Dell Fluid File System

Version 6.0 Support Matrix

Notes, cautions, and warnings

(i) **NOTE:** A NOTE indicates important information that helps you make better use of your product.

⚠ **CAUTION: A CAUTION indicates either potential damage to hardware or loss of data and tells you how to avoid the problem.**

⚠ **WARNING: A WARNING indicates a potential for property damage, personal injury, or death.**

Contents

Preface

This document provides information about supported software and hardware configurations as well as usage requirements and recommendations for Dell FluidFS v6.x products.

Revision History

Revision	Date	Changes from previous revision
A	February 2017	Initial release of FluidFS v6.0
B	March 2017	- Added ports 3033 and 9445 - Updated supported NDMP applications - Minimum SC version updated to 6.5.30
C	July 2017	- Level-based backups for EMC Networker - Dell Storage Manager 2016 R3.1
D	December 2017	- Added performance metrics disclaimer - Updated supported NDMP sessions
E	May 2018	- Updated Storage Center Models - Maintenance release 6.0.300135
F	September 2019	Maintenance release 6.0.400016
G	February 2021	Update snapshot metrics
H	June 2021	Maintenance release 6.0.500135
I	June 2021	Corrections to software update path table
J	August 2022	Maintenance release 6.0.600004

Contacting Dell Support

Dell provides several online and telephone-based support and service options. Availability varies by country and product, and some services might not be available in your area.

To contact Dell for sales, technical support, or customer service issues, go to Dell.com/support.

- For customized support, type your system service tag on the support page and click **Submit**.
- For general support, browse the product list on the support page and select your product.
- Have your HSN/SSN number, case number, service tag, or Express Service Code available to validate support coverage.

Introduction

FluidFS software supports FS8600 systems. The performance-related metrics in this document might not always be reachable due to specific combinations of workload and/or dataset characteristics resulting in specific resource utilization.

Glossary

The following table defines the terms that are used in this document:

Table 1. Glossary of Terms

Term	Definition
FluidFS—FluidFS firmware	A special-purpose, Dell-proprietary operating system providing enterprise-class NAS services using SAN storage systems
FluidFS controller	A Dell hardware device capable of running the FluidFS firmware
NAS (FluidFS) appliance	A Dell hardware product containing two FluidFS controllers in a single enclosure
FluidFS system/cluster	Multiple FluidFS controllers who are appropriately connected and configured together into a single functional unit
NAS pool	The Storage Center system LUNs (and their aggregate size) allocated and provisioned to a FluidFS system
NAS volume	File system (single-rooted directory/folder and file hierarchy), defined using FluidFS management functions over a portion of the NAS pool
SMB share	A file system subhierarchy available to SMB clients using the SMB protocol
NFS export	A file system subhierarchy available to NFS clients using the NFS protocol

FluidFS Models and Platforms

The tables in this section list the platforms, features, and configurations supported by the Storage Center systems.

The following table lists the supported platforms and configurations:

Table 2. Supported Platforms and Configurations

Feature	FS8600 FC		FS8600 iSCSI
Client interface and speed	**1 GbE**	**10 GbE**	**10 GbE**
Memory per controller (GB)	24	24 or 48	24 or 48
Client ports – per appliance	8	4	4
SAN storage interface and speed	8 Gb		10 GbE
SAN ports – per appliance	8		4
Ethernet network port type	RJ45	SFP+—Intel modules only	
Storage Center version	6.5.30 or later		
Dell Storage Manager version	2016 R3.1 or later		
Storage Center models	SCv2080, SCv3000, SCv3020, SC40, SC4020, SC5020, SC7020, SC8000, and SC9000		
Maximum NAS appliances—per system	4 appliances—8 controllers		
Maximum Storage Center systems in a NAS pool	8		
Maximum NAS pool size	4 PB		

> ⓘ **NOTE:** Dell recommends running the latest supported Storage Center Operating System version for each connected Storage Center. See the Storage Center documentation for the latest version information.

The following table lists the maximum sizes that are supported in the NAS pool and the global namespace:

Table 3. Maximum NAS Pool Size

Feature	Maximum Size
Per Storage Center	3 PB—depends on Storage Center model
NAS pool capacity	4 PB
FluidFS global namespace	20 PB

> ⓘ **NOTE:**
> - The actual limits per Storage Center system depend on the Storage Center models, configurations, and firmware versions.
> - The total capacity of the NAS pool is 4 PB. The global namespace can reach 20 PB with five FluidFS clusters using redirection folders.

Topics:

- Supported Hardware Upgrades

Supported Hardware Upgrades

The following sections provide information about hardware upgrades.

1 GbE FC to 10 GbE FC Controller Upgrade

FS8600 1 GbE FC configurations can be upgraded to 10 GbE FC by replacing the network interface cards (NICs). Contact Dell Technical Support for details about this upgrade.

24-GB and 48-GB Appliances

The 48-GB FS8600 appliance supports 48-GB controllers only. The 24-GB FS8600 appliance supports 24-GB and 48-GB controllers; however, 48-GB controllers in a 24-GB appliance are limited to 24 GB.

Appliance Replacement

A 24-GB FS8600 appliance can be replaced with a 24-GB or 48-GB appliance.

A 48-GBFS8600 appliance can be replaced with a 48-GB appliance only.

(i) **NOTE:** All appliances in the system must be equal in terms of client connectivity type (1 GbE or 10 GbE), storage connectivity type (FC or iSCSI), and port count.

System Expansion (Adding Appliance)

A 24-GB FS8600 FluidFS system can be expanded by adding either a 24-GB or 48-GB appliance. If the system includes a 48-GB FS8600 appliance, the system can be expanded by adding a 48-GB appliance only.

All appliances in the system must have the same client connectivity type (1 GbE or 10 GbE), storage connectivity type (FC or iSCSI), and port count.

Software Update Paths

The following table lists the supported update paths for FS8600 systems, following the release of version 6.0.600004.

If a better update path becomes available, a version in the **Next Supported Version** column might be removed from the table.

Table 4. Supported Update Paths

Current (Base) Version	Next Supported Version
6.0.500135	6.0.600004
6.0.400016	6.0.500135 or 6.0.600004
#6.0.310011	6.0.400016
6.0.300135	6.0.400016 or 6.0.500135
6.0.140010	6.0.300135 or 6.0.400016
#6.0.120023	6.0.140010
6.0.110054	6.0.300135
#6.0.000039	6.0.140010
6.0.003169	6.0.140010
# 6.0.003162	6.0.110054
5.0.400014	6.0.110054 or 6.0.500135 or 6.0.600004
5.0.300109	5.0.400014 or 6.0.003169
5.0.200081	5.0.400014 or 6.0.003169
5.0.100128	5.0.400014
5.0.002821	5.0.400014
4.0.300098	5.0.400014
4.0.230030	5.0.400014
# 4.0.220058	4.0.230030 or 5.0.400014
4.0.210020	5.0.400014
4.0.200700	4.0.300098
# 4.0.110064 or 4.0.120016	4.0.210020
4.0.100714	4.0.300098
4.0.003214	4.0.300098
# 3.0.941005 or 3.0.942004	4.0.300098
3.0.940120	4.0.300098
3.0.930714	3.0.940120
# 3.0.921013 or 3.0.922022	3.0.930714
3.0.920760	3.0.940120 or 4.0.300098
3.0.911021	3.0.920760 or 3.0.940120
3.0.910390	3.0.920760

Table 4. Supported Update Paths (continued)

Current (Base) Version	Next Supported Version
# 3.0.8700 or 3.0.8701	3.0.920760
3.0.8690	3.0.920760 or 3.0.940120
2.0.7680	3.0.920760 or 3.0.940120
2.0.7630	3.0.920760 or 3.0.940120
2.0.7170	2.0.7680 or 3.0.920760
2.0.7040	2.0.7680
2.0.6940	2.0.7680
2.0.6730	2.0.7680 or 3.0.920760
2.0.6110	2.0.7680
2.0.5110 or 2.0.5120	2.0.7680

\# - Limited availability version. If you are running one of these versions, contact Dell Technical Support for assistance in updating your FluidFS system.

FluidFS File-System Metrics

The following tables list the maximum supported configurations.

ⓘ **NOTE:** The system does not always prevent you from or warn you about exceeding these numbers.

Table 5. FluidFS System Metrics

Feature	Maximum per FluidFS System
NAS volumes	1024
Cloned volumes from a volume	1000
Files and/or directories	10 billion
Files in a directory	1,000,000
Directory depth levels	1000
Open files (per appliance)	250,000 (24-GB appliance) / 800,000 (48-GB appliance)
File size	128 TB
Number of local ACLs	180 per file
Cloned files from single file	1,048,576
Minimum file size for file cloning	4 KB
Minimum file size for data reduction	64 KB
Snapshot creation and expiration rate	Up to 300 per hour*
Number of local users	1000
Number of local groups	1000
Maximum number of ADS entries per file	5000
Maximum number of file-access notification policies	1024

*Snapshot creation and expiration rate

FluidFS supports from 20 to 300 snapshots per hour system-wide (across all NAS Volumes). The supported number of snapshots per hour varies based on the following factors:

- **Load on the system**. When a snapshot is expired on FluidFS, the background reclaimer process crawls the file system to reclaim space to the NAS pool. If UNMAP is enabled, the process also UNMAPs space on the SAN backend. The reclaimer process is resource-intensive, and if there is a large amount of load on the system, fewer snapshots per hour should be used to prevent the snapshot reclaimer from affecting end users.
  - Load on the system from external SMB and NFS clients. If the system is under heavy load to service SMB or NFS clients, it will have less system resources available for snapshot expiry. For systems under heavy load, fewer snapshots per hour should be used.
  - Load on the system from FluidFS Replication or NDMP backups. For systems under heavy load due to replication or NDMP backups, fewer snapshots per hour should be used.
  - The capabilities of the backend SAN. FluidFS clusters that are using a backend SAN with SSDs can support more snapshots per hour than backend SANs using slower spinning disks.
- **Content of the snapshots**. When snapshots are expired, the snapshot reclaimer crawls the file system to locate freed blocks. Depending on the content of the snapshots, the reclaimer could take more or less resources to expire them. The resources that the snapshot reclaimer uses to expire snapshots is based on:
  - Amount of data that is unique to the snapshot that is being expired. Snapshots that contain a larger total amount of data take more resources to expire.

- The makeup of the data. Snapshots which contain many small files result in a more randomized access pattern and take longer to expire and consume more system resources. Snapshots with large files being reclaimed result in a more sequential access pattern and consume less system resources.
- Potential inode imbalance between file system domains. If there are FluidFS File System Domains which contain a disproportionately larger number of inodes than other File System Domains, the snapshot takes longer to expire, as the reclaimer process could be bottlenecked on one File System Domain.

Table 6. FluidFS NAS Volume Metrics

Feature	Maximum per NAS Volume/System
NAS volume size	Available NAS pool (minimum 20 MB)
Snapshots	10,000 / 100,000
Snapshot schedules	1024 / 1024
Redirection folders	1024 / 1024

Client Network Capabilities

The following table lists the supported subnets and VLANs.

Table 7. Supported Subnets and VLANs

Feature	Maximum
Subnets / VLANs	400
VIPs per system	400
Static routes	400
Flat (non-routed) clients	1000

6

Customer Environment Management Protocols

The following tables list the supported levels for identity management servers and interfaces:

Table 8. Identity Management Servers

Functionality	Service Provider	Supported Functionality
Active Directory/Native	Microsoft AD Windows 2008R2, 2012R2, 2016	Directory service Kerberos5 authentication Domain trusts
Active Directory/LDAP	Microsoft AD Windows 2008R2, 2012R2, 2016	Directory service Kerberos5 authentication
Active Directory	Samba	Not supported
OpenLDAP/LDAP	OpenLDAP	Directory service
NIS2	Linux/UNIX	Directory service
NIS3—NIS+	Any	Not supported

ⓘ **NOTE:** Authenticated bind to an LDAP server requires Domain or OU Administrator credentials and must be allowed by the LDAP server.

Table 9. Maximum Identity, DNS, and Time Servers

Functionality	Service Provider	Maximum Servers
Active Directory preferred controller	Microsoft AD Windows 2008R2, 2012R2, 2016	10
LDAP/NIS server	Any Linux or UNIX server	10
DNS server	Any	10
NTP server	Any	10

SMB Support

FluidFS version 6 supports SMB1, SMB2, SMB2.1, SMB3, and SMB3.1 protocols.

ⓘ **NOTE:**
- Lower-than-maximum SMB level connections are also supported.
- Setting ACL from Linux SMB clients is not supported.

Supported SMB Configurations

Each appliance can support a certain number of concurrent (active) SMB connections, even if one of the controllers is not available. The following table lists the supported SMB configurations.

Table 10. Supported SMB Configurations

Feature	Maximum Value
SMB share name	80 bytes[1]
SMB shares	1024 per volume / 1024 per system
Concurrent connections	• 10,000 per 24-GB appliance • 30,000 per 48-GB FS8600 appliance
Concurrent active connections	5000 per appliance
Large MTU (up to 256 KB) connections	• 50 per 24-GB controller • Unlimited per 48-GB FS8600 controller
Maximum file size for branch cache hash calculations	256 MB

[1] Share names are kept as UTF-8 characters, which might, depending on the character set used, consume multiple bytes. Therefore, the actual maximum length depends on the character set used.

NFS Support

FluidFS version 6.x supports NFSv3, NFSv4, and NFSv4.1 protocols only. NFSv2 clients are not supported.

(i) **NOTE:**

- Lower-than-maximum NFS level connections are also supported.
- For NFSv4 clients, only Active Directory authentication is currently supported. See Customer Environment Management Protocols.
- For NFSv4 clients, AUTH_SYS, Krb5, Krb5i, and Krb5p modes are supported.

Table 11. Supported NFS Configurations

Client OS	Maximum per NAS Volume / System
NFS exports	1024 / 1024
NFS ACLs per export	100
NFS connections (per appliance)	16,000

FTP Support

FluidFS version 6.x supports both anonymous FTP configurations (user name=anonymous, password=*email_address*), and authenticated FTP configurations (with either a single landing directory, or a home-folders structure with a directory per authenticated user).

Each appliance can support the following number of concurrent (active) FTP connections, even if one of the nodes or controllers is not available.

Table 12. Supported FTP Configurations

Feature	Maximum Value
Concurrent FTP connections	800 per appliance

10

User and Group Quotas

The following table lists the maximum number of supported quota rules per NAS volume for each system.

Table 13. Supported Quota Configurations

Feature	Maximum per System
Quota rules	1024
Quota usage entries	100,000
Quota directories	30,000

(i) **NOTE:**
- Quotas for Active Directory (AD) and NIS/LDAP users are independent of each other, even if users are mapped automatically or manually. For NAS volumes with mixed security styles, separate quotas should be set for AD and NIS/LDAP users.
- For NAS volumes with NTFS or UNIX style permissions, one unique quota should be set for each user. For mapped users, the usage and limits are applied using the target identity and are shared with the native Windows or UNIX account.
- In general, Dell recommends using the NTFS security style in mixed environments.

FluidFS Replication

Note the following information regarding FluidFS replication:

● Replication can be performed from FluidFS v5.x to FluidFS v6.x. Replication between systems running different major versions should be performed only during a short-term update, and is not recommended as a normal operating state.
● Replication partners can differ in network interface speeds (1 GB or 10 GB) or in memory size (24 GB or 48 GB).

The following table lists replication-compatible systems, assuming they satisfy all other conditions:

Table 14. Supported FluidFS Replication Features

Attribute	Support
Maximum number of replication partners	100
Maximum number of replicated NAS volumes	1024
Maximum number of concurrent replications (rest are queued)	10 outgoing and 100 incoming
Maximum replication schedules (as source)	1024
Maximum number of replication bandwidth limiter policies	100
Single NAS volume to multiple NAS volumes	Up to 10 targets per source
Cascading replication of a NAS volume	Up to a depth of 5

The following table lists the supported FluidFS replication TCP ports. These target-system ports must be accessible through any firewall from the source system.

Table 15. FluidFS Replication TCP Ports

Functionality	Port Numbers
Partnership setup	9445
Management	10560 or 3260 (configured during partnership setup)
Data	

VMware and the FluidFS VAAI Plugin

The FluidFS VAAI plugin supports the following VAAI NAS Primitives and allows offloading them to the underlying FluidFS system:

- **Full File Clone** — Offloads the creation of a virtual disk full clone
- **Fast File Clone (Native Snapshot)** — Offloads the creation of virtual machine snapshots
- **Extended Statistics** — Enables visibility into space usage on FluidFS datastores

The FluidFS VAAI plugin supports ESXi versions 6 and 6.5 (NFS3 only).

ⓘ **NOTE:** The FluidFS VAAI NAS plugin supports single-level native snapshots only.

Integration with Third-Party Products

This section provides information about supported third-party applications:

Topics:

- Anti-virus Applications
- Backup and Restore – NDMP
- File Access Notification (Governance)

Anti-virus Applications

The following table lists the supported anti-virus applications:

Table 16. Anti-virus Application Support

Vendor	Product
Kaspersky	• Anti-Virus 8.0 for Windows Servers Enterprise Edition • Kaspersky Security for Windows Server 10
McAfee	VirusScan Enterprise for Storage 1.1.0
Quest	NetVault 11.x for three-way back up
Symantec	Protection Engine for NAS 7.5, 7.8
TrendMicro	InterScan Web Security Virtual Appliance (IWSVA) 6.x

The following table lists the maximum number of supported anti-virus server configurations:

Table 17. Maximum Anti-virus Server Configurations per System

Feature	Maximum Value per FS8600 System
Anti-virus servers	10

Backup and Restore – NDMP

The following table lists the supported backup and restore applications.

Table 18. Backup and Restore Applications

Application	Supported Version	3-Way NDMP Support
CommVault Simpana	11	Yes
EMC Networker	9	Yes*
Veritas BackupExec	2016	Yes
Veritas NetBackup	7.7	Yes

* Level-based incremental backups are supported from the EMC Networker CLI. Token-based backups are not supported.

Refer to the application documentation for the minimal revision/service pack supporting Dell FluidFS systems.

The following table lists the NDMP agent characteristics. Refer to the application documentation for the minimum revision/service pack supporting Dell FluidFS systems.

Table 19. NDMP Agent Characteristics

Functionality	Supported Range
NDMP version	v2, v3, v4
DMA address type	IPv4 only
DMA servers configured	Up to 10
Concurrent NDMP sessions per controller	Up to 48
DMA user-name length	1–63 bytes (accepts Unicode)
DMA password length	1–32 characters
Maximum number of *include* paths for an NDMP job	32
Maximum number of *exclude* paths for an NDMP job	32

ⓘ **NOTE:** Your environment should allow ICMP (ping) traffic between the FluidFS controllers' private IP addresses (not the access VIPs) and the backup server.

File Access Notification (Governance)

The following table lists the supported governance applications.

Table 20. Governance Applications

Application	Supported Version
Varonis DatAdvantage	6.3

Space Pre-Allocation

The following tables provide an estimation of the pre-allocated (reserved) space for various file-system functions. These calculations can help you estimate disk space requirements and space growth of FluidFS systems.

Table 21. Reserved Space by Function

Allocation per	Reserved space
Cluster	10.4 GB
Appliance	345.5 GB
LUN	4 GB
Data Reduction	0.012% of total space, minimum 16 GB, maximum 256 GB
Total space	0.5%

The amount of reserved space can also be estimated using the following table.

Table 22. Reserved Space by Pool Size

NAS Pool Size	Percentage of Reserved Space
10 TB – 20 TB	2.5% – 4.5%
20 TB – 128 TB	1% – 2.5%
> 128 TB	< 1 %

Services and Ports

FluidFS systems provide and access services through the ports listed in the following tables. Firewall settings should allow communication to and from these ports. Actual ports used depend on the enabled protocols and features. All port numbers are fixed unless specified otherwise.

The services and ports listed in the following tables are accessed by FluidFS systems on the client network.

Table 23. Services Provided by FluidFS

Port Number	Protocol	Function / Service Name
21	TCP and UDP	File Transfer Protocol (FTP/FTPS)
22	TCP	Support Access (SSH)
111	TCP and UDP	RPC portmapper
161	UDP	SNMP agent
162	UDP	SNMP trap
427	TCP and UDP	Server Location Protocol (SLP)
443	TCP	HTTPS for SupportAssist
445	TCP and UDP	SMB
2049 – 2057	TCP and UDP	NFS
4000 – 4007	TCP and UDP	NFS statd
4050 – 4057	TCP and UDP	Network lock manager (NLM)
5001 – 5008	TCP and UDP	NFS mount
5051 – 5058	TCP and UDP	NFS quota
9445	TCP	Replication partnership setup
10000	TCP	Network Data Management Protocol (NDMP)
10560 or 3260	TCP	Replication
13033 and 3033	TCP	Dell Storage Manager communications
44421	TCP	File Transfer Protocol (FTP)
44430 – 44439	TCP	Passive FTP/ FTPS

Table 24. Services Accessed by FluidFS

Port Number	Protocol	Function / Service Name
53	TCP	Domain Name Service (DNS)
88	TCP and UDP	Kerberos
111	TCP and UDP	RPC portmapper
123	UDP	Network Time Protocol (NTP)
135	TCP	Active Directory
138	UDP	NetBIOS datagram service
139	TCP	NetBIOS session service
389	TCP and UDP	Lightweight Directory Access Protocol (LDAP)

Table 24. Services Accessed by FluidFS (continued)

Port Number	Protocol	Function / Service Name
464	TCP and UDP	Kerberos
543	TCP	Kerberos login
544	TCP	Kerberos shell
RPC/portmapper dependent	UDP	Network Information Service (NIS)
636	TCP and UDP	LDAP over TLS/SSL
749	TCP and UDP	Kerberos administration
9445	TCP	Replication partnership setup
1344	TCP	Antivirus – Internet Content Adaptation Protocol (ICAP)
3268	TCP	LDAP global catalog
3269	TCP	LDAP global catalog over TLS/SSL
8443	TCP	Copilot access (reverse tunnel SSH)
10000	TCP	Network Data Management Protocol (NDMP)

Management

This section provides management information for FluidFS systems.

Events

FluidFS can store up to 10 million system and SACL events. The actual amount depends on the amount of storage space configured by the administrator to hold event data.

Multitenancy

FluidFS v6 supports multiple tenants. The following table specifies the limits relating to multitenancy, if the feature is enabled on the system.

Table 25. Multitenancy

Feature	Maximum Supported
Number of tenants per FluidFS system	100
Local users per tenant	100
Local groups per tenant	100
VIPs per subnet per tenant	16 (but not more than 400 VIPs per system)

SNMP

FluidFS supports SNMP version 2c and version 3. It also provides a custom MIB for integration with SNMP-based management frameworks. The interface/MIB provides read access to the following data:

- System and controller status
- CPU utilization
- I/O statistics
- NFS statistics

The maximum number of SNMP recipients per system is 10.