



Performance Report

PAC Storage GS 3000/4000 Gen2

Version: 2.7

Updated: August 2020

Summary

PAC Storage PS Family is a unified storage which can provide excellent performance in SAN or NAS. PAC Storage PS 3000/4000 Gen2 is the next generation of PS 3000/4000. The main difference is the CPU platform. The CPU of PS 3000/4000 Gen2 is upgraded which can make up to 60% improvement on file-level performance.

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Applicable Models

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

Series	Applicable Models
PS 3000 Gen2	PS 3012 Gen2 PS 3025B Gen2 PS 3016 Gen2 PS 3024 Gen2 PS 3060 Gen2 PSa 3025 Gen2 (Only for SSD performance)
PS 4000 Gen2	PS 4012 Gen2 PS 4025B Gen2 PS 4016 Gen2 PS 4024 Gen2 PS 4060 Gen2 PSa 4025 Gen2 (Only for SSD performance)

***For PSa Family performance, please refer to the SSD performance of PS Family.**

Audience

This performance report is intended for the Infortrend partners, customers, and employees who want to deploy PAC Storage GS 3000/4000 Gen2 as their storage.

Terminology

- **GS 3000/4000 Gen2** – PAC Storage shorten name for PAC Storage PS 3000/4000 Gen2 series.
- **EonOne** – Management software for PAC Storage GS/GSa/GSc/GSe/GSe Pro/GSi Family.
- **File-level** – PAC Storage GS Family is an unified storage, which can be configured as SAN or NAS. If you are configuring GS as NAS, the configurations should be set in file-level, including volume and network.
- **Block-level** – If you are configuring GS 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** in the rest of this report.
- **Better performance for file access service** – Assign more CPU cores for file-level IO. Referred as **file mode** in the rest of this report.

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)

SAS SSD Drive

Block-Level Section

● IOPS with small block size

Host Type: FC_16Gb/s		Block Level				
		Profile	End-to-End			All Cache Hit*
		IO Behavior	Random			Sequential
		Size	4KB	8KB	64KB	512B
PS 3000 Gen2 FW: 1.44D.01 Block mode	RAID 5	Read (IOPS)	818,709	781,142	176,939	778,396
		Write (IOPS)	131,132	127,283	31,101	503,313
PS 4000 Gen2 FW: 1.44D.02 Block mode	RAID 5	Read (IOPS)	861,449	835,050	169,780	1,129,736
		Write (IOPS)	133,181	130,829	31,624	608,491

Host Type: FC_32Gb/s		Block Level				
		Profile	End-to-End			All Cache Hit*
		IO Behavior	Random			Sequential
		Size	4KB	8KB	64KB	512B
PS 3000 Gen2	RAID 5	Read (IOPS)	901,952	878,242	190,225	1,247,003

FW: 1.44D.02 Block mode		Write (IOPS)	133,798	116,982	29,715	-
PS 4000 Gen2 FW: 1.44D.02 Block mode	RAID 5	Read (IOPS)	869,819	846,914	190,257	1,260,409
		Write (IOPS)	139,189	118,835	30,792	611,312

Host Type: iSCSI_25Gb/s		Block Level				
		Profile	End-to-End			All Cache Hit*
		IO Behavior	Random			Sequential
		Size	4KB	8KB	64KB	512B
PS 3000 Gen2 FW: 1.45G.05 Block mode	RAID 5	Read (IOPS)	411,484	420,392	112,876	276,604*
		Write (IOPS)	135,035	130,170	27,116	352,350*
PS 4000 Gen2 FW: 1.44G.02 Block mode	RAID 5	Read (IOPS)	690,467	695,526	181,591	867,577
		Write (IOPS)	138,656	134,911	30,997	604,975

*We mapped one volume to multiple servers to ensure getting the maximum all cache hit performance value. This mapping is not the same as regular performance test.

● Throughput with large block size

Host Type: FC_16Gb/s		Block Level				
		Profile	End-to-End			All Cache Hit
		IO Behavior	Sequential		Random	Sequential
		Size	64KB	1MB	1MB	1MB
PS 3000 Gen2 FW: 1.44D.01 Block mode	RAID 5	Read (MB/s)	11,236	11,112	11,017	12,586
		Write (MB/s)	6,709	7,789	4,272	9,345
PS 4000 Gen2 FW: 1.44D.02 Block mode	RAID 5	Read (MB/s)	11,610	10,804	10,520	25,142
		Write (MB/s)	7,046	7,911	2,705	9,359

Host Type: FC_32Gb/s		Block Level				
		Profile	End-to-End			All Cache Hit
		IO Behavior	Sequential		Random	Sequential
		Size	64KB	1MB	1MB	1MB
PS 3000 Gen2 FW: 1.44D.01 Block mode	RAID 5	Read (MB/s)	11,894	11,821	11,673	24,164
		Write (MB/s)	6,781	7,903	2,813	9,359
PS 4000 Gen2 FW: 1.44D.02 Block mode	RAID 5	Read (MB/s)	11,853	11,832	11,859	24,166
		Write (MB/s)	6,999	7,902	2,793	9,348

Host Type: iSCSI_25Gb/s		Block Level				
		Profile	End-to-End			All Cache Hit
		IO Behavior	Sequential		Random	Sequential
		Size	64KB	1MB	1MB	1MB
PS 3000 Gen2 FW: 1.45G.05 Block mode	RAID 5	Read (MB/s)	6,781	8,329	8,640	11,743
		Write (MB/s)	5,767	4,243	2,783	6,606
PS 4000 Gen2 FW: 1.44G.02 Block mode	RAID 5	Read (MB/s)	11,107	11,882	11,734	14,184
		Write (MB/s)	6,101	5,600	2,718	6,516

● Applications

Host Type: FC_16Gb/s		Block Level			
		Profile	End-to-End		
		Application	Database R/W = 70%/30%		VDI R/W = 20%/80%
		Size	4KB	8KB	4KB
PS 3000 Gen2 FW: 1.44D.01 Block mode	RAID 5	Read (IOPS)	292,998	275,307	137,996

PS 4000 Gen2 FW: 1.44D.02 Block mode	RAID 5	Read (IOPS)	258,040	259,044	121,375
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Host Type: FC_32Gb/s		Block Level			
		Profile	End-to-End		
		Application	Database R/W = 70%/30%		VDI R/W = 20%/80%
		Size	4KB	8KB	4KB
PS 3000 Gen2 FW: 1.44D.01 Block mode	RAID 5	Read (IOPS)	214,752	215,636	123,272
PS 4000 Gen2 FW: 1.44D.02 Block mode	RAID 5	Read (IOPS)	241,515	245,842	123,916

Host Type: iSCSI_25Gb/s		Block Level			
		Profile	End-to-End		
		Application	Database R/W = 70%/30%		VDI R/W = 20%/80%
		Size	4KB	8KB	4KB
PS 3000 Gen2 FW: 1.45G.05 Block mode	RAID 5	Read (IOPS)	234,636	224,463	130,261
PS 4000 Gen2 FW: 1.44G.02 Block mode	RAID 5	Read (IOPS)	265,304	-	122,439

File-Level Section

Host Type: Ethernet _10Gb/s		File Level- CIFS (IOmeter)			
	IO Type	Sequential (MBPS)		Random (IOPS)	
RAID 5	Size	1MB	512KB	4KB	Database 8KB (R/W: 70%/30%)
PS 3000 Gen2 FW: 1.44G.04 File mode	Read	9,601	9,191	133,134	35,788
	Write	3,961	3,857	53,208	
PS 4000 Gen2 FW: 1.44G.04 File mode	Read	10,697	10,676	148,257	41,130
	Write	5,382	5,266	62,317	

Host Type: Ethernet _10Gb/s		File Level- CIFS (Vdbench)			
	IO Type	Sequential (MBPS)		Random (IOPS)	
RAID 5	Size	1MB	512KB	4KB	Database 8KB (R/W: 70%/30%)
PS 3000 Gen2 FW: 1.44G.04 File mode	Read	9,539	9,309	139,472	32,546
	Write	3,704	3,564	42,692	
PS 4000 Gen2 FW: 1.44G.04 File mode	Read	11,403	11,384	143,854	33,780
	Write	5,117	4,448	50,678	

Host Type: Ethernet _10Gb/s		File Level- NFS (Vdbench)			
	IO Type	Sequential (MBPS)		Random (IOPS)	
RAID 5	Size	1MB	512KB	4KB	Database 8KB (R/W: 70%/30%)
PS 3000 Gen2 FW: 1.44G.04 File mode	Read	8,565	8,364	105,877	51,017
	Write	3,863	3,668	26,498	
PS 4000 Gen2	Read	10,944	10,863	134,362	61,844

FW: 1.44G.04 File mode	Write	5,035	4,339	33,740	
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Host Type: Ethernet _25Gb/s	IO Type	File Level- CIFS (IOmeter)			
		Sequential (MBPS)		Random (IOPS)	
RAID 5	Size	1MB	512KB	4KB	Database 8KB (R/W: 70%/30%)
PS 3000 Gen2 FW: 1.44G.04 File mode	Read	9,785	9,536	136,079	31,347
	Write	4,220	4,064	37,410	
PS 4000 Gen2 FW: 1.44G.20 File mode	Read	10,349	10,233	125,188	31,212
	Write	5,524	5,358	37,790	

Host Type: Ethernet _25Gb/s	IO Type	File Level- CIFS (Vdbench)			
		Sequential (MBPS)		Random (IOPS)	
RAID 5	Size	1MB	512KB	4KB	Database 8KB (R/W: 70%/30%)
PS 3000 Gen2 FW: 1.44G.04 File mode	Read	10,812	10,667	139,780	27,798
	Write	3,956	3,474	34,194	
PS 4000 Gen2 FW: 1.44G.20 File mode	Read	11,251	11,063	125,321	27,794
	Write	5,127	4,106	39,352	

Host Type: Ethernet _25Gb/s	IO Type	File Level- NFS (Vdbench)			
		Sequential (MBPS)		Random (IOPS)	
RAID 5	Size	1MB	512KB	4KB	Database 8KB (R/W: 70%/30%)
PS 3000 Gen2	Read	9,042	8,779	136,871	53,444

FW: 1.44G.04 File mode	Write	3,936	3,383	28,080	
PS 4000 Gen2 FW: 1.44G.20 File mode	Read	11,266	11,260	151,012	61,262
	Write	4,927	3,868	34,077	

10K SAS HDD Drive

Block-Level Section

● IOPS with small block size

Host Type: FC_16Gb/s		Block Level				
		Profile	End-to-End			All Cache Hit*
		IO Behavior	Random			Sequential
		Size	4KB	8KB	64KB	512B
PS 3000 Gen2 FW: 1.44G.04 Block mode	RAID 5	Read (IOPS)	17,276	17,307	15,529	857,378
		Write (IOPS)	9,424	9,362	6,205	492,252

*We mapped one volume to multiple servers to ensure getting the maximum all cache hit performance value. This mapping is not the same as regular performance test.

● Throughput with large block size

Host Type: FC_16Gb/s		Block Level				
		Profile	End-to-End		All Cache Hit	
		IO Behavior	Sequential		Random	
		Size	64KB	1MB	1MB	
PS 3000 Gen2 FW: 1.44G.04 Block mode	RAID 5	Read (MB/s)	10,177	11,584	-	25,146
		Write (MB/s)	7,848	8,617	-	25,059

● Applications

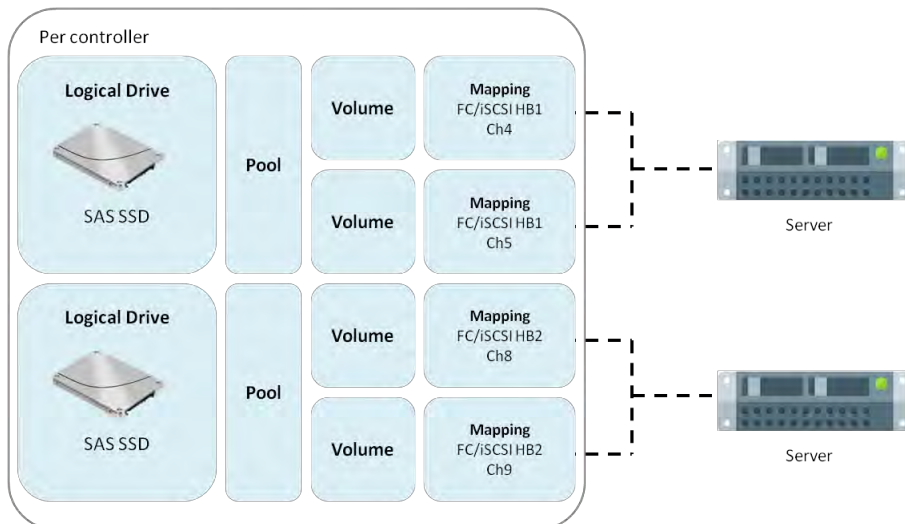
Host Type: FC_16Gb/s		Block Level			
		Profile	End-to-End		
		Application	Database R/W = 70%/30%		VDI R/W = 20%/80%
		Size	4KB	8KB	4KB
PS 3000 Gen2 FW: 1.44G.04 Block mode	RAID 5	Read (IOPS)	13,538	13,514	9,632

Topology

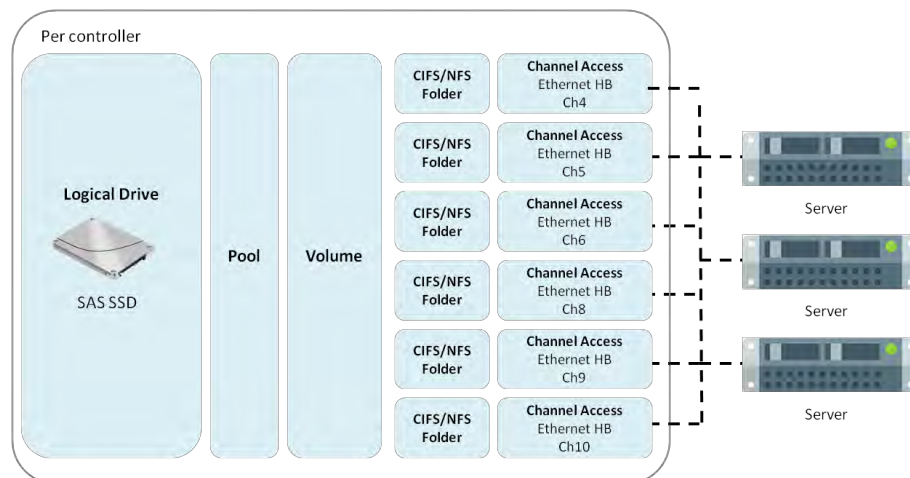
This section illustrates the principle of the network topology and storage configuration. Please refer to topology section and the system configuration section PAC Storage get the best performance from PAC Storage PS family. **Note:** In order to leverage the advantage of multi-thread, please create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

SAS SSD Drive

● Block-Level

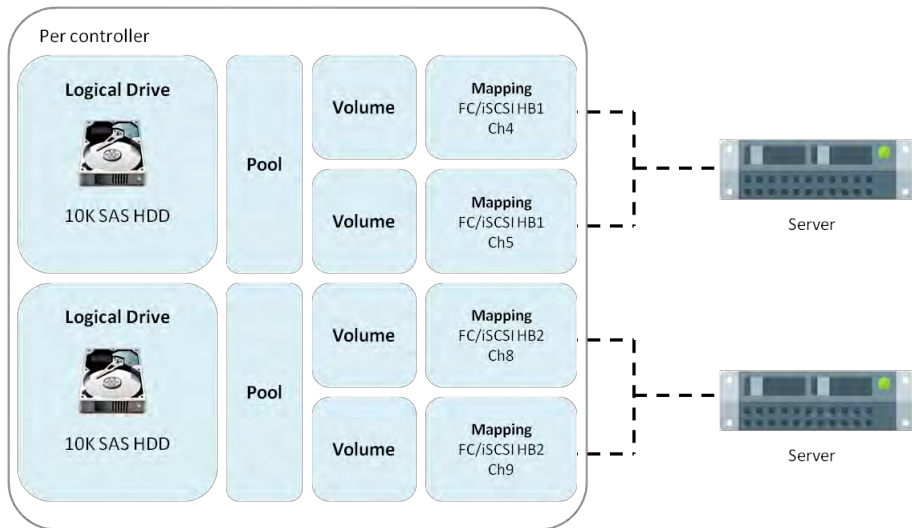


● File-Level

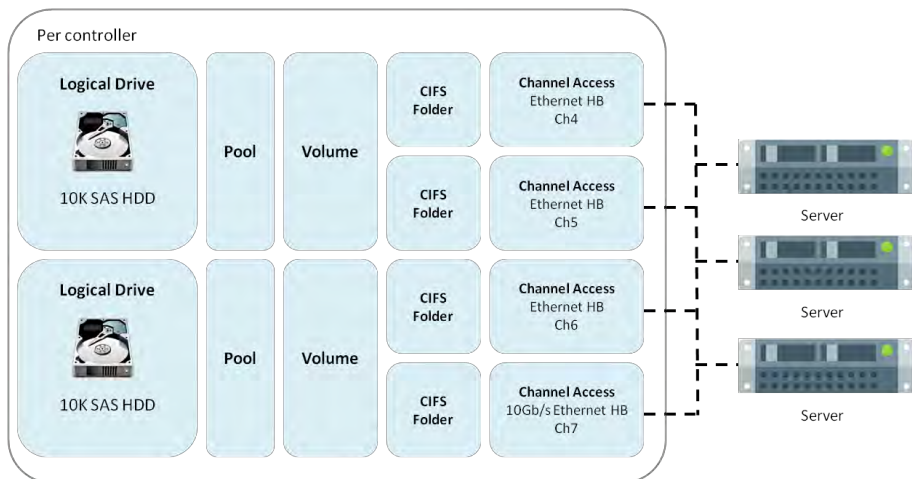


10K SAS HDD Drive

- **Block-Level**



- **File-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 16Gb/s	PS 3000 Gen2	2	4
	PS 4000 Gen2	2	4
FC 32Gb/s	PS 3000 Gen2	2	4
	PS 4000 Gen2	2	4
iSCSI 25Gb/s	PS 3000 Gen2	2	4
	PS 4000 Gen2	2	4

File-level	Model	# of Host Board per controller	# of Channel per controller
Ethernet 10Gb/s	PS 3000 Gen2	1	6
	PS 4000 Gen2	1	6
Ethernet 25Gb/s	PS 3000 Gen2	2	4
	PS 4000 Gen2	2	4

System Configurations

Storage Configuration Profile

PS following table shows the configuration adopted from our PS/PSe 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 Gen2	16	2	2	4	4
PS 4000 Gen2	16	2	2	4	4

● Block-Level HDD

Model	# of Drive	# of LD	# of Pool	# Volume	# of Client
PS 3000 Gen2	64	4	4	4	4

● File-Level SSD

Model	# of Drive	# of LD	# of Pool	# Volume	# of Folder	# of Client
PS 3000 Gen2	16	2	2	2	10	6
PS 4000 Gen2	22	2	2	2	12	6

● File-Level HDD

Model	# of Drive	# of LD	# of Pool	# Volume	# of Folder	# of Client
PS 3000 Gen2	64	4	4	4	8	6

Storage System Settings

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

RAM (per system)	64GB
RAID Level	6
Stripe size	256K
Read-ahead for NAS file transfer	2M
Maximum Tag Count	64
Jumbo Frame	Disable
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.

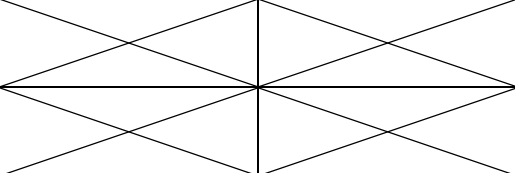
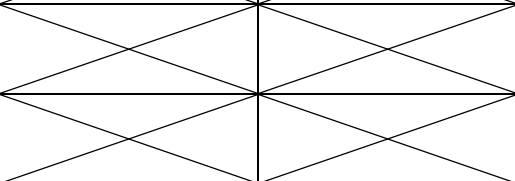
M/B	Super Micro X9SRL-F
CPU	Intel® Xeon® CPU E5-1620 v2 @ 3.70GHz (3.70GHz)
RAM	DDR III 1866 8G*4 (32.0GB)
PCI	2 PCI-E 3.0 x8, 2 PCI-E 3.0 x8 (in x16), 2 PCI-E 3.0 x4 (in x8), 1 PCI-E 2.0 x4 (in x8)
System Drive	SATA HITACHI 500G (HDS725050KLA360)
OS. 1	Microsoft Windows Server 2016 (HP)
OS. 2	macOS Mojave 10.14.6
GPU card (for Windows Client)	NVIDIA Quadro M6000 12G
HBA card	Emulex OneConnect OCe11102® x2 (2-Port 10GbE SFP+ PCIe iSCSI CNA, Dual Port (10G SFP+)*2)
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 Gen2 performance enhancement**

		PS 3000	PS 3000 T	PS 3000 Gen2	PS 4000 Gen2
Block-level IOPS (Read)		740K		900K	
Block-level Throughput (Read/Write MB/s)		11,800/6,400			
File-level Throughput (CIFS Read/Write MB/s)		6,700/3,300	6,800/3,500	8,300/3,800	9,900/5,500
Performance Enhancement (PSVS PS 3000)	Read			24%	48%
	Write			15%	67%
Performance Enhancement (PSVS PS 3000T)	Read			22%	46%
	Write			8%	57%

- **Why is the performance enhancement only on file-level?**

PS we mentioned in the summary, the main difference between PS 3000/4000 Gen1 and Gen2 is the CPU platform. The new CPU platform, which is Skylake-D, can handle the IO request more efficiently, so the block-level IOPS and file-level performance can be improved. However, since the PCIe tunnels of the CPU remain the same, the block-level throughput has no difference. And the only difference between PS 3000 Gen2 and PS 4000 Gen2 is the number of CPU core. The number of CPU cores actually affects the file-level performance the most, since NAS needs multiple cores to handle IO requests from multiple clients.

- **Block mode or File mode?**

What if users intend to configure PS 3000/4000 Gen2 as SAN and NAS simultaneously? Comparing 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 Gen2 as SAN and NAS at the same time.

Legal Information

All PAC Storage products, including the product/s that customers have purchased from PAC Storage, are subject to the latest Standard Warranty Policy available on the PAC Storage website.

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/output 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.

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