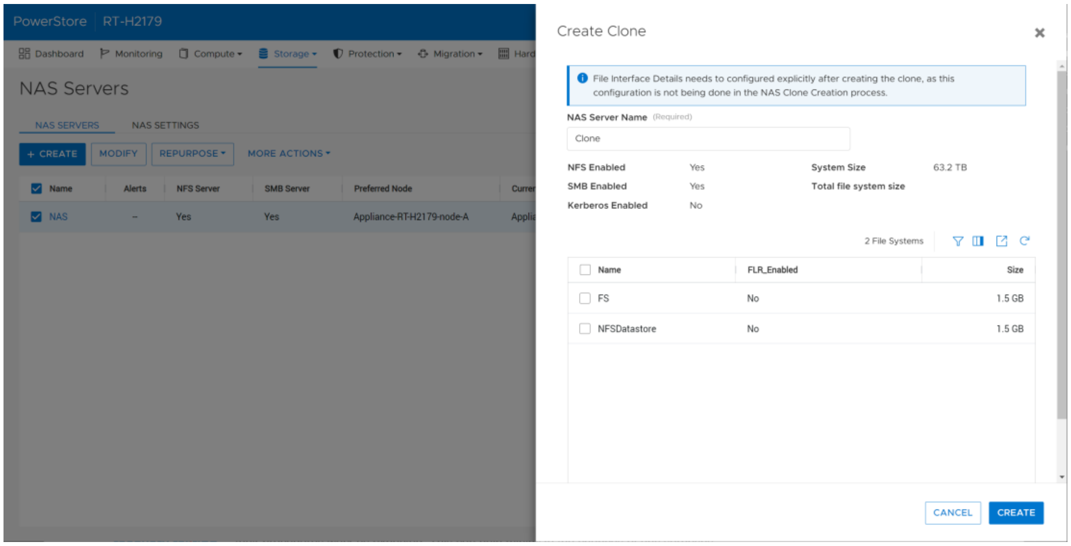
Because they are treated as independent resources, a thin clone can have its own set of snapshots and protection policy applied. When a thin clone is created, it inherits the source file system protection policy but can be changed after the clone is created. A thin clone does not inherit the snapshots, SMB shares, or NFS exports from the source.

NAS server thin clones

Starting with PowerStoreOS 3.0, NAS servers can be cloned to create a NAS server with the same configuration. The only settings that are not copied are ones that would cause conflicts, such as the network interfaces and joining the SMB server to the domain. To enable access to the newly cloned NAS server, a new interface must be added to the clone. If a domain-joined SMB server is needed, enter a new SMB Computer Name, Domain Username, and Password to join it to the domain.

When cloning a NAS server, you can optionally choose any file systems that you also want to clone onto the new NAS server. Any file systems included in the NAS server clone operation have their SMB shares and NFS exports cloned as well, but snapshots are not cloned.

Therefore, you can easily configure new NAS servers for use cases such as test/dev and analytics, without affecting the production NAS server. A NAS server clone can also be used to access data on a replication destination. Figure 42 shows cloning a NAS server along with its file systems.



NAS Servers

☑ Name	Alerts	NFS Server	SMB Server	Preferred Node	Curre
☑ NAS	--	Yes	Yes	Appliance-RT-H2179-node-A	Applia

Create Clone

File Interface Details needs to configured explicitly after creating the clone, as this configuration is not being done in the NAS Clone Creation process.

NAS Server Name (Required): Clone

NFS Enabled	Yes	System Size	63.2 TB
SMB Enabled	Yes	Total file system size	
Kerberos Enabled	No		

□ Name	FLR_Enabled	Size
□ FS	No	1.5 GB
□ NFSDatastore	No	1.5 GB

Figure 42. NAS server clone

For more information about thin clones, see the *Dell PowerStore: Snapshots and Thin Clones white paper*.

Disaster recovery testing

Organizations should orchestrate periodic Disaster Recovery (DR) tests to ensure that their procedures work as expected. This can help minimize the chances of any surprises or unexpected issues in an actual disaster scenario. A comprehensive DR test ensures that the dataset on the replication destination system can be read and written to. It also allows applications to be brought online using the data from the destination system to ensure that there are no errors.

NAS server clone using unique IP addresses

Starting with PowerStoreOS 3.0, a NAS server thin clone can be used for DR testing purposes. The NAS server can be cloned along with one, some, or all its file systems. This is the recommended option to perform a DR test because there is no impact to production and this can be easily configured using PowerStore Manager.

The NAS server can be cloned on either the source or destination system. If the NAS server is cloned on the source system, the administrator can replicate the cloned NAS server and perform a planned failover operation to bring the resources online on the destination system for the DR test. If the NAS server is cloned on the destination system, then no failover is necessary because the cloned resources are already accessible on the destination system.

The NAS server clone creates a NAS server with the same configuration as the destination NAS server. The only settings that are not copied are ones that would cause conflicts, such as the network interfaces and joining the SMB server to the domain. To enable access to the newly cloned NAS server, add a new and unique interface to the clone. Adding an IP address that is in use on either the source or destination is not allowed. If a domain-joined SMB server is needed, enter a new and unique SMB Computer Name, Domain Username, and Password to join it to the domain.

The cloned NAS server and its file systems can be mounted to perform the DR test without any impact to production or replication. Any changes made on the cloned resources and production resources do not impact each other. After the DR test completes, you can delete the cloned resources.

DR Test (DRT) NAS server using an isolated network with duplicate IP addresses

Some organizations may have a requirement to run their DR test using the exact same configuration as production. This enables the ability to run through the DR process and procedures without requiring any changes. This methodology can reduce risk and increase reproducibility in an actual failure scenario. However, re-using IP addresses on the production network creates IP address conflicts. To avoid this, this type of DR test must be run in a network bubble that is completely isolated from the production environment.

Starting with PowerStoreOS 3.6, you can create a DR Test (DRT) NAS server using the CLI or REST API. DRT NAS servers allow creating a NAS server with the same configuration as production, including the ability to use duplicate IP addresses. If a duplicate IP address is not required, the NAS server clone functionality can be leveraged instead.

Before configuring this feature, it is critical to ensure that dedicated network segments for the network bubble are configured at the destination site. The network configuration is done externally to PowerStore and can be configured in many ways, depending on your environment and requirements. This ensures that there is no overlap or interference with production or replication. The contents inside of the network bubble can be an exact clone of the production environment and can have its own set of clients and services.

Creating a DRT NAS server creates a NAS server with the same configuration as the destination NAS server. The only settings that are not copied are the network interfaces and joining the SMB server to the domain. The NAS server interfaces must be configured afterwards because they need to be placed on a different LA or FSN bond than the destination NAS server uses. This ensures that there is no interference between the destination and DRT NAS servers in case a failover is initiated.

A DRT NAS server can be created using one of the following commands:

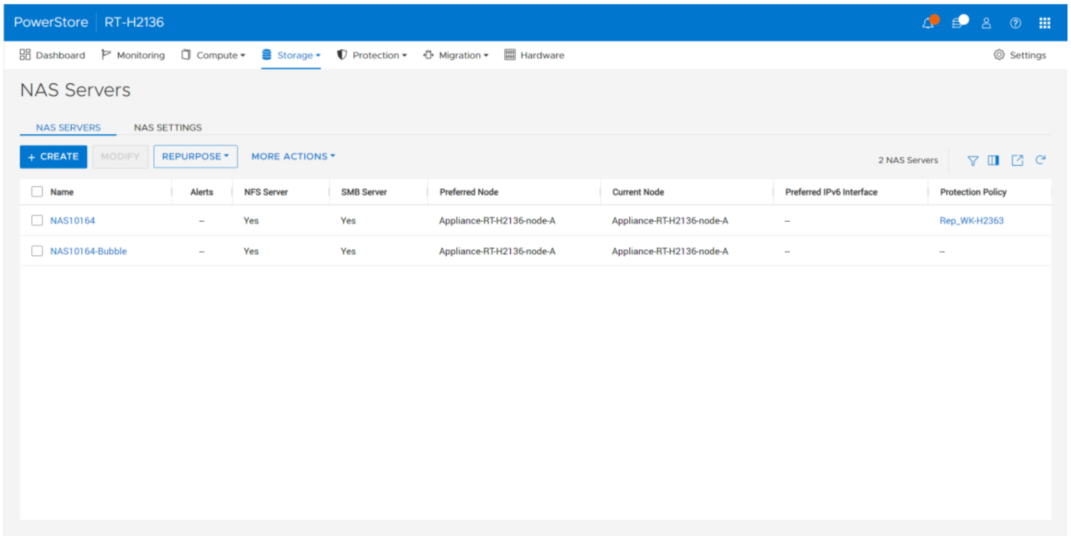
- PSTCLI: `pstcli nas_server clone -is_dr_test`
    - `[Optional] -is_dr_test { yes | true | no | false }`
- REST API: `POST /nas_server/{id}/clone`
    - `is_dr_test: boolean`
    - `default: false`

When the DRT NAS server is created, add a file interface using one of the following commands:

- PSTCLI: `pstcli file_interface create`
- REST API: `POST /file_interface`

For more information about PSTCLI and REST API commands, see *Dell PowerStore CLI Reference Guide* and *Dell PowerStore REST API Reference Guide* on Dell.com/powerstoredocs.

Although the initial configuration of DRT NAS servers can only be done using the PSTCLI or REST API, you can manage these resources using any of the standard tools after creation. DRT NAS servers, file interfaces, file systems, SMB shares, and NFS exports can be modified or deleted using PowerStore Manager, PSTCLI, or REST API. Figure 43 shows a destination NAS server along with a DRT NAS server in PowerStore Manager.



Name	Alerts	NFS Server	SMB Server	Preferred Node	Current Node	Preferred IPv6 Interface	Protection Policy
NAS10164	–	Yes	Yes	Appliance-RT-H2136-node-A	Appliance-RT-H2136-node-A	–	Rep_WK-H2363
NAS10164-Bubble	–	Yes	Yes	Appliance-RT-H2136-node-A	Appliance-RT-H2136-node-A	–	–

Figure 43. DRT NAS server in PowerStore Manager

If the production NAS server uses a domain-joined SMB server, the DRT NAS server must be joined separately to the AD domain in the bubble. If the production AD environment is cloned, the AD computer object may already exist, and the domain join operation will fail. In this situation, the computer object must be deleted from the domain in the network bubble or the join operation must be performed using the CLI with the –`reuse_computer_account` option.

When a DRT NAS server is created, all its file systems, SMB shares, and NFS exports are automatically copied. If there are any unwanted resources that were created as part of the DRT NAS server operation, they can be deleted. Note that snapshots from the source file systems are not copied.

When the DRT NAS server is configured, the DR test can be performed without any impact to production or replication. Any changes made on the DRT resources and production resources do not impact each other. After the DR test completes, you can delete the cloned resources.

Replication planned failover

Starting with PowerStoreOS 3.0, a planned failover operation can be leveraged to perform a DR test. Because the production NAS server and file systems are being failed over, this operation can impact the production workloads. This option should only be used during a maintenance window.

When the planned failover operation completes, the NAS server and resources are accessible on the destination system and the DR test can be performed. The source system can also be shut down at this time, if desired.

Note that an unplanned failover should never be used for DR testing purposes. An unplanned failover is intended to be used only when the source system is inaccessible and any changes since the last synchronization are lost. An unplanned failover that is initialized from the destination system is not allowed while the source system and production resources are online.

It is also critical to avoid bringing down the replication connection and initiating an unplanned failover operation to perform a DR test. Because the communication path between the systems is unavailable, PowerStore cannot ensure that both NAS servers are in a compatible state. When the connection is restored, PowerStore recognizes that both NAS servers are in production mode, which could result in a split-brain scenario. To prevent split-brain, PowerStore places both NAS servers into maintenance mode to prevent data from being written to both locations. In this situation, engage Dell Technical Support for assistance.

Preserving changes

Any changes made to the destination system after the failover are normally preserved. They are replicated back to the original source when a normal reprotect operation is initiated on the NAS server. After the NAS server is reprotected, another planned failover operation can be initiated to bring the resources online on the original source system.

Discarding changes

If the administrator does not want to preserve the changes made to the destination system after the failover, they can use the `discard_changes_after_failover` option when running the reprotect command. Starting with PowerStoreOS 4.0, this option is available when issuing a reprotect using PSTCLI or REST API on asynchronous replication sessions.

This feature enables the ability to make changes during the DR test without making them persistent. It alleviates the need to manually revert changes by changing the configuration and restoring from a snapshot. The benefits of this include minimizing the chances of errors and reducing the time and effort needed to bring production back online after the DR test is complete.

The reprotect with discard changes is a single command that reverses the changes that were made for the DR test. It discards changes made after the failover, fails back to the original source system, and reprotects the replication session in the original direction. Unlike a standard reprotect, replication never reverses direction. This restores the environment to the original production configuration that was in place before the failover. This should be run only after the DR test is complete.

The reprotect with discard changes operation cannot be run if the replication session is already reprotected. If the administrator plans to use the reprotect with discard changes option, they must issue a normal “failover to destination” and not use “failover to destination and reprotect”.

When using the reprotect with discard changes command, all of the following changes are discarded:

- NAS server – Configuration changes (DNS, UDS, interfaces, protocols, Kerberos, CAVA, and so on)

- File system - Configuration changes, file system data changes, snapshot restores, size changes, and quota changes
- Exports and shares – NFS export and SMB share changes

Note that some changes are not discarded when using this feature. This includes:

- New file systems provisioned or cloned
  - Newly created or cloned file systems remain available, but only on the destination system
  - Any new NFS exports or SMB shares created on this file system are still discarded
  - These file systems are not replicated
  - If replication synchronizes with this system as the source at a later time, these new file systems are also replicated
- File systems deleted
  - File systems are permanently deleted on the destination system
  - This also deletes the associated replication session and this file system is no longer replicated
  - If replication needs to be re-established, you must unassign and reassign the replication protection policy to the NAS server on the original source
- Snapshots created or deleted
  - File snapshots are not replicated, so the snapshots on the source and destination systems are independent of each other
  - Any changes to the snapshots on the both source or destination remain intact
  - A snapshot can be created on the destination system to preserve the dataset from the DR test if desired
- NAS server cloned
  - A cloned NAS server creates a separate NAS server instance, which remains available
  - Everything on the cloned NAS server is preserved on the destination system, including file systems, configuration, NFS exports, SMB shares, and so on

To run the reprotect with discard changes command:

- PSTCLI: `pstcli replication_session -id <value> reprotect [ -discard_changes_after_failover { yes | true | no | false } ]`
- REST API: `POST /replication_session/{id}/reprotect`
  - `discard_changes_after_failover`
  - Boolean
  - Default: false

For more information about PSTCLI and REST API commands, see *Dell PowerStore CLI Reference Guide* and *Dell PowerStore REST API Reference Guide* on Dell.com/powerstoredocs.

NDMP

PowerStore file supports three-way Network Data Management Protocol (NDMP) backups, allowing administrators to protect file systems by backing up to a tape library or other backup device. In an NDMP configuration, there are three primary components:

- Primary system - Source system to be backed up, such as PowerStore
- Data Management Application (DMA)—Backup application that orchestrates the backup sessions, such as Dell NetWorker
- Secondary system - The backup target, such as Data Domain

Three-way NDMP transfers both the metadata and backup data over the network. The metadata travels from the primary system to the DMA. The data travels from the primary system to the DMA and then finally to the secondary system. Figure 44 shows an example of a three-way NDMP configuration.

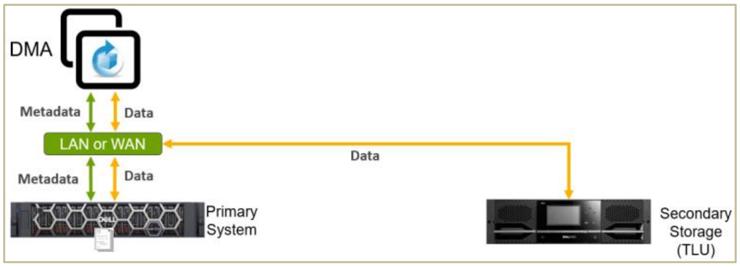


Figure 44. Three-way NDMP backup

PowerStore supports taking NDMP full backups, incremental backups, restores, and tape cloning. Both dump and tar backups are supported, but volume-based backups (VBBs) are not supported. Enable these parameters when running an NDMP backup:

- HIST: Allows the backup application to request the file history from the storage system
- UPDATE: Allows the backup application to request the file history for incremental backups
- DIRECT: Enables the ability to restore a single file from a backup
- SNAPSURE: Allows the backup application to request a snapshot of the file system for backup purposes

File-Level Retention

Starting with PowerStoreOS 3.0, File-Level Retention (FLR) is available. FLR is a feature that is used to protect file data from deletion or modification until a specified retention date. This functionality is also known as Write-Once, Read-Many (WORM).

FLR modes

PowerStore supports FLR-Enterprise (FLR-E) and FLR-Compliance (FLR-C). FLR-C has additional restrictions and is designed for companies that need to comply with federal regulations. Table 14 shows a comparison of FLR-E and FLR-C.

Table 14. FLR-E and FLR-C

Item	FLR-Enterprise (FLR-E)	FLR-Compliance (FLR-C)
Functionality	Prevents file modification and deletion by users and administrators through NAS protocols such as SMB, NFS, and FTP	
Deleting a file system with locked files	Allowed (warning is displayed)	Not allowed
Factory reset (destroys all data)	Allowed	
Infinite retention period behavior	Soft - A file locked with infinite retention can be reduced to a specific time later	Hard - A file locked with infinite retention can never be reduced (a FLR-C file system that has a file locked with infinite retention can never be deleted)
Data integrity check	Not available	Available (for more information, see the paragraph that follows this table)
Restoring file system from a snapshot	Allowed	Not allowed
Meets requirements of SEC rule 17a-4(f)	No	Yes

FLR-C includes a data integrity check, as required by SEC rule 17a-4(f). When data is written, it is read back by the storage system to ensure that it has not changed during the write process. If the data does not match, the comparison is retried two more times. If there is still a mismatch, an error is reported. Files that are already locked do not have any additional write verification because they cannot be written to anymore. The write verification functionality is disabled by default because the additional overhead can have a performance impact. However, enable write verification if it is required for compliance reasons. It can be enabled by changing the NAS server parameter `FLRCompliance.writeverify` from `0` to `1`.

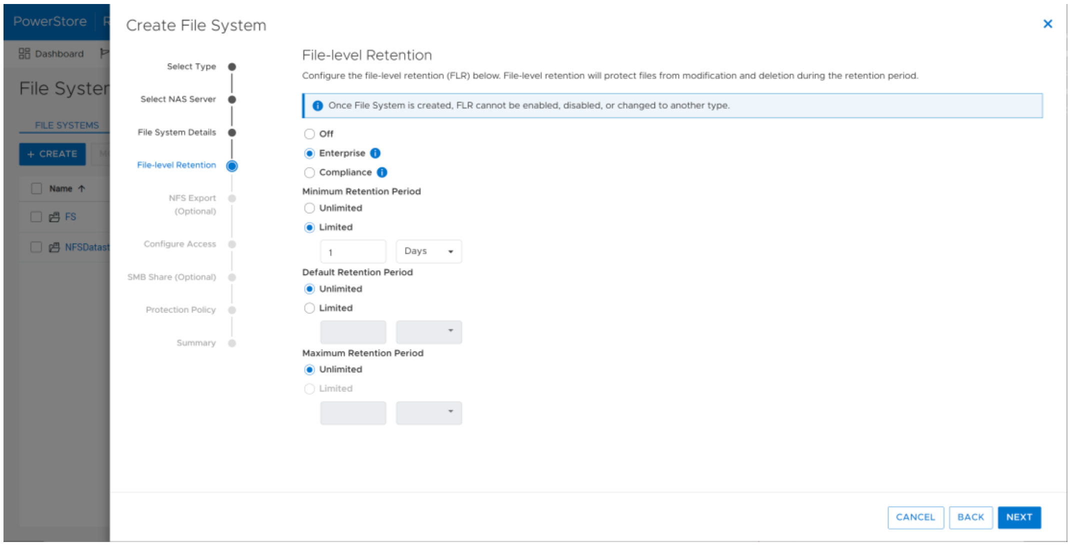
The FLR mode is set when a general file system is created and cannot be changed afterwards. FLR is not available on VMware file systems because file locking is not necessary for NFS datastores. The available FLR modes are Off (default), Enterprise, and Compliance.

Retention settings

If FLR is enabled, the following retention periods can be configured:

- Minimum—Specifies the shortest period for which files can be locked
- Default—Used when a file is locked, and a retention period is not specified
- Maximum—Specifies the longest period that files can be locked

The minimum, maximum, and default retention periods can be changed afterwards but any updates do not apply to any files that are already locked. Figure 45 shows the FLR step of the file system provisioning wizard.



Create File System

File-level Retention

Configure the file-level retention (FLR) below. File-level retention will protect files from modification and deletion during the retention period.

Once File System is created, FLR cannot be enabled, disabled, or changed to another type.

○ Off
● Enterprise
○ Compliance

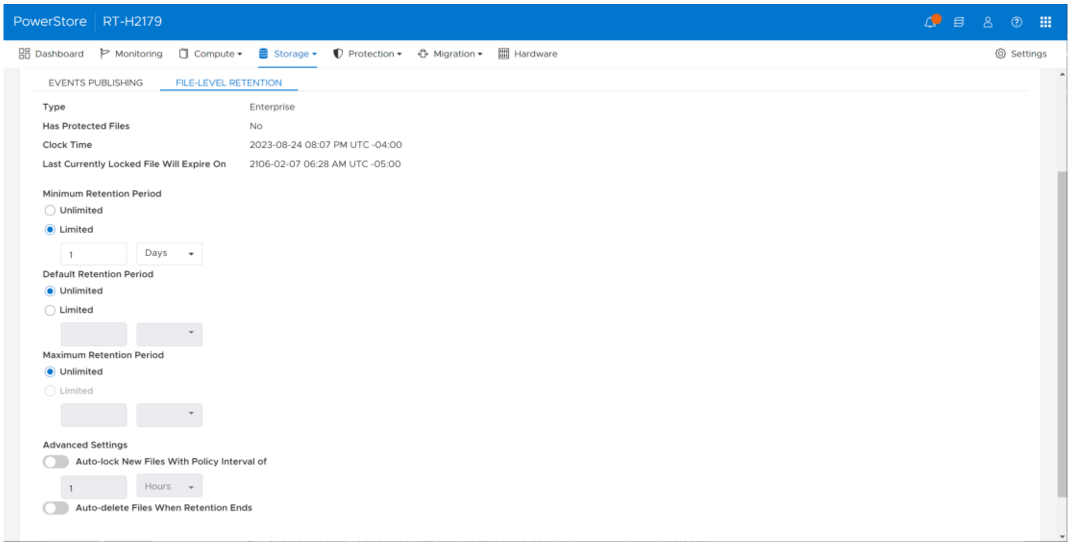
Minimum Retention Period
○ Unlimited
● Limited
1 Days

Default Retention Period
● Unlimited
○ Limited

Maximum Retention Period
● Unlimited
○ Limited

Figure 45. File Level Retention configuration

FLR also has integrated Auto-Lock and Auto-Delete functionality that can optionally be enabled for automation purposes. These settings can be configured on an FLR-enabled file system after it is provisioned, as shown in Figure 46. They are both disabled by default and can be modified at any time.



Type: Enterprise
Has Protected Files: No
Clock Time: 2023-08-24 08:07 PM UTC -04:00
Last Currently Locked File Will Expire On: 2106-02-07 06:28 AM UTC -05:00

Minimum Retention Period
○ Unlimited
● Limited
1 Days

Default Retention Period
● Unlimited
○ Limited

Maximum Retention Period
● Unlimited
○ Limited

Advanced Settings
○ Auto-lock New Files With Policy Interval of
1 Hours
○ Auto-delete Files When Retention Ends

Figure 46. File Level Retention properties

- Auto-Lock—Files are automatically locked if they are not modified for a user-specified period (Policy Interval)
  - Automatically locked files use the default retention period
  - Files in append-only mode are also subject to automatic locking
- Policy Interval—Specifies how long to wait after files are modified before they are automatically locked
  - Specifies how long to wait after files are modified before they are automatically locked

    - Default: 1 Hour; Minimum: 1 Minute, Maximum, 365 Days
- Auto-Delete—Automatically deletes locked files after their retention date has expired
    - Weekly process that scans the file system to search for expired files
    - The first scan is initiated seven days after the feature is enabled

FLR file states

In an FLR-enabled file system, files can be in one of four states:

- Not locked
    - Initial state of a new file
    - Treated in the same manner as a file in a non-FLR file system (can be modified, deleted, renamed, moved, and so on)
- Locked
    - Cannot be modified or deleted until the retention date has passed
    - Files can be manually locked by a user or automatically locked by the system or FLR Toolkit
    - A locked file can have its retention period extended, but not shortened
- Append only
    - Existing data cannot be modified or deleted
    - New data can be added to the end of the file
    - Useful for log files
    - Can be locked later
- Expired
    - File that was previously locked, but the retention date has passed
    - An expired file can only be relocked or deleted from the file system; it cannot be changed to append-only (unless it is empty)
    - Data in expired files cannot be modified

Locking files on Linux

The process to set a retention date and lock a file depends on the client operating system. Linux natively includes commands to perform these operations.

- Users can set the retention period using the `touch` command to set the last access time of the file to a future date and time
    - `root@vm:~# touch -at 202201141200 FLRtest01.txt`
- Users can lock the file by changing the access permissions to read-only using the `chmod` command
    - `root@vm:~# chmod -w FLRtest01.txt`

Locking files on Windows

Windows does not offer a native UI or CLI option and requires using the Windows API `SetFileTime` function instead. The Dell FLR Toolkit is a Windows application that presents the `SetFileTime` function in a user-friendly manner, enabling administrators to manage files on an FLR-enabled file system.

The FLR Toolkit includes the following user interfaces and tools:

- FLR Explorer—GUI that can be used to set retention periods, lock files, run queries, and generate reports
- FLRApply—CLI options for setting retention periods and locking files
- FLR Monitor Service—Service that monitors folders in FLR-enabled file systems and acts on them, based on a user-configured policy
- Windows Explorer Enhancements—Adds FLR options to the Windows Explorer right-click and Properties menus

To set up the FLR Toolkit, enable the Distributed Hierarchical Storage Management (DHSM) API on the NAS server, specify the credentials that the toolkit will use, and install the toolkit on a Windows client.

Creating append-only files

To create an append-only file, create an empty file, remove write permissions, and then reapply write permissions to the file. To later lock an append-only file, set the retention date and remove write permissions again. You can make these changes with native Linux commands or by using the FLR Toolkit.

FLR interoperability

Operations such as thin clones and replication on an FLR-enabled file system maintain the same FLR mode. For example, if the source file system has FLR-E enabled, the clone or replication destination file system also has FLR-E enabled, and this cannot be changed.

FLR activity log

When an FLR-enabled file system is created, an FLR_Logs directory is automatically created on the root of the file system to store all FLR-related activity. This activity includes operations such as files getting locked successfully, attempted changes to locked files, and retention settings updates. Individual details of each event, such as the user, timestamp, file information, and results, are also included. Files in the activity log are identified by their inode number.

The log itself is an append-only file. When the size reaches 10 MB, it is locked with the maximum retention period, and a new log is created. The following is an example of the FLR activity log:

```
root@vm:~# cd /mnt/FLR_Logs/

root@vm:/mnt/FLR_Logs/# ls

flrLog20220126193040

root@vm:/mnt/FLR_Logs/# cat flrLog20220126193040
```

```
Wed Jan 26 19:30:40 2022 : Activity log file created

Wed Jan 26 19:30:40 2022 : Initial fs rp range: max = infinite,
default = 1D, min = 0D

Wed Jan 26 19:36:27 2022 : Set auto lock feature: oldVal = disable
: newVal = enable : Passed

Wed Jan 26 19:36:27 2022 : Set auto lock policy Interval: oldVal =
3600 : newVal = 60 : Passed

Wed Jan 26 19:40:58 2022 : Worm commit clean file : Inode No =
9459 : Generation No = 1643225480 : Uid = 0 : Gid = 1 : FileMode =
444 : FileSize = 14 : RP = Thu Jan 27 19:40:58 2022 : Passed
```

CAVA

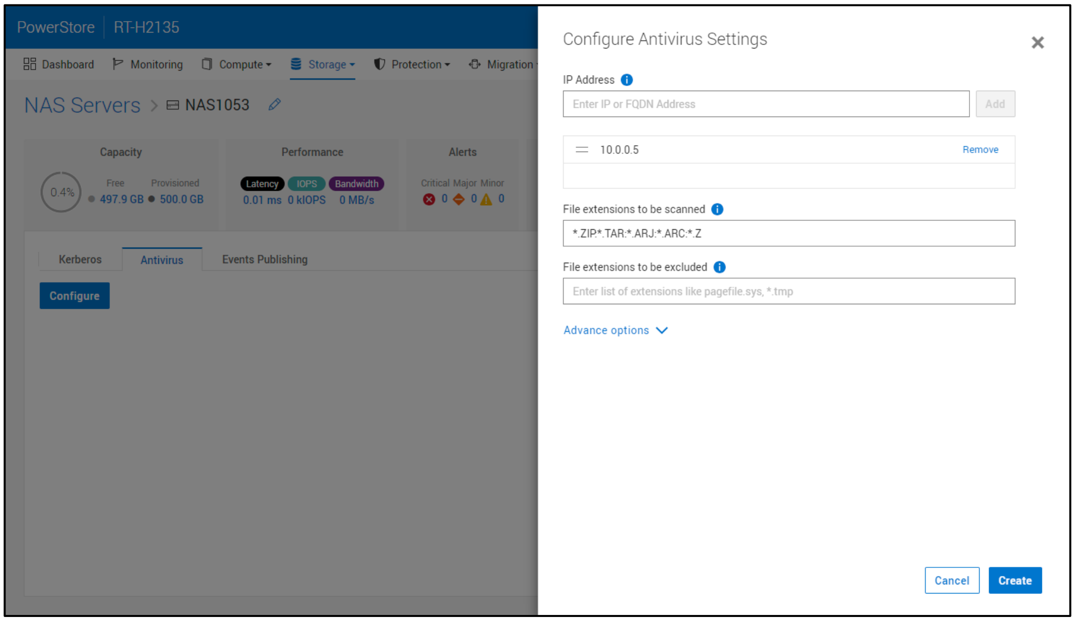
Common Anti-Virus Agent (CAVA) provides an anti-virus solution to SMB clients by using third-party anti-virus software to identify and eliminate known viruses before they infect files on the storage system. Windows clients require CAVA to reduce the chance of storing infected files on the file system and protects them if they happen to open an infected file. This anti-virus solution consists of a combination of the PowerStore, Common Event Enabler (CEE) CAVA agent, and a third-party anti-virus engine. CAVA is enabled on a per NAS server basis.

PowerStore monitors events and triggers the anti-virus engine to initiate a scan when necessary. Some of the possible event triggers include file renames, modifications, and first reads. While a file is being scanned, access to the file from any SMB client is temporarily blocked. The CAVA solution is for clients running the SMB protocol only. If clients use the NFS or FTP protocols to create, modify, or move files, the CAVA solution does not scan these files for viruses.

CAVA can be customized depending on your specific needs. It can scan specific file extensions, exclude specific file extensions, configure the maximum file size to be scanned, configure the behavior if the anti-virus server goes offline, and more. To ensure that file scanning is maintained if an anti-virus server goes offline or cannot be reached, you should configure at least two CAVA servers.

Starting with PowerStoreOS 4.0, the CAVA configuration process has been enhanced to improve usability. Functions that were previously provided by service scripts, configuration files, and off-array tools are now also available natively in PowerStore Manager, PSTCLI, and REST API. This includes operations such as configuring CAVA, assigning virus checker privileges, viewing status, and on-demand file system scans. These enhancements make the setup, management, and monitoring of CAVA easier for administrators. The CAVA functionality and behavior continues to be the same as before.

Figure 47 shows the antivirus configuration page in PowerStore Manager.



Configure Antivirus Settings

IP Address: Enter IP or FQDN Address

10.0.0.5

File extensions to be scanned: *.ZIP*.TAR:*.ARJ:*.ARC:*.Z

File extensions to be excluded: Enter list of extensions like pagefile.sys, *.tmp

Figure 47. Antivirus configuration

For a list of supported AV engines or for more information about how to configure CAVA, see *Dell PowerStore Simple Support Matrix* and *Dell PowerStore Configuring SMB* on Dell.com/powerstoredocs.

CEPA

Starting with PowerStoreOS 3.0, Common Event Publishing Agent (CEPA) is available. CEPA delivers SMB and NFS file and directory event notifications to a server, enabling them to be parsed and controlled by third-party applications. This can be used for use cases such as detecting ransomware, managing user access, configuring quotas, and providing storage analytics. The event notification solution consists of a combination of the PowerStore, Common Event Enabler (CEE) CEPA software, and a third-party application.

CEPA includes the following facilities that can be leveraged by third-party applications:

- Auditing—Enables file auditing for operations such as create, open, delete, close, rename, and ACL updates
- Centralized Quota Management (CQM)—Enables managing quotas across multiple storage systems
- VCAPS—Notifies search and indexing appliances when it is time to re-scan files

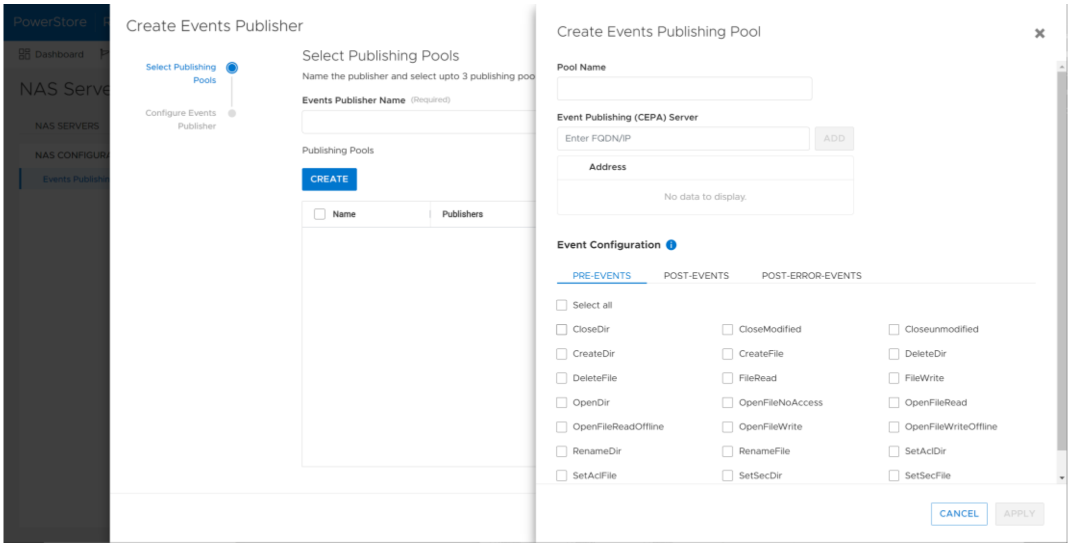
Publishing Pools

To configure CEPA, create a Publishing Pool and Events Publisher at **Storage** > **NAS Servers** > **NAS Settings** page in PowerStore Manager. The publishing pool specifies which events should trigger notifications and to which servers they should be sent. There can be up to five CEPA servers, which can be specified by IPv4 address, IPv6 address, or FQDN. The available events fall under three categories:

- Pre-Events—When an operation is requested, the NAS server sends a notification and waits for approval before allowing the operation to occur

- Post-Events—NAS server sends a notification after an operation occurs
- Post-Error-Events—NAS server sends a notification if an operation generates an error

Figure 48 shows the publishing pool configuration page.



Create Events Publisher

Select Publishing Pools ●
Configure Events Publisher ○

Select Publishing Pools

Name the publisher and select upto 3 publishing poo

Events Publisher Name (Required)

Publishing Pools

CREATE

□ Name	Publishers

Create Events Publishing Pool ✕

Pool Name

Event Publishing (CEPA) Server

Enter FQDN/IP ADD

Address
No data to display.

Event Configuration

PRE-EVENTS POST-EVENTS POST-ERROR-EVENTS

□ Select all

□ CloseDir	□ CloseModified	□ Closeunmodified
□ CreateDir	□ CreateFile	□ DeleteDir
□ DeleteFile	□ FileRead	□ FileWrite
□ OpenDir	□ OpenFileNoAccess	□ OpenFileRead
□ OpenFileReadOffline	□ OpenFileWrite	□ OpenFileWriteOffline
□ RenameDir	□ RenameFile	□ SetAclDir
□ SetAclFile	□ SetSecDir	□ SetSecFile

CANCEL APPLY

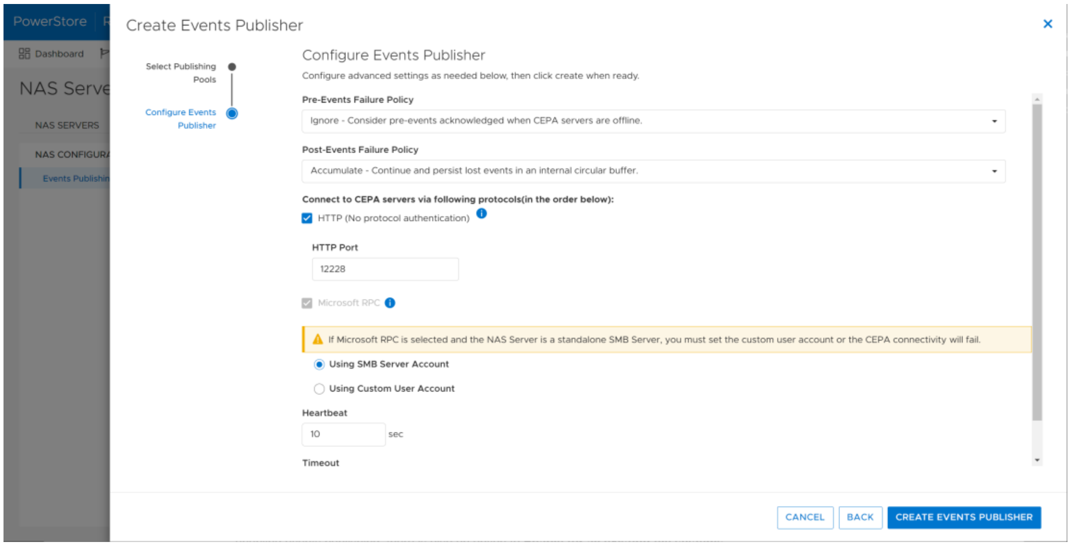
Figure 48. Publishing pool configuration

Events publisher

The events publisher specifies one to three publishing pools and enables configuration of advanced settings.

- Pre-Events Failure Policy—Determines the pre-event behavior if PowerStore cannot reach CEPA Server
  - Ignore (default)—Consider pre-events acknowledged when CEPA servers are offline
  - Deny—Deny user access when a corresponding pre-event request to CEPA servers failed
- Post-Events Failure Policy—Determines the post-event behavior if PowerStore cannot reach CEPA Server
  - Ignore—Continue and tolerate lost events
  - Accumulate (default)—Continue and persist lost events in an internal buffer
  - Guarantee—Persist lost events, deny file systems access when the buffer is full
  - Deny—Deny access to file systems when CEPA servers are offline
- Connectivity and protocol settings
  - HTTP and Port—HTTP and 12228, by default
  - Microsoft RPC and Accounts—Enabled and SMB, by default
  - Heartbeat and Timeout—10 sec and 1000 ms, by default

Figure 49 shows the events publisher configuration page.



Create Events Publisher

Configure Events Publisher

Configure advanced settings as needed below, then click create when ready.

Pre-Events Failure Policy

Ignore - Consider pre-events acknowledged when CEPA servers are offline.

Post-Events Failure Policy

Accumulate - Continue and persist lost events in an internal circular buffer.

Connect to CEPA servers via following protocols(in the order below):

☑ HTTP (No protocol authentication)

HTTP Port

12228

☑ Microsoft RPC

⚠ If Microsoft RPC is selected and the NAS Server is a standalone SMB Server, you must set the custom user account or the CEPA connectivity will fail.

● Using SMB Server Account

○ Using Custom User Account

Heartbeat

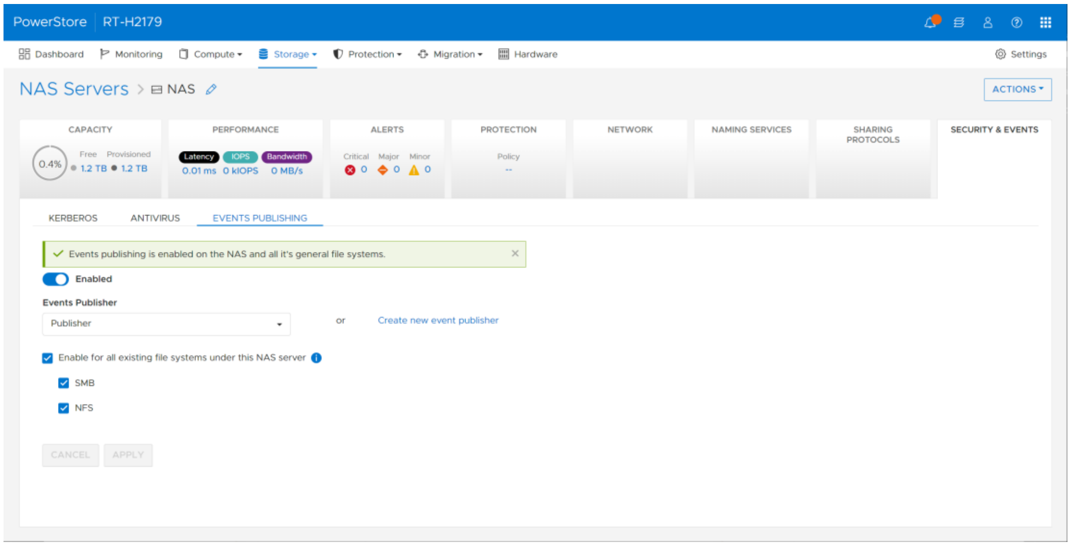
10 sec

Timeout

Figure 49. Events publisher configuration

Enabling events publishing

When an events publisher is created, events publishing can be enabled on a NAS server. Multiple NAS servers can use the same events publisher. You can enable events publishing at **NAS server properties** > **Security & Events** > **Events Publishing**. When enabling events publishing, there is also an option to **Enable for all existing file systems under the NAS server** for SMB and NFS, as shown in Figure 50.



✓ Events publishing is enabled on the NAS and all it's general file systems.

Enabled

Events Publisher

Publisher or Create new event publisher

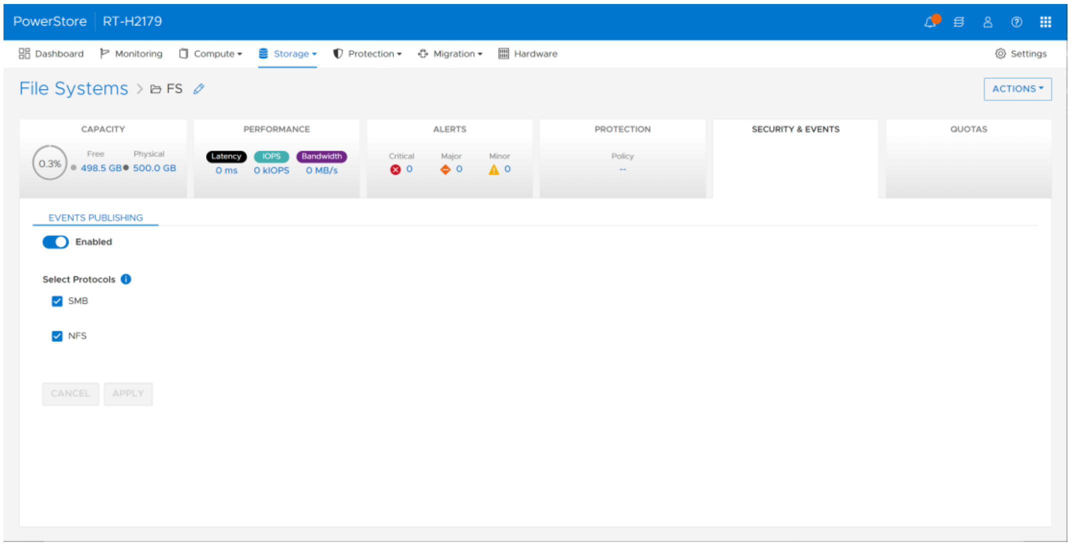
☑ Enable for all existing file systems under this NAS server

☑ SMB

☑ NFS

Figure 50. Enabling events publisher on a NAS server

A NAS server can contain a mix of file systems with and without events publishing enabled. When events publishing is enabled on the NAS server, it can be enabled or disabled on each individual file system at **Storage** > **File Systems** > **file system properties** > **Security & Events**, as shown in Figure 51.



Enabled

Select Protocols

☑ SMB

☑ NFS

Figure 51. Events publishing on a file system

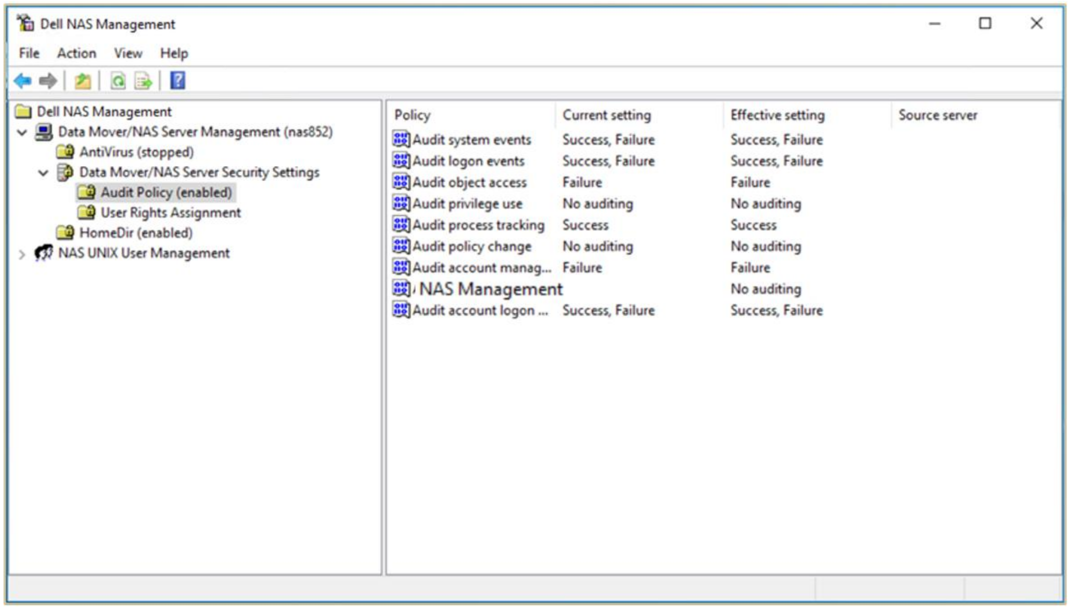
For a list of supported third-party applications or for more information about how to configure CEPA, see *Dell PowerStore Simple Support Matrix, Dell PowerStore Configuring SMB, and Dell PowerStore Configuring NFS* on Dell.com/powerstoredocs.

MMC snap-in

The Microsoft Management Console (MMC) snap-in enables management of the file features and functions directly from a Windows client. Features that can be configured using the snap-in include:

- AntiVirus: Enables configuring anti-virus parameters such as file extensions to scan or exclude, maximum file size to scan, retry timeouts, and more.
- Audit Policy: Determines which security events are logged in the SMB security log. You can log successful attempts, failed attempts, both, or neither. These events can be viewed in the Windows Event Viewer.
- User Rights Assignment: Manages the privileges that users and groups have on the SMB server.
- HomeDir (home directories): Configures settings for the home directories feature. This feature can be used for options such as automatically creating home directories if they do not exist.

Figure 52 shows the audit policy management screen using the MMC snap-in.



Dell NAS Management
- Data Mover/NAS Server Management (nas852)
  - AntiVirus (stopped)
  - Data Mover/NAS Server Security Settings
    - Audit Policy (enabled)
    - User Rights Assignment
  - HomeDir (enabled)
- NAS UNIX User Management

Policy	Current setting	Effective setting	Source server
Audit system events	Success, Failure	Success, Failure	
Audit logon events	Success, Failure	Success, Failure	
Audit object access	Failure	Failure	
Audit privilege use	No auditing	No auditing	
Audit process tracking	Success	Success	
Audit policy change	No auditing	No auditing	
Audit account manag...	Failure	Failure	
NAS Management		No auditing	
Audit account logon ...	Success, Failure	Success, Failure	

Figure 52. MMC snap-in

Metrics

In PowerStoreOS 1.0, performance metrics display the overall backend performance, which includes both file and block workloads. Starting with PowerStoreOS 2.0, the ability to view file-specific performance metrics is also available. The **Overall** tab displays overall back-end performance metrics, and the **File** tab displays file metrics.

File metrics are available at the node, appliance, and cluster level:

- Node—20-second granularity
  - Node-level SMB metrics—5-second granularity
  - Node-level NFS metrics—5-second granularity
- Appliance—20-second granularity
- Cluster—5-second granularity

The available metrics are:

- Read, write, and total IOPS
- Read, write, and total bandwidth
- Read, write, and average latency
- Read, write, and average IO size

Figure 53 shows the file metrics page, displaying the node-level SMB protocol metrics on Node B.

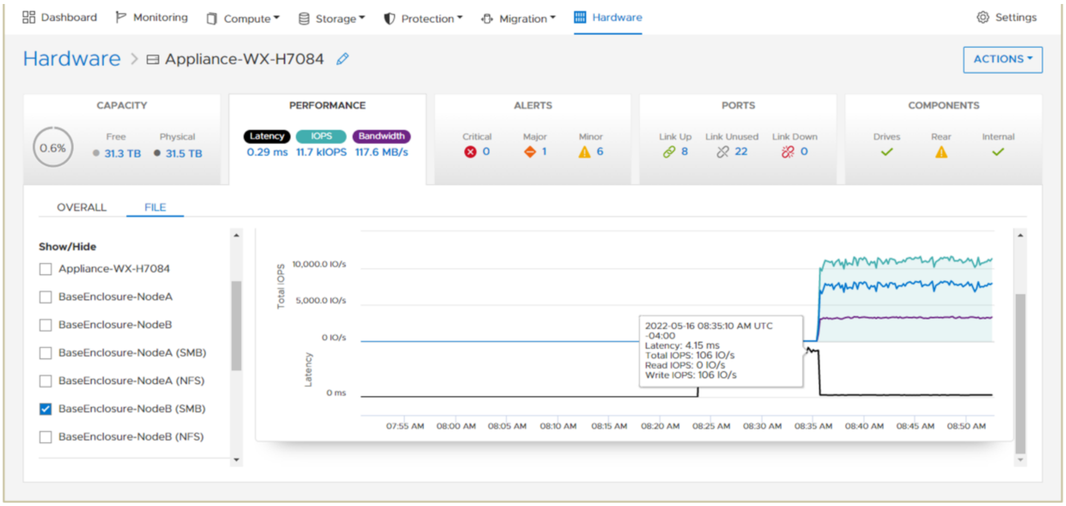


Figure 53. SMB protocol metrics on Node B

Starting with PowerStoreOS 3.0, additional capacity and performance metrics for file systems and NAS servers are available. As shown in Figure 54, the following file system capacity metrics are available at a 5-minute granularity:

- Thin savings
- Snap savings
- Snap/thin clone space
- File system family unique data

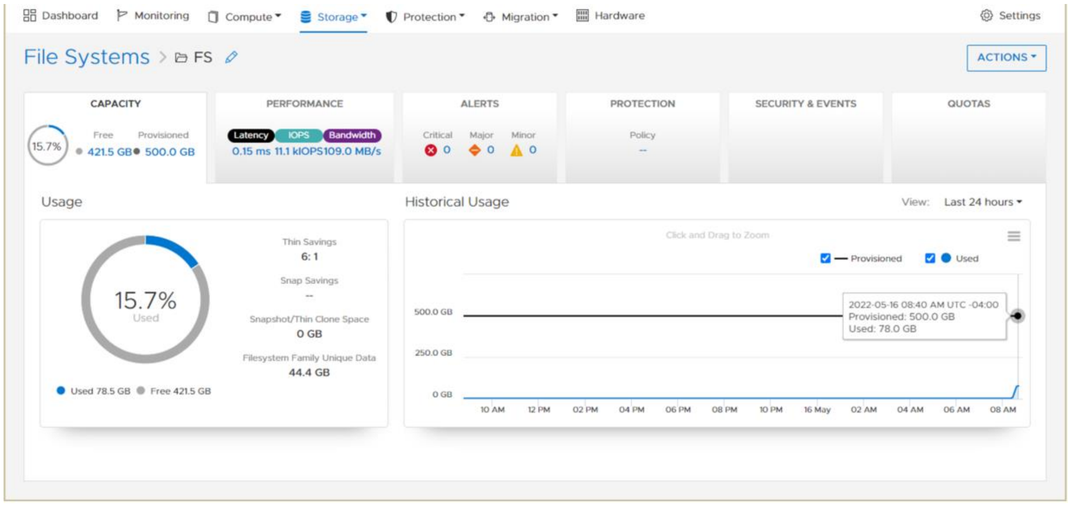
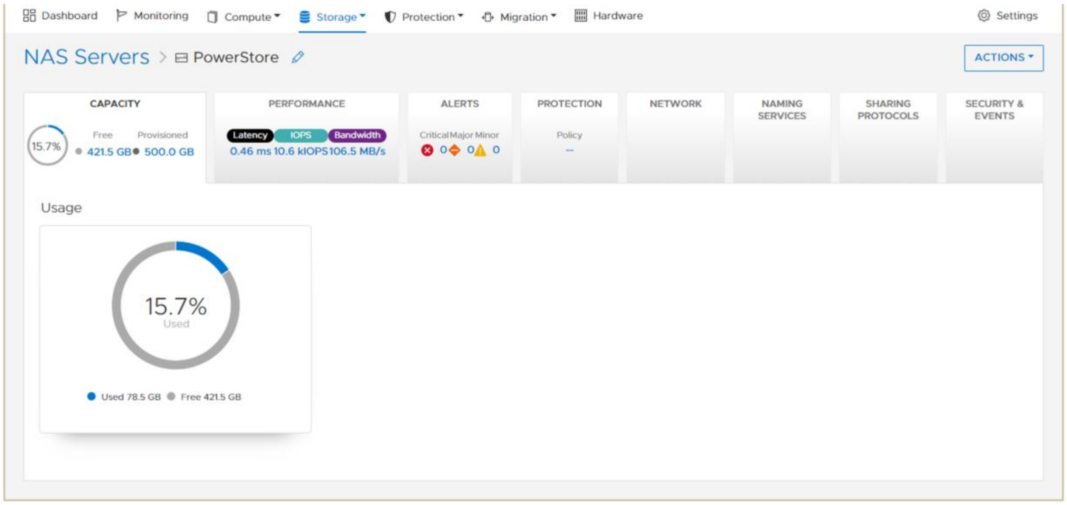


Figure 54. File system capacity metrics

NAS server metrics enable administrators to view aggregated data for all file systems that reside on the NAS server. As shown in Figure 55, the following NAS server capacity metrics are available at a 5-minute granularity:

- Size used
- Size provisioned



NAS Servers > PowerStore

15.7% Free 421.5 GB Provisioned 500.0 GB

0.46 ms 10.6 kIOPS 106.5 MB/s

0 0 0

Policy --

Usage

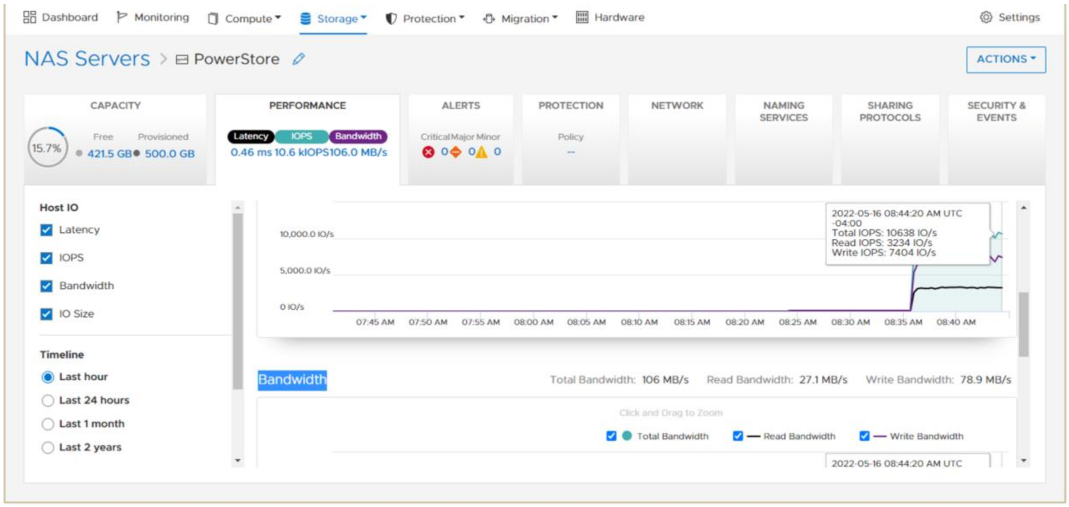
15.7% Used

Used 78.5 GB Free 421.5 GB

Figure 55. NAS server capacity metrics

As shown in Figure 56, the following NAS server performance metrics are available at a 20-second granularity:

- Read, write, and average latency
- Read, write, and average IOPS
- Read, write, and average bandwidth
- Read, write, and average IO size



NAS Servers > PowerStore

15.7% Free 421.5 GB Provisioned 500.0 GB

0.46 ms 10.6 kIOPS 106.0 MB/s

0 0 0

Policy --

Host IO

☑ Latency

☑ IOPS

☑ Bandwidth

☑ IO Size

Timeline

● Last hour

○ Last 24 hours

○ Last 1 month

○ Last 2 years

2022-05-16 08:44:20 AM UTC -04:00
Total IOPS: 10638 IO/s
Read IOPS: 3234 IO/s
Write IOPS: 7404 IO/s

Bandwidth Total Bandwidth: 106 MB/s Read Bandwidth: 27.1 MB/s Write Bandwidth: 78.9 MB/s

☑ Total Bandwidth ☑ Read Bandwidth ☑ Write Bandwidth

2022-05-16 08:44:20 AM UTC

Figure 56. NAS server performance metrics

Migration

Dell Select Datadobi DobiMigrate

Datadobi, a Dell Select partner, offers the migration software DobiMigrate to perform file system migrations to the PowerStore platform. DobiMigrate is compatible with many source storage systems, including Dell storage systems and a set of third-party storage arrays. For more details, see the DobiMigrate support matrix.

DobiMigrate is run on a hypervisor supporting OVA deployment (such as VMware ESXi) or installed on a Red Hat Enterprise Linux or CentOS Linux host through an RPM. It supports NFS, SMB, and basic multiprotocol migration, with host machines known as proxies running DobiMigrate software to handle the data transfer of the migration. Management of migration sessions using DobiMigrate is performed through an intuitive UI that provides status and reporting options through each step of the migration operation.

Figure 57 shows a configuration diagram from the Datadobi document NAS and Object Migration Software for Modern Data Centers.

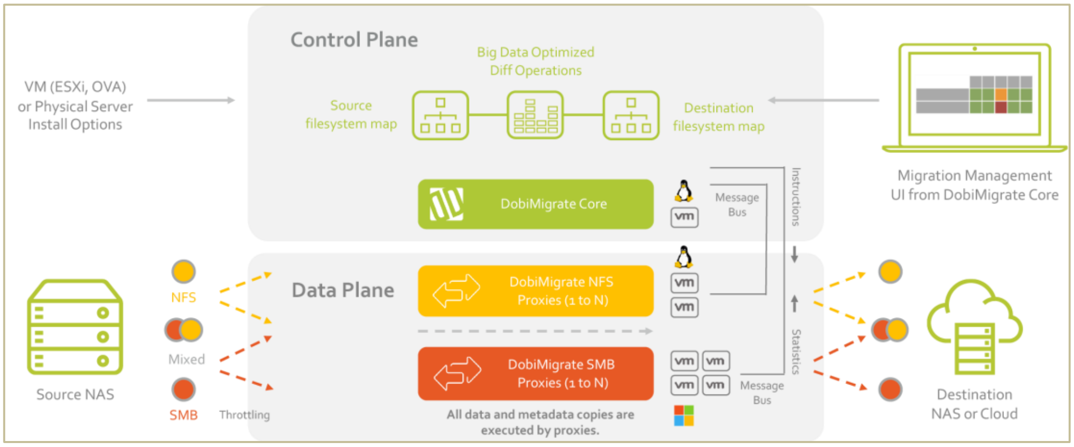


Figure 57. DobiMigrate configuration

More information about Datadobi DobiMigrate can be found on the Datadobi site. Information about Datadobi and its integration points with Dell storage can be found on Dell Support.

Native file import

Starting with PowerStoreOS 3.0, native file import from VNX2 is available. Starting with PowerStoreOS 4.0, native file import from Unity is available. This feature provides the ability to import file storage resources from the source system to PowerStore. The creation, monitoring, and management of the migration session are all handled by PowerStore and have a similar user experience to native block import.

For more information about native file import, see:

- *Dell PowerStore: Migration Technologies white paper*
- *Dell PowerStore: Importing External Storage to PowerStore*

Conclusion

With the native file capabilities available on PowerStore, administrators can easily implement a highly scalable, efficient, performant, and flexible solution that is designed for the modern data center. The rich supporting feature set and mature architecture provide the ability to support a wide array of use cases. Because these file capabilities are integrated, no additional hardware, software, or licenses are required to leverage this functionality. Because all file management, monitoring, and provisioning capabilities are available in the HTML5-based PowerStore Manager, administration is quick and simple. PowerStore file provides great value to environments that leverage block, file, or a mixture of both.

Technical support and resources

The Dell Technologies Storage Info Hub provides expertise that helps to ensure customer success with Dell storage platforms.

Dell.com/powerstoredocs provides detailed documentation about how to install, configure, and manage Dell PowerStore systems.