PAC STORAGE

PAC Storage PS 3000/4000 G3

Version: 1.2 Updated: Jan. 2023

Summary

PAC Storage PS Family is a unified storage which can provide excellent performance in SAN or NAS. PAC Storage PS 3000/4000 G3 is the next generation of PS 3000/4000 Gen2. The main difference is the CPU platform. The CPU of PS 3000/4000 G3 is upgraded which can make up to 40% improvement on file-level performance.

Contents

Applicable Models

For your reference, below are the applicable models in this performance report:

Series	Applicable Models
PS 3000 G3	PS 3012 **G3** PS 3016 **G3** PS 3024 **G3** PS 3040 **G3** PS 3060 **G3** PS 3040C **G3** GS3060C **G3 (C: U.2 SSD cache in the chassis)**
PS 4000 G3	PS 4012 **G3** PS 4016 **G3** PS 4024 **G3** PS 4040 **G3** PS 4060 **G3**

Audience

This performance report is intended for the PAC Storage partners, customers, and employees who want to deploy PAC Storage PS 3000/4000 G3 as their storage.

Terminology

- **PS 3000/4000 G3** – A shorten name for PAC Storage PS 3000/4000 G3 series.
- **EonOne** – Management software for PAC Storage PS Family.
- **File-level** – PAC Storage PS Family is an unified storage, which can be configured as SAN or NAS. If you are configuring PS as NAS, the configurations should be set in file-level, including volume and network.
- **Block-level** – If you are configuring PS as SAN, the configurations should be set in block-level, including volume and network.
- **File system protocol** – With file system, users can share files via network. File system has plenty of protocols, such as CIFS/SMB, NFS and FTP.
- **Shared folder** – A location for shared storage access via file system protocol.
- **Better performance for block data access** – Assign more CPU cores for block-level IO. Referred as block mode
- **Better performance for file access service** – Assign more CPU cores for file-level IO. Referred as file mode

Performance Results

The following section demonstrates the highest performance of each system. Please also check the configuration in System Configuration section to see how we run the tests. There are also some descriptions of the results in the Conclusion section.

***Color of Performance optimization value:**

Better performance for block data access (Referred as block mode in this report) / Better performance for file access service (Referred as file mode in this report)

7.2K NL-SAS HDD Drive

Block-Level Section

- **IOPS with small block size**

Host Type: FC_16G		Block Level				
		Profile	End-to-End			All Cache Hit
		IO Behavior	Random			Random
		Size	4KB	8KB	64KB	4KB
PS 3000C* G3 FW: 1.64D.07 Block mode	RAID 5	Read (IOPS)	638,674	638,662	88,093	-
		Write (IOPS)	26,844	19,087	8,571	-
PS 4000 G3 FW: 1.64A.12 Block mode	RAID 5	Read (IOPS)	14,289	14,296	13,680	1,601,852
		Write (IOPS)	9,237	8,597	6,427	980,911

*C: U.2 SSD cache in the chassis

Host Type: iSCSI_25G		Block Level				
		Profile	End-to-End			All Cache Hit
		IO Behavior	Random			Random
		Size	4KB	4KB	64KB	4KB
PS 3000 G3 FW: 1.64A.12 Block mode	RAID 5	Read (IOPS)	12,472	12,433	11,984	969,302
		Write (IOPS)	8,754	8,725	6,496	779,981
PS 4000 G3 FW: 1.64A.12 Block mode	RAID 5	Read (IOPS)	12,515	12,513	12,069	872,339
		Write (IOPS)	8,720	9,216	6,216	935,641

Throughput with large block size

Host Type: FC_16G		Block Level			
		Profile	End-to-End		All Cache Hit
		IO Behavior	Sequential		Sequential
		Size	64KB	1MB	1MB
PS 3000 G3 FW: 1.64A.12 Block mode	RAID 5	Read (MB/s)	16,493	16,522	25,147
		Write (MB/s)	9,864	10,638	18,301
PS 4000 G3 FW: 1.64A.12 Block mode	RAID 5	Read (MB/s)	16,491	16,504	25,147
		Write (MB/s)	9,002	9,198	18,322

Host Type: iSCSI_25G		Block Level			
		Profile	End-to-End		All Cache Hit
		IO Behavior	Sequential		Sequential
		Size	64KB	1MB	1MB
PS 3000 G3 FW: 1.64A.12 Block mode	RAID 5	Read (MB/s)	16,403	16,525	22,898
		Write (MB/s)	6,994	7,290	8,163
PS 4000 G3 FW: 1.64A.12 Block mode	RAID 5	Read (MB/s)	16.451	16.497	23,208
		Write (MB/s)	7,202	7,453	8,114

Applications

Host Type: FC_16G		Block Level			
		Profile	End-to-End		
		Application	Database R/W = 70%/30%		VDI R/W = 20%/80%
		Size	4KB	8KB	4KB
PS 3000 G3 FW: 1.64D.05 Block mode	RAID 5	Read (IOPS)	11,937	11,846	8,660
PS 3000C* G3 FW: 1.64D.07 Block mode	RAID 5	Read (IOPS)	43,434	44,352	21,966
PS 4000 G3 FW: 1.64A.16 Block mode	RAID 5	Read (IOPS)	11,877	11,897	8,029

*C: U.2 SSD cache in the chassis

Host Type: iSCSI_25G		Block Level			
		Profile	End-to-End		
		Application	Database R/W = 70%/30%		VDI R/W = 20%/80%
		Size	4KB	8KB	4KB
PS 3000 G3 FW: 1.64A.12 Block mode	RAID 5	Read (IOPS)	11,225	11,241	8,493
PS 4000 G3 FW: 1.64A.12 Block mode	RAID 5	Read (IOPS)	11,719	11,196	8,406

File-Level Section

Host Type: Ethernet_25G		File Level- CIFS (Vdbench)			
	IO Type	Sequential (MBPS)		Random (IOPS)	
RAID 5	Size	1MB	512KB	4KB	Database 8KB (R/W: 70%/30%)
PS 3000 G3 FW: 1.64A.21 File mode	Read	13,100	13,145	36,632	3,566
	Write	4,107	3,818	23,079	
PS 4000 G3 FW: 1.64A.21 File mode	Read	13,507	13,510	23,103	2,532
	Write	5,552	5,175	23,069	

*C: U.2 SSD cache in the chassis

Host Type: Ethernet_25G		File Level- NFS (Vdbench)			
	IO Type	Sequential (MBPS)		Random (IOPS)	
RAID 5	Size	1MB	512KB	4KB	Database 8KB (R/W: 70%/30%)
PS 3000 G3 FW: 1.64A.21 File mode	Read	12,014	12,271	14,053	9,823
	Write	4,098	3,813	21,664	
PS 4000 G3 FW: 1.64A.21 File mode	Read	13,666	13,702	16,460	10,412
	Write	5,380	5,076	22,408	

SAS SSD Drive

Block-Level Section

- **IOPS with small block size**

Host Type: FC_16G		Block Level				
		Profile	End-to-End			All Cache Hit
		IO Behavior	Random			Random
		Size	4KB	8KB	64KB	4KB
PS 3000 G3 FW: 1.64A.15 Block mode	RAID 5	Read (IOPS)	896,615	872,248	238,189	1,612,174
		Write (IOPS)	177,453	176,967	56,469	771,679
PS 4000 G3 FW: 1.64A.15 Block mode	RAID 5	Read (IOPS)	1,067,501	1,011,030	234,392	1,629,176
		Write (IOPS)	220,682	217,266	63,753	968,042

- **Throughput with large block size**

Host Type: FC_16G		Block Level			
		Profile	End-to-End		All Cache Hit
		IO Behavior	Sequential		Sequential
		Size	64KB	1MB	1MB
PS 3000 G3 FW: 1.64A.15 Block mode	RAID 5	Read (MB/s)	15,841	15,790	25,147
		Write (MB/s)	9,479	10,353	18,283
PS 4000 G3 FW: 1.64A.15 Block mode	RAID 5	Read (MB/s)	15,823	15,780	25,147
		Write (MB/s)	12,202	12,763	18,325

Applications

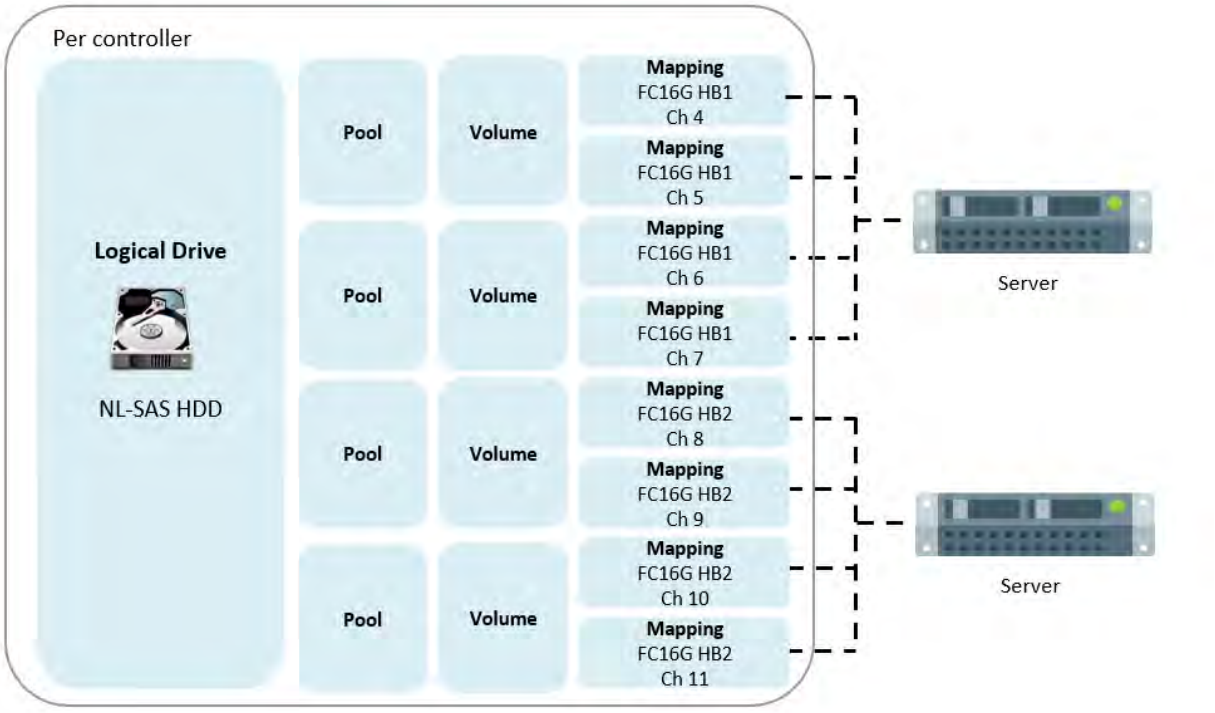
Host Type: FC_16G		Block Level			
		Profile	End-to-End		
		Application	Database R/W = 70%/30%		VDI R/W = 20%/80%
		Size	4KB	8KB	4KB
PS 3000 G3 FW: 1.64A.15 Block mode	RAID 5	Read (IOPS)	361,253	339,198	203,998
PS 4000 G3 FW: 1.64A.15 Block mode	RAID 5	Read (IOPS)	459,637	433,558	225,349

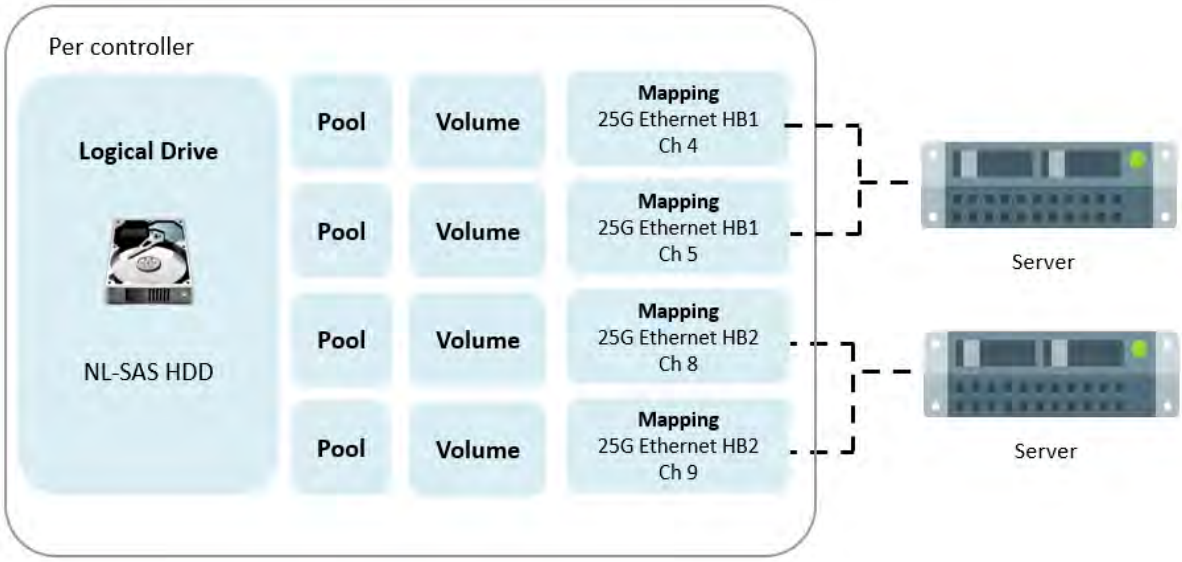
Topology

This section illustrated the principle of the network topology and storage configuration. Please refer to topology section and the system configuration section to get the best performance from PAC Storage PS family. **Note**: In order to leverage the advantage of multi-thread, please create multiple shared folders to run the file-level tests.

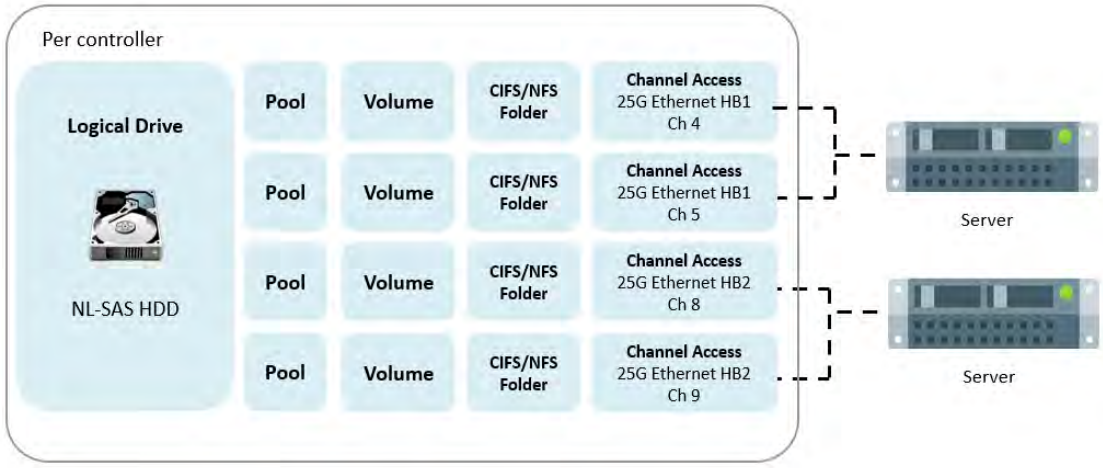
7.2K NL-SAS HDD Drive

- **Block-Level**



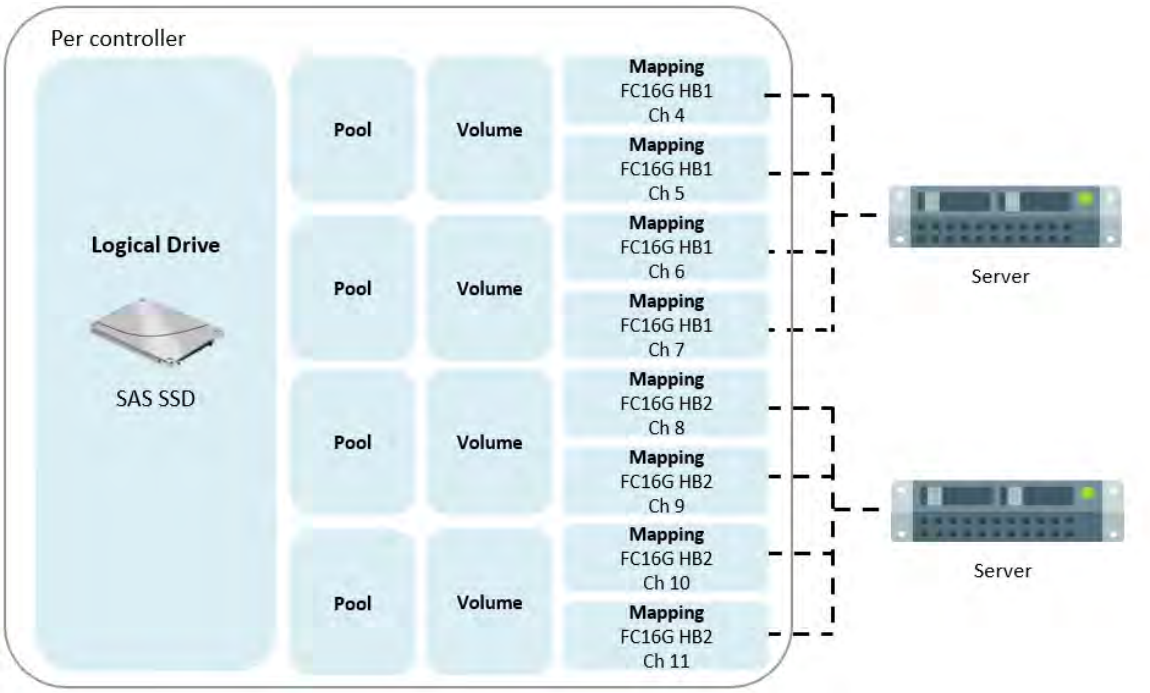

Per controller
Logical Drive
NL-SAS HDD
Pool
Volume
Mapping
25G Ethernet HB1
Ch 4
Pool
Volume
Mapping
25G Ethernet HB1
Ch 5
Pool
Volume
Mapping
25G Ethernet HB2
Ch 8
Pool
Volume
Mapping
25G Ethernet HB2
Ch 9
Server
Server

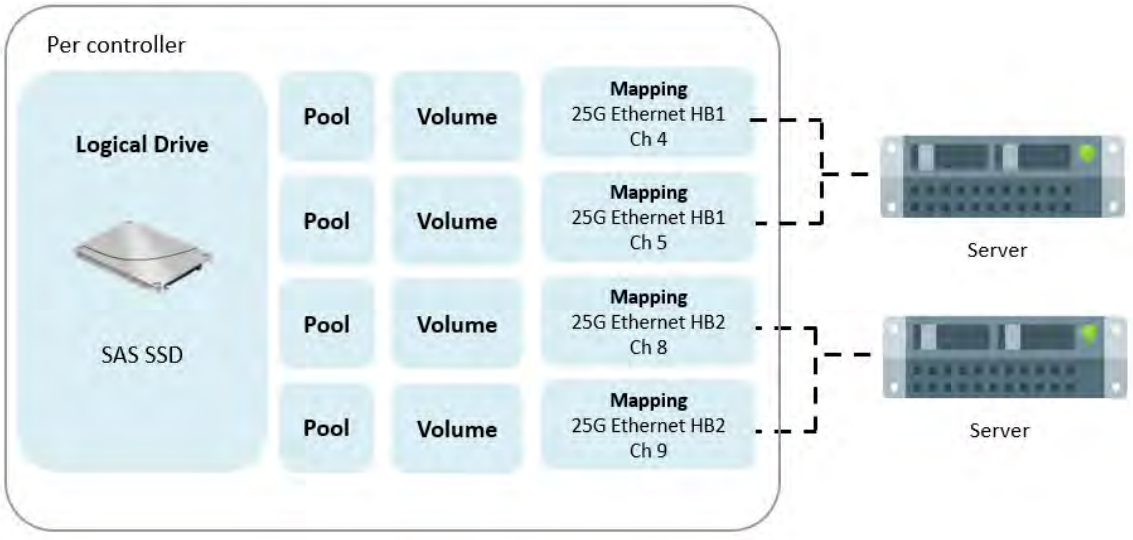
- **File-Level**


Per controller
Logical Drive
NL-SAS HDD
Pool
Volume
CIFS/NFS
Folder
Channel Access
25G Ethernet HB1
Ch 4
Pool
Volume
CIFS/NFS
Folder
Channel Access
25G Ethernet HB1
Ch 5
Pool
Volume
CIFS/NFS
Folder
Channel Access
25G Ethernet HB2
Ch 8
Pool
Volume
CIFS/NFS
Folder
Channel Access
25G Ethernet HB2
Ch 9
Server
Server

SAS SSD Drive

- **Block-Level**





Note: The diagrams above are just for your references. If you need detailed number of channels, please refer to below forms.

Block-level	Model	# of Host Board per controller	# of Channel per controller
FC 16G	PS 3000 G3	2	8
	PS 4000 G3	2	8
iSCSI 25G	PS 3000 G3	2	4
	PS 4000 G3	2	4
File-level	**Model**	**# of Host Board per controller**	**# of Channel per controller**
Ethernet 25G	PS 3000 G3	2	4
	PS 4000 G3	2	4

System Configurations

Storage Configuration Profile

The following table shows the configuration adopted from our PS best practice with a storage pool and a shared folder. To provide a single namespace sharing solution, we configured the PS dual controller models with an active-standby configuration.

As a tradeoff between usable capacity and failure tolerance, we recommend to build the LD within 15 drives.

- **Block-Level SSD**

Model	# of Drive	# of LD	# of Pool	# Volume	# of Client
PS 3000 G3	24	2	2	8	4
PS 4000 G3	24	2	2	8	4

- **Block-Level HDD**

Model	# of Drive	# of LD	# of Pool	# Volume	# of Client
PS 3000 G3	92	8	8	8	4
PS 3000T G3	92	8	8	8	4
PS 3000TC G3	92	8	8	8	4
PS 4000 G3	92	8	8	8	4

- **File-Level HDD**

Model	# of Drive	# of LD	# of Pool	# Volume	# of Folder	# of Client
PS 3000 G3	92	8	8	8	8	4
PS 3000T G3	92	8	8	8	8	4
PS 3000TC G3	92	8	8	8	8	4
PS 4000 G3	92	8	8	8	8	4

Storage System Settings

We use the following parameters to optimize the media workload, which differs from the PS default settings. For detail parameter settings on EonOne, please refer to EonOne software manual.

RAM (per system)	48GB
RAID Level	5
Stripe size	256K
Read-ahead for NAS file transfer	2M
Maximum Tag Count	64
Jumbo Frame	9K
Keep connected with the storage system	Disable
AV Optimization	Disable
Periodic SAF-TE and SES Device Check Time	Disable
Verification on Normal Drive Writes	Disable
Verification on LD Rebuild Writes	Disable
Max Drive Response Timeout	Enable, 160ms
Drive Access Delay Time	No Delay

Client Workstation Information

The following table shows the specification of the client workstation we used for the performance test. To ensure optimal system performance, we recommend that you deploy a solution with better specifications, especially PCIe lanes and CPU.

M/B	Super Micro X9SRL-F
CPU	Intel® Xeon® CPU E5-1620 v2 @ 3.70GHz (3.70GHz)
RAM	DDR III 1866 8G*4 (32.0GB)
PCI	2 PCI-E 3.0 x8, 2 PCI-E 3.0 x8 (in x16), 2 PCI-E 3.0 x4 (in x8), 1 PCI-E 2.0 x4 (in x8)
System Drive	SATA HITACHI 500G (HDS725050KLA360)
OS. 1	Microsoft Windows Server 2016 (HP)
OS. 2	macOS Mojave 10.14.6
GPU card (for Windows Client)	NVIDIA Quadro M6000 12G
HBA card	QLogic FastLinQ QL41212H 25GbE Adapter (VBD Client) Emulex LPe16002B-M6 PCIe 2-port 16Gb Fibre Channel Adapter (QueueDepth:254)
MPIO	OS native
Power Option	High Performance

Benchmark Tool Settings

Benchmark Tool	**Vdbench**	
I/O setting	Threads: CIFS	Sequential 10, Random 64 (HDD unable to accept high threads)
	Ramp Up Time	20 sec
	Run Time	120 sec

Conclusion

- **PS 3000/4000 G3 performance enhancement**

		GS 3000 Gen2	PS 4000 Gen2	PS 3000 G3	PS 4000 G3
Block-level IOPS (Read)		900K		1000K	
Block-level Throughput (Read/Write MB/s)		11,000/6,700	11,000/7,000	15,000/10,000	15,000/12,000
File-level Throughput (Read/Write MB/s)		8,300/3,800	9,900/5,500	13,000/4,000	13,000/5,500
Performance Enhancement (Block-level)	**Read**			**36%**	**36%**
	Write			**49%**	**71%**
Performance Enhancement (File-level)	**Read**			**56%**	**31%**
	Write			**8%**	**0%**

- **Why is the performance enhancement not on file-level write?**

  PS G3 series is aimed as HDD storage solution for providing balanced performance and cost. Therefore, this test result of file-level uses NL-SAS HDD, and the previous PS Gen2 uses SAS SSD for the test result. As SSD has better performance than HDD, even though, the performance of PS G3 with HDD is still better than PS Gen2 with SSD in general.

  If users are looking for all-flash solution, please refer to PAC Storage PS All-Flash U.2 NVMe Series.

- **Block mode or File mode?**

  What if users intend to configure PS 3000/4000 G3 as SAN and NAS simultaneously? Compared to SAN, NAS needs to handle multiple IO requests from multiple clients, and this will need to consume more CPU resources. To conclude this, please enable file mode when you are configuring PS 3000/4000 G3 as SAN and NAS at the same time.

Legal Information

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PAC Storage may from time to time modify, update or upgrade the software, firmware or any accompanying user documentation without any prior notice. PAC Storage will provide access to these new software, firmware, or documentation releases from certain download sections of our website or through our service partners. Customer will be responsible for maintaining updated version of the software, firmware, or other documentation by downloading or obtaining from PAC Storage, and installing designated updated code, including but not limited to firmware, microcode, basic input/out system code, utility programs, device drivers, and diagnostics delivered with PAC Storage product.
Before installing any software, applications or components provided by a third party, customer should ensure that they are compatible and interoperable with PAC Storage product by checking in advance with PAC Storage. Customer is solely responsible for ensuring the compatibility and interoperability of the third party's products with PAC Storage product.

Customer is further solely responsible for ensuring its systems, software, and data are adequately backed up as a precaution against possible failures, alternation, or loss. For any questions of hardware/ software compatibility, and the update/ upgrade code, customer should contact PAC Storage sales representative or technical support for assistance.

To the extent permitted by applicable laws, PAC Storage will NOT be responsible for any interoperability or compatibility issues that may arise when (1) products, software, or options not certified and supported by PAC Storage are used; (2) configurations not certified and supported by PAC Storage are used; (3) parts intended for one system are installed in another system of different make or model.