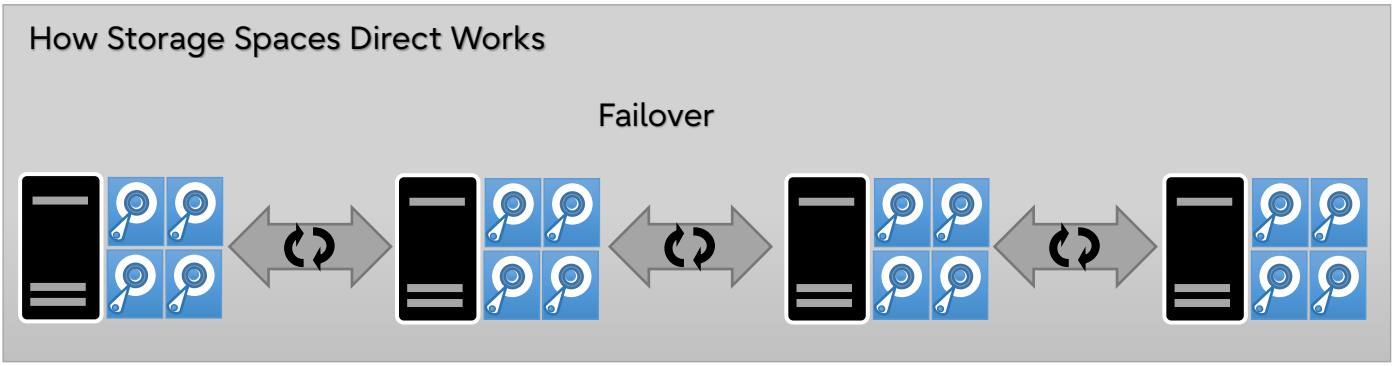
Windows Server 2016
Addendum: Storage Spaces Direct

A supplement to the Windows Server 2016 Datasheet, this document provides information on hardware requirements for and availability of Storage Spaces Direct on Fujitsu PRIMERGY servers.

Storage Spaces Direct (S2D)

Storage Spaces Direct (S2D) is a powerful Windows Server 2016/2019/2022 Datacenter feature that consolidates, through software manipulation, on-premises servers' physical drives into a virtual storage space that can be easily expanded or reduced as needed. For more information about S2D, please access here.



Caution
There are driver considerations when using PCIe SSDs with S2D. Be sure to check "What to Know and What to Do When Using PCIe SSDs".

S2D on Fujitsu PRIMERGY Servers: Overview

Storage Spaces Direct can be implemented on the following Fujitsu PRIMERGY models:

Fujitsu PRIMERGY models	Abbreviated name in this Datasheet
PRIMERGY RX2530 M5, PRIMERGY RX2540 M5	2M5
PRIMERGY RX2530 M4, PRIMERGY RX2540 M4	2M4
PRIMERGY RX2530 M2, PRIMERGY RX2540 M2	2M2

Please note that Storage Spaces Direct is available for Hyper-V or SQL Server workloads only.

The implementation of S2D on the above PRIMERGY models requires a minimum of 9 disk slots, either built in the base unit or added to it via a disk expansion option.

Please apply the latest BIOS and firmware, available for download at https://support.ts.fujitsu.com/IndexDownload.asp, to PRIMERGY servers.

Please also apply the latest drivers and firmware, available for download at https://support.ts.fujitsu.com/IndexDownload.asp, to component parts.

S2D on PRIMERGY RX2530 M5 and RX2540 M5

For RX2530 M5's and RX2540 M5's configuration data, access
https://sp.ts.fujitsu.com/dmsp/Publications/public/cnfgRX2530M5.pdf (RX2530 M5)

https://sp.ts.fujitsu.com/dmsp/Publications/public/cnfgRX2540M5.pdf (RX2540 M5)

Use the following base units and upgrade kits, when S2D is to be implemented on Windows Server 2016.

Order Number	Base Unit / Upgrade Kit	Note
S26361-K1659-V501	PY RX2530 M5 10x 2.5'	—
S26361-K1659-V601	PY RX2530 M5 10x 2.5' SATA / NVMe	AIC PCIe-SSDs cannot be used.
S26361-K1655-V112	PY RX2540 M5 12x 3.5'	PCIe-SSDs can be used if the SFF option is available.
S26361-K1655-V408 and S26361-F2495-L445	PY RX2540 M5 8x 2.5' Upgr. kit from 8 to 16x2.5"	PCIe-SSDs can be used if the SFF option is available.
S26361-K1655-V424	PY RX2540 M5 24x 2.5'	PCIe-SSDs can be used if the SFF option is available.
S26361-K1655-V884	PY RX2540 M5 2.5' Hybrid Flash	PCIe-SSDs must be used. Storage Spaces Direct cannot be implemented when only HDDs/SSDs are used or when HDDs/SSDs are combined with PCIe-SSDs.

S2D on PRIMERGY RX2530 M4 and RX2540 M4

For RX2530 M4's and RX2540 M4's configuration data, access
https://sp.ts.fujitsu.com/dmsp/Publications/public/cnfgRX2530M4.pdf (RX2530 M4)

https://sp.ts.fujitsu.com/dmsp/Publications/public/cnfgRX2540M4.pdf (RX2540 M4)

Use the following base units and upgrade kits, when S2D is to be implemented on Windows Server 2016.

Order Number	Base Unit / Upgrade Kit	Note
S26361-K1592-V501	PY RX2530 M4 10x 2.5"	—
S26361-K1592-V601	PY RX2530 M4 10x 2.5" NVMe	AIC PCIe-SSDs cannot be used.
S26361-K1567-V112	PY RX2540 M4 12x 3.5"	PCIe-SSDs can be used if the SFF option is available.
S26361-K1567-V408 and S26361-F2495-E416	PY RX2540 M4 8x 2.5" and Upgrade kit from 8x to 16x 2.5"	PCIe-SSDs can be used if the SFF option is available.
S26361-K1567-V424	PY RX2540 M4 24x 2.5"	PCIe-SSDs can be used if the SFF option is available.
S26361-K1567-V884	PY RX2540 M4 2.5" Hybrid Flash	PCIe-SSDs must be used. Storage Spaces Direct cannot be implemented when only HDDs/SSDs are used or when HDDs/SSDs are combined with PCIe-SSDs.

S2D on PRIMERGY RX2530 M2 and RX2540 M2

For RX2530 M2's and RX2540 M2's configuration data, access
https://sp.ts.fujitsu.com/dmsp/Publications/public/cnfgRX2530M2.pdf (RX2530 M2)

https://sp.ts.fujitsu.com/dmsp/Publications/public/cnfgRX2540M2.pdf (RX2540 M2)

If S2D is to be implemented on Windows Server 2016, use the following base units and disk expansion options.

Order Number	Base Unit
S26361-K1565-V501	PY RX2530 M2 10x 2.5"
S26361-K1566-V424	PY RX2540 M2 24x 2.5"
S26361-K1566-V112	PY RX2540 M2 12x 3.5"

S2D-Ready Network Cards

For the connection between nodes, please use 10Gbps or higher network card that is supported by Windows Server 2016.

The following network cards are available to use S2D.

Order Number	Product Name	Supported Server for S2D	Driver / Package [a]	Firmware / Package [a]
S26361-F4054-L502	PLAN EP MCX4-LX 25Gb 2p SFP28 LP, FH	2M4, 2M5	>= 1.80.18500.0 / Mellanox driver package (WinOF-2) for Windows 1.80 (or higher)	>= 14.21.1000 / Mellanox mlxup Firmware Bundle for Linux/Windows/ESX FW1x.21.1000_PXE3.5.0305_UEFI14.17.11 (or higher)
S26361-F4054-E2	PLAN EP MCX4-LX 25Gb 2p SFP28 FH			
S26361-F4054-E202	PLAN EP MCX4-LX 25Gb 2p SFP28 LP			
S26361-F4056-L502	PLAN EP QL41212 25Gb 2p SFP28 LP, FH	2M4, 2M5	QL41xxx, QL45611 Windows Driver Installer 20.40.4.4 (or higher)	QL41xxxH Firmware Upgrade utility(Multi Boot Image) 8.40.30 (or higher)
S26361-F4056-E2	PLAN EP QL41212 25Gb 2p SFP28 FH			
S26361-F4056-E202	PLAN EP QL41212 25Gb 2p SFP28 LP			
S26361-F4068-L502	PLAN EP QL41112 2X 10GBASE-T. LP,FH	2M4, 2M5	Same as above	Same as above
S26361-F4068-E2	PLAN EP QL41112 2X 10GBASE-T, FH			
S26361-F4068-E202	PLAN EP QL41112 2X 10GBASE-T, LP			
S26361-F4068-L504	PLAN EP QL41134 4X 10GBASE-T. LP,FH	2M4, 2M5	Same as above	Same as above
S26361-F4068-E4	PLAN EP QL41134 4X 10GBASE-T, FH			

Order Number	Product Name	Supported Server for S2D	Driver / Package [a]	Firmware / Package [a]
S26361-F4068-E204	PLAN EP QL41134 4X 10GBASE-T, LP			
S26361-F4069-L502	PLAN EP QL41132 2X 10G SFP+, LP,FH	2M4, 2M5	Same as above	Same as above
S26361-F4069-E2	PLAN EP QL41132 2X 10G SFP+, FH			
S26361-F4069-E202	PLAN EP QL41132 2X 10G SFP+, LP			
S26361-F4069-L504	PLAN EP QL41134 4X 10G SFP+, LP,FH	2M5	Same as above	Same as above
S26361-F4069-E4	PLAN EP QL41134 4X 10G SFP+, FH			
S26361-F4069-E204	PLAN EP QL41134 4X 10G SFP+, LP			
S26361-F4070-L502	PCNA EP QL41262 2X 25G SFP28, LP,FH	2M4, 2M5	Same as above	Same as above
S26361-F4070-E2	PCNA EP QL41262 2X 25G SFP28, FH			
S26361-F4070-E202	PCNA EP QL41262 2X 25G SFP28, LP			
S26361-F4057-L501	PLAN EP QL45611 100Gb 1p QSFP28 LP, FH	2M4, 2M5	Same as above	Same as above
S26361-F4057-E1	PLAN EP QL45611 100Gb 1p QSFP28 FH			
S26361-F4057-E201	PLAN EP QL45611 100Gb 1p QSFP28 LP			
S26361-F3948-L502	PLAN EP X550-T2 2x 10GBASE-T	2M4, 2M5	2M5: Intel® Ethernet Adapters Connections CD v23.1 (or higher) 2M4: Intel® Ethernet Adapters Connections CD v22.2 (or higher)	NVM Update Package for Intel® X550 Series v2.20 (or higher)
S26361-F3948-E2	PLAN EP X550-T2 2x 10GBASE-T			
S26361-F3948-E202	PLAN EP X550-T2 2x 10GBASE-T LP			

[a] Please apply the latest network card drivers and firmware available for download at: https://support.ts.fujitsu.com/IndexDownload.asp.

S2D-Ready SAS Controller Cards

Use the SAS controller cards, when S2D is to be implemented on Windows Server 2016.

Order Number	Product Name	Supported Server for S2D	Driver / Package [a]	Firmware / Package [a]
S26361-F3842-E2	PSAS CP400i	2M2, 2M4, 2M5	LSI_SAS3 Win2016-Driver WHQL /2.51.24.00 (or higher)	Firmware for PSAS CP400i (ASP for Windows) /13.00.00.00 (or higher)
S26361-F3842-L502	PSAS CP400i FH/LP	2M4, 2M5	LSI_SAS3 Win2016-Driver WHQL /2.51.24.00 (or higher)	Firmware for PSAS CP400i (ASP for Windows) /13.00.00.00 (or higher)
S26361-F5888-E201	PSAS CP 2100-8i LP for MS HCI	2M5	>= 106.190.4.1062 / PSAS CP 2100-8i Windows driver	>= 3.21 / FW of this version or higher is already applied to it at the same time of shipment.
S26361-F5888-E202	PSAS CP2100-8i LP	2M5	>= 1010.6.0.1025 / PSAS CP 2100-8i Windows driver	>= 4.11 / FW of this version or higher is already applied to it at the same time of shipment.
S26361-F5888-L502	PSAS CP2100-8i FH/LP			

[a] Please apply the latest PSAS CP400i drivers and firmware available for download at: https://support.ts.fujitsu.com/IndexDownload.asp.

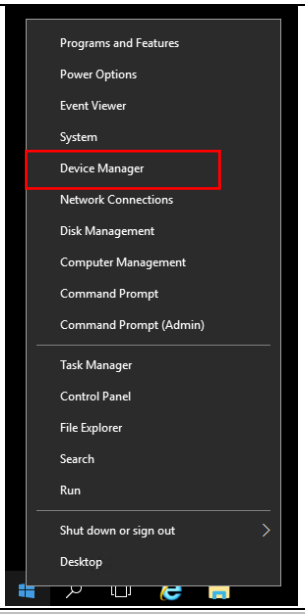
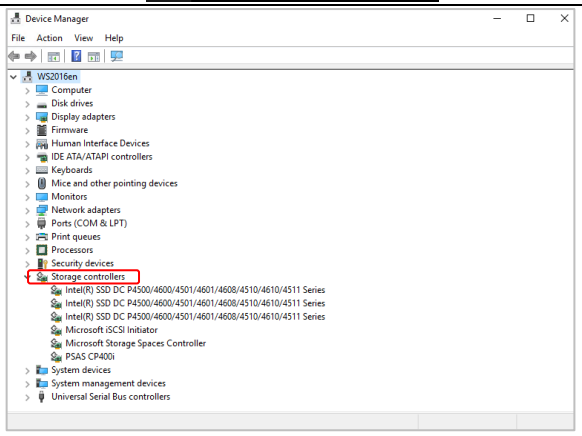
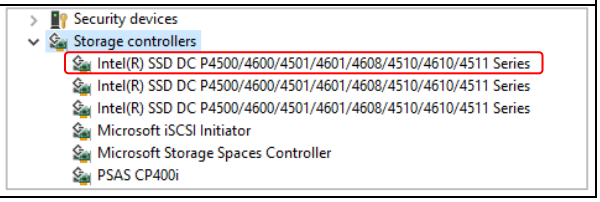
S2D-Ready HDDs/SSDs

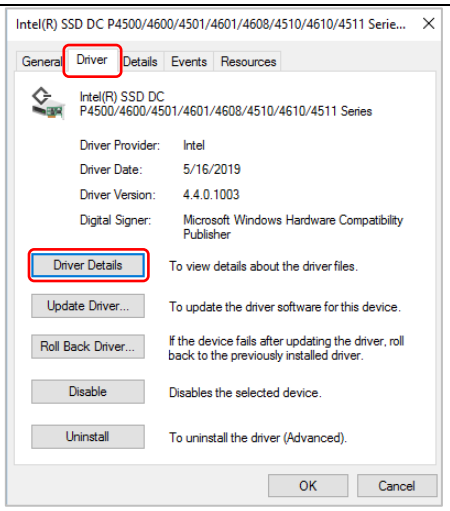
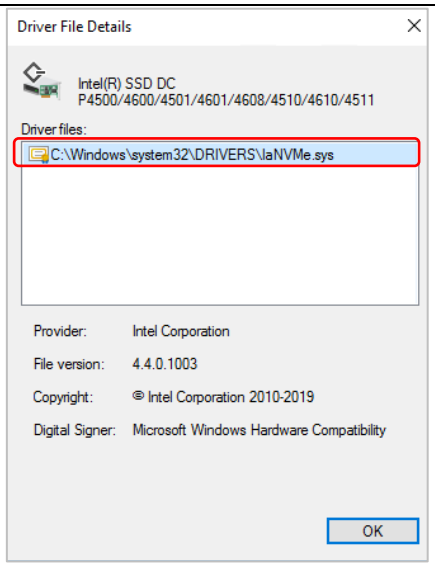
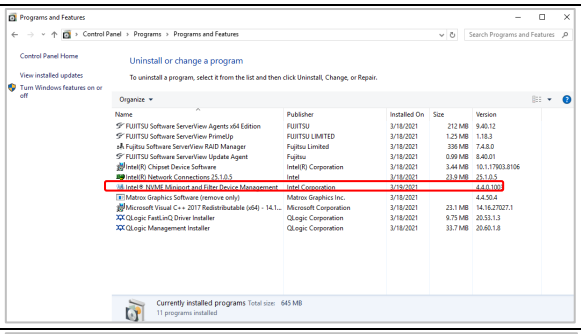
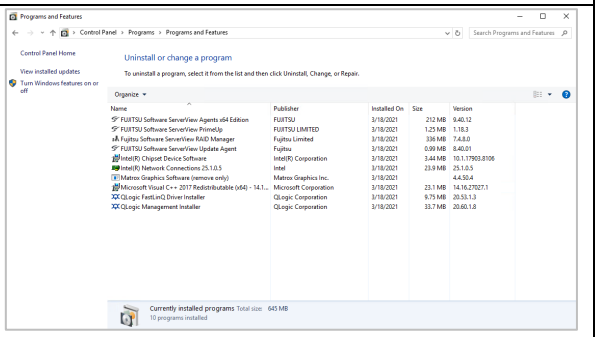
What to Know and What to Do When Using PCIe SSDs

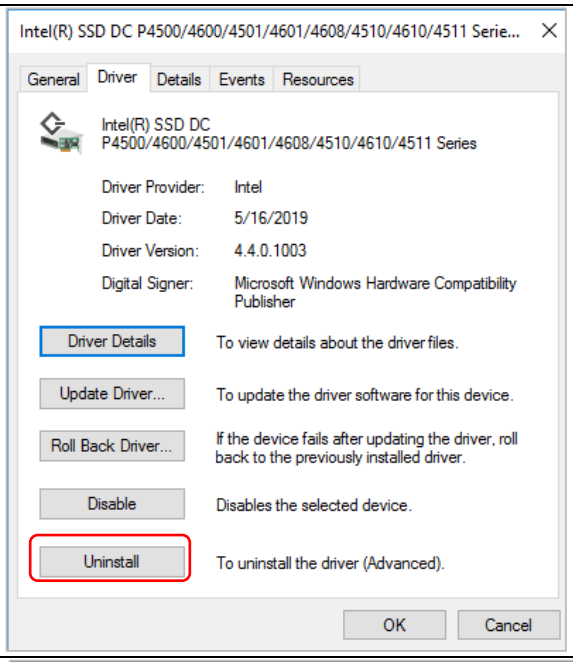
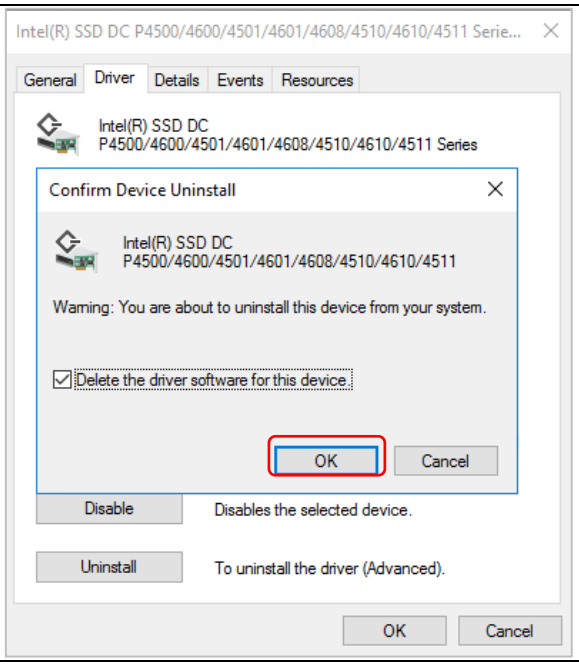
Fujitsu PCIe SSD drivers (IaNVMe.sys) do not support S2D. Therefore, in order to use PCIe SSD with S2D, you need to apply the driver provided by Microsoft (stornvme.sys), not the one provided by Fujitsu (IaNVMe.sys).

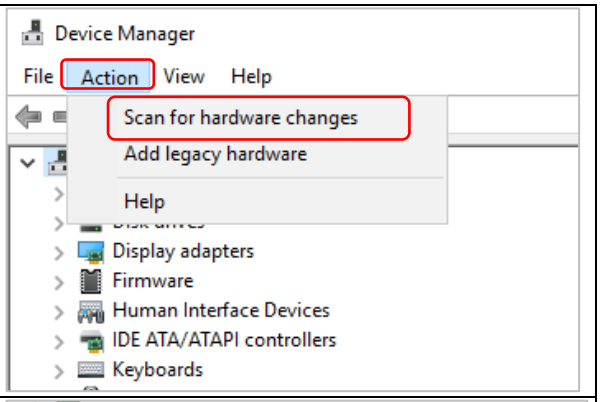
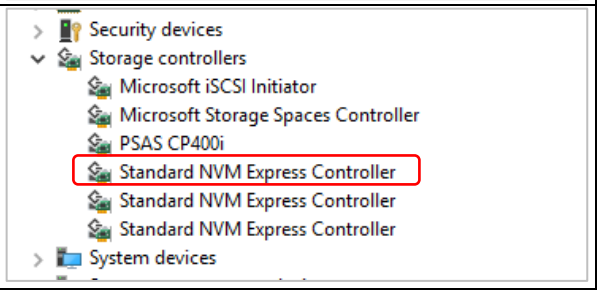
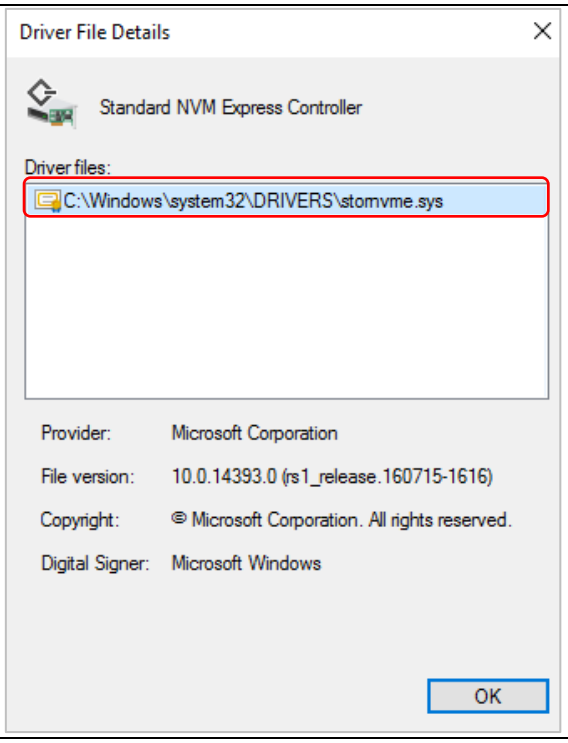
Use the following procedure to determine which driver is applied, and if IaNVMe.sys was applied, change it to stornvme.sys.

IaNVMe.sys applies when Windows Server 2016 is installed using the ServerView Installation Manager.

1	Right-click the [Start] button, and then click the [Device Manager].	
2	The [Device Manager] is displayed. Click the [>] of [Storage controllers] to expand the storage controller.	
3	Double-click the PCIe SSD device (hereinafter abbreviated as "Target Devices") to be used in S2D. In the image on the right, double-click the [Intel(R) SSD DC P 4500/4600/4501/4601/4608/4510/4610/4511 Series].	

4	The target device properties are displayed. Click the [Driver] tab, and then click the [Driver Details].	
5	The [Driver File Details] is displayed. Check the file name of [Driver files]. If the file is named [IaNVMe.sys], change the driver to [stornvme.sys] in the following steps. Click the [OK] to close the [Driver File Details]. *If the file name of [Driver files] is [stornvme.sys] on all target devices, the following steps are unnecessary.	
6	Open the Control Panel. Click the [Programs and Features]. Check to see if the Intel NVME Miniport and Filter Device Management (hereinafter abbreviated as "Driver Tools") is listed. If the driver tool is displayed, go to step 7. If the driver tool is not displayed, go to step 8.	
7	Double-click the driver tool for that device to uninstall it. Verify that the driver tools have been removed and proceed to step 11.	

8	Open the [Device Manager]. Open the target device properties. On the [Driver] tab, click the [Uninstall].	
9	The [Confirm Device Uninstall] is displayed. Put a "☑" in the [Delete the driver software for this device.], and then click the [OK]. *[Delete the driver software for this device.] may not be displayed. If so, click the [OK].	
10	Perform step 8 to 9 for all target devices whose driver file name is not [stornvme.sys]. *If an OS reboot dialog appears, select [No]. Perform an OS reboot after performing a [uninstalling devices] on all affected devices.	

11	Open the [Device Manager]. Click the [Action], and then click [Scan for hardware changes]. Click the [>] of [Storage controllers] in [Device Manager].	
12	Double-click the target device ([Standard NVM Express Controller]).	
13	The target device properties are displayed. Click the [Driver], and then click the [Driver File Details]. The file name of [Driver files] in [Driver File Details] has been changed to [stornvme.sys]. *If the file name of [Driver files] is [IaNVMe.sys], repeat step 8 to 9. Repeat step 11 to 12 until you have verified that the [Driver files] file name is [stornvme.sys] for all target devices.	

Available HDDs and SSDs

The disks are listed in the “System configurator and order information guide” of server can be used as S2D disks except for Self Encrypting Drives.(*1)

The disks that you want to use as cache must meet one of the following conditions.

- DWPD value 3 or more
- DWPD value multiplied by Disk Capacity is over 4TB

There are no conditions to use as capacity.

Windows Server 2016/2019’s online firmware update function is not supported.

(*1):The following disks are being checked.

S26361-F5904-E160 / SSD PCIe4 1.6TB Mixed-Use 2.5' H-P EP

S26361-F5904-E320 / SSD PCIe4 3.2TB Mixed-Use 2.5' H-P EP

S26361-F5904-E640 / SSD PCIe4 6.4TB Mixed-Use 2.5' H-P EP

S26361-F5904-E128 / SSD PCIe4 12.8TB Mixed-Use 2.5' H-P EP

S26361-F5905-E960 / SSD PCIe4 960GB Read-Int. 2.5' H-P EP

S26361-F5905-E192 / SSD PCIe4 1.92TB Read-Int. 2.5' H-P EP

S26361-F5905-E384 / SSD PCIe4 3.84TB Read-Int. 2.5' H-P EP

S26361-F5905-E768 / SSD PCIe4 7.68TB Read-Int. 2.5' H-P EP

S26361-F5905-E153 / SSD PCIe4 15.36TB Read-Int. 2.5' H-P EP

Technical Notes on Storage Spaces Direct (S2D)

Storage Spaces Direct makes it possible to combine multiple physical disks of different kinds into what is called a "storage pool" - a scalable, virtual storage space. S2D automatically detects what kind of disk is available and determines whether a given disk is to be used as a cache or a capacity disk; disks of the highest performance will be used as cache disks, and the remaining disks are to be used as capacity disks. To be included in a storage pool, a server must contain at least 2 cache disks and at least 4 capacity disks.

PCIe SSDs, SSDs, and HDDs can be combined in many different ways to form storage pools. Table 1 shows six such patterns and refers to the storage pools thus-formed as Storage Pool A to F.

Table 1. How PCIe SSDs, SSDs, and HDDs Can Be Combined to Form Storage Pools

Storage Pool	PCIe SSD	SSD	HDD
A	—	≥2 cache disks	≥4 capacity disks
B	≥2 cache disks	—	≥4 capacity disks
C	≥2 cache disks	≥4 capacity disks	—
D	≥2 cache disks	≥4 capacity disks (can be combined with HDDs)	≥4 capacity disks (can be combined with SSDs)
E	—	≥4 capacity disks	—
F	≥4 capacity disks	—	—

Some SSDs are meant to be used as cache disks, while other SSDs as capacity disks. HDDs can be used only as capacity disks. The lists of 2.5-inch and 3.5-inch disks in the previous section classify HDDs, SSDs, and PCIe SSDs according to the purpose for which they are to be used in a storage pool (i.e., whether to be used as cache or capacity disks). Those disks can be grouped into five categories. Table 2 summarizes them and refers to them as Disk Category 1 to 5. The numbers in the aforementioned disk lists refer to the Disk Categories.

Table 2. Disk Category and Purpose

Disk Category	Purpose
1	PCIe SSDs (for cache and capacity)
2	PCIe SSDs (for capacity only)
3	SSDs (for cache and capacity)
4	SSDs (for capacity only)
5	HDDs (for capacity only)

Table 3 shows which Disk Category's disks (see Table 2) are to be used for Storage Pool A to F (see Table 1). For example, Storage Pool A can consist of cache disks from Disk Category 3 and capacity disks from Disk Category 5. Please refer to your PRIMERGY server's technical specifications to determine which disks can be used with your system.

Table 3. Storage Pool by Disk Category

Storage Pool	Disk Category	
	For Cache	For Capacity
A	3	5
B	1	5
C	1	3 or 4
D	1	3 and 5, 4 and 5
E	—	3 or 4 (3 and 4 can be combined)
F	—	1 or 2

Version history

Version	Date	Document changes
1.0	October 10, 2017	Initial Release
2.0	June 29, 2021	S2D-Ready Network Cards' order numbers added
3.0	October 12, 2021	Available HDDs and SSDs information updated
4.0	November 30, 2021	Available HDDs and SSDs information updated
5.0	April 22, 2022	S2D-Ready SAS Controller Card CP2100-8i added

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2022-4-22 WW EN