



Performance Report

PAC Storage PS 5000 Hybrid 90 Bay

Version: 1.0

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Summary

PAC Storage PS Family are unified storage systems which can provide excellent performance in SAN, NAS, and Object Storage.

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1. Applicable Models

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

Series	Applicable Models
PS 5000	PS 5090 PS 5090C (C: U.2 SSD cache)

2. Audience

This performance report is intended for the PAC Storage partners, customers, and employees who want to deploy PAC Storage PS 5000 as their storage.

3. Terminology

- **PAC Storage PS Family** - PAC Storage PS Family is an enterprise unified storage which can be configured as SAN or NAS.
- **PAC Storage software** - Management software for PAC Storage PS Family.
- **File-level** - PAC Storage PS Family is 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** 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.

4. 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)

4.1 7.2K NL-SAS HDD Drive

4.1.1 Block-Level Section

- IOPS with small block size

Host Type: iSCSI_25G RDMA (iSER)		Block Level				
		Profile	End-to-End			All Cache Hit
		IO Behavior	Random			Random
		Size	4KB	8KB	64KB	4KB
PS 5090RC FW: 1.68G.31 Block mode	RAID 5	Read (IOPS)	27,522	27,449	26,591	1,121,593
		Write (IOPS)	21,898	21,862	14,860	825,025

Host Type: iSCSI_25G		Block Level				
		Profile	End-to-End			All Cache Hit
		IO Behavior	Random			Random
		Size	4KB	8KB	64KB	4KB
PS 5090RC FW: 1.68G.31 Block mode	RAID 5	Read (IOPS)	32,222	32,092	31,063	1,387,613
		Write (IOPS)	21,953	21,731	14,905	1,118,167

Host Type: FC_32G		Block Level				
		Profile	End-to-End			All Cache Hit
		IO Behavior	Random			Random
		Size	4KB	8KB	64KB	4KB
PS 5090RC FW: 1.68G.27 Block mode	RAID 5	Read (IOPS)	36,853	36,839	26,302	2,467,913
		Write (IOPS)	21,022	20,959	14,841	1,113,522

Host Type: iSCSI_100G RDMA (iSER)		Block Level				
		Profile	End-to-End			All Cache Hit
		IO Behavior	Random			Random
		Size	4KB	8KB	64KB	4KB
PS 5090RC FW: 1.68G.27 Block mode	RAID 5	Read (IOPS)	21,065	20,847	19,518	1,165,095
		Write (IOPS)	21,065	21,008	13,516	675,820

Host Type: iSCSI_100G		Block Level			
		Profile	End-to-End		
		IO Behavior	Random		
		Size	4KB	8KB	64KB
PS 5090RC FW: 1.68G.27 Block mode	RAID 5	Read (IOPS)	26,823	26,745	26,077
		Write (IOPS)	21,055	21,016	14,842

● Throughput with large block size

Host Type: iSCSI_25G RDMA (iSER)		Block Level		
		Profile	End-to-End	
		IO Behavior	Sequential	
		Size	64KB	1MB
PS 5090RC FW: 1.68G.31 Block mode	RAID 5	Read (MB/s)	42,269	45,980
		Write (MB/s)	18,773	19,197

Host Type: iSCSI_25G		Block Level		
		Profile	End-to-End	
		IO Behavior	Sequential	
		Size	64KB	1MB
PS 5090RC FW: 1.68G.31 Block mode	RAID 5	Read (MB/s)	-	43,205
		Write (MB/s)	-	13,583

Host Type: FC_32G		Block Level			
		Profile	End-to-End		All Cache Hit
		IO Behavior	Sequential		Sequential
		Size	64KB	1MB	1MB
PS 5090RC FW: 1.68G.27 Windows Iometer Block mode	RAID 5	Read (MB/s)	43,540	47,027	50,285
		Write (MB/s)	16,718	19,008	31,936

Host Type: iSCSI_100G RDMA (iSER)		Block Level			
		Profile	End-to-End		All Cache Hit
		IO Behavior	Sequential		Sequential
		Size	64KB	1MB	1MB
PS 5090RC FW: 1.68G.27 Block mode	RAID 5	Read (MB/s)	44,093	46,944	53,460
		Write (MB/s)	18,674	19,133	38,921

Host Type: iSCSI_100G		Block Level			
		Profile	End-to-End		All Cache Hit
		IO Behavior	Sequential		Sequential
		Size	64KB	1MB	1MB
PS 5090RC FW: 1.68G.27 Block mode	RAID 5	Read (MB/s)	33,499	44,326	50,073
		Write (MB/s)	12,922	14,192	15,624

● Applications

Host Type: iSCSI_25G RDMA (iSER)		Block Level			
		Profile	End-to-End		
		Application	Database R/W = 70%/30%	VDI R/W = 20%/80%	
		Size	4KB	8KB	4KB
PS 5090RC FW: 1.68G.31 Block mode	RAID 5	Read (IOPS)	24,543	24,532	21,335

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 5090RC FW: 1.68G.31 Block mode	RAID 5	Read (IOPS)	26,366	26,294	21,259

Host Type: FC_32G		Block Level			
		Profile	End-to-End		
		Application	Database R/W = 70%/30%	VDI R/W = 20%/80%	
		Size	4KB	8KB	4KB
PS 5090RC FW: 1.68G.27 Windows Iometer Block mode	RAID 5	Read (IOPS)	27,706	27,814	20,131

*C: U.2 SSD cache in the chassis

Host Type: iSCSI_100G RDMA (iSER)		Block Level			
		Profile	End-to-End		
		Application	Database R/W = 70%/30%		VDI R/W = 20%/80%
		Size	4KB	8KB	4KB
PS 5090RC FW: 1.68G.27 Block mode	RAID 5	Read (IOPS)	20,477	20,649	19,767

Host Type: iSCSI_100G		Block Level			
		Profile	End-to-End		
		Application	Database R/W = 70%/30%		VDI R/W = 20%/80%
		Size	4KB	8KB	4KB
PS 5090RC FW: 1.68G.27 Block mode	RAID 5	Read (IOPS)	23,104	23,166	20,199

4.1.2 File-Level Section

Host Type: Ethernet_25G	File Level- CIFS (Vdbench)			
	IO Type	Sequential (MBPS)	Random (IOPS)	
RAID 5	Size	1MB	4KB	Database 8KB (R/W: 70%/30%)
PS 5090RC FW: 1.68G.31 File mode	Read	25,479	51,895	4,058
	Write	12,037	33,156	

Host Type: Ethernet_25G	File Level- NFS (Vdbench)			
	IO Type	Sequential (MBPS)	Random (IOPS)	
RAID 5	Size	1MB	4KB	Database 8KB (R/W: 70%/30%)
PS 5090RC FW: 1.68G.31 File mode	Read	24,162	-	15,367
	Write	11,385	-	

Host Type: Ethernet_25G	File Level- NFS_RDMA (Vdbench)			
	IO Type	Sequential (MBPS)	Random (IOPS)	
RAID 5	Size	1MB	4KB	Database 8KB (R/W: 70%/30%)
PS 5090RC FW: 1.68G.31 File mode	Read	25,618	-	16,182
	Write	12,661	-	

Host Type: Ethernet_100G	File Level- NFS (Vdbench)			
	IO Type	Sequential (MBPS)	Random (IOPS)	
RAID 5	Size	1MB	4KB	Database 8KB (R/W: 70%/30%)
PS 5090RC FW: 1.68G.27 File mode	Read	24,386	19,834	15,799
	Write	11,717	25,176	

Host Type: Ethernet_100G	File Level- NFS_RDMA (Vdbench)			
	IO Type	Sequential (MBPS)	Random (IOPS)	
RAID 5	Size	1MB	4KB	Database 8KB (R/W: 70%/30%)
PS 5090RC FW: 1.68G.27 File mode	Read	26,020	21,611	16,803
	Write	12,598	24,519	

Host Type: Ethernet_200G	File Level- CIFS (Vdbench)			
	IO Type	Sequential (MBPS)	Random (IOPS)	
RAID 5	Size	1MB	4KB	Database 8KB (R/W: 70%/30%)
PS 5090RC FW: 1.69F.18 File mode	Read	25,837	50,621	4,647
	Write	13,550	36,051	

Host Type: Ethernet_200G	File Level- NFS (Vdbench)			
	IO Type	Sequential (MBPS)	Random (IOPS)	
RAID 5	Size	1MB	4KB	Database 8KB (R/W: 70%/30%)
PS 5090RC FW: 1.69F.18 File mode	Read	24,732	43,096	31,691
	Write	13,153	35,454	

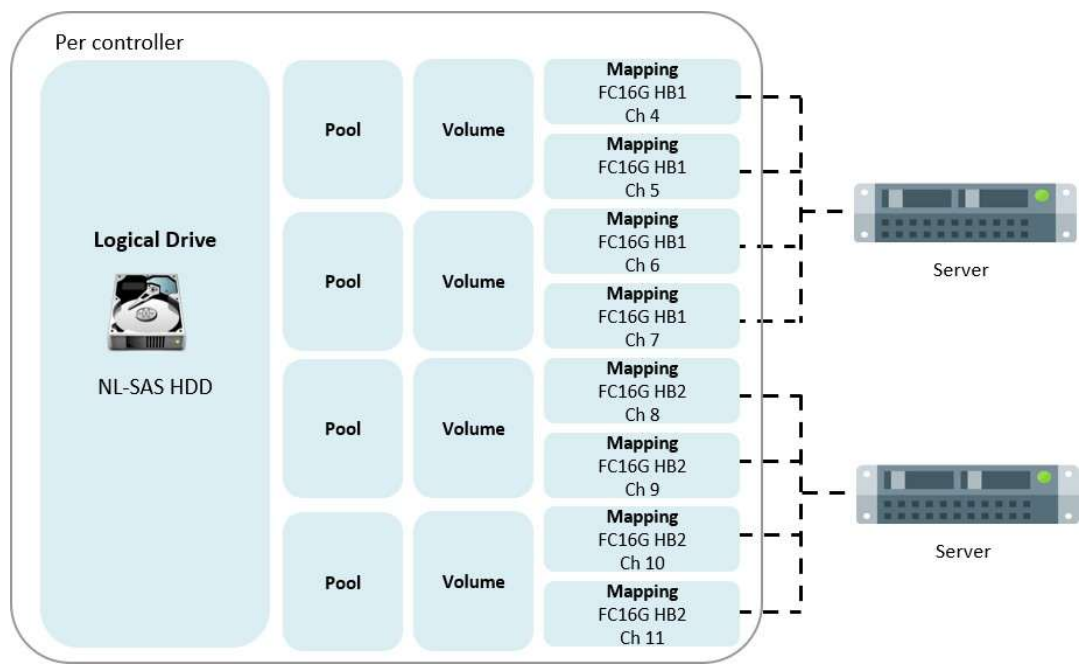
Host Type: Ethernet_200G	File Level- NFS_RDMA (Vdbench)			
	IO Type	Sequential (MBPS)	Random (IOPS)	
RAID 5	Size	1MB	4KB	Database 8KB (R/W: 70%/30%)
PS 5090RC FW: 1.69F.18 File mode	Read	24,911	28,846	24,482
	Write	14,542	35,654	

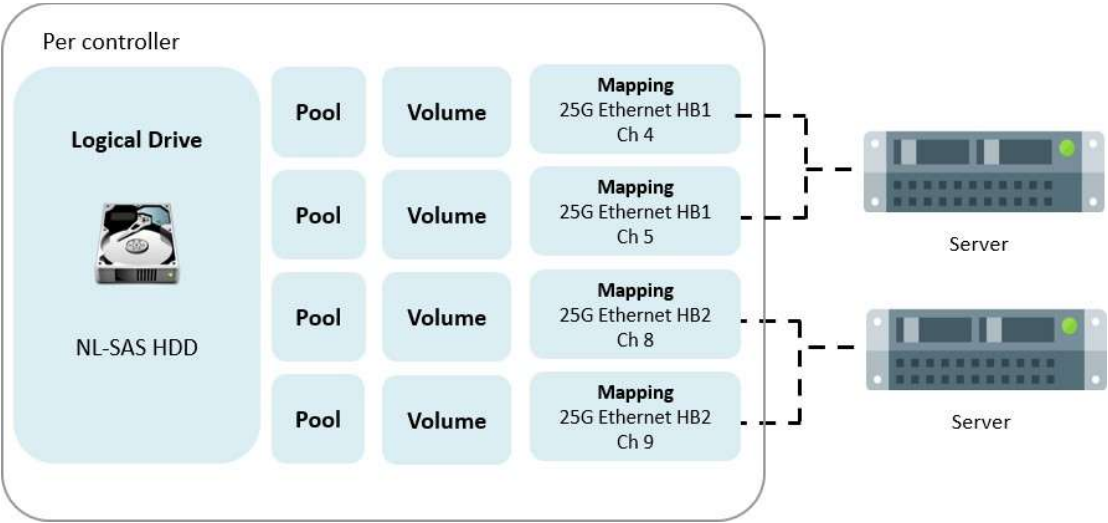
5. Topology

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.

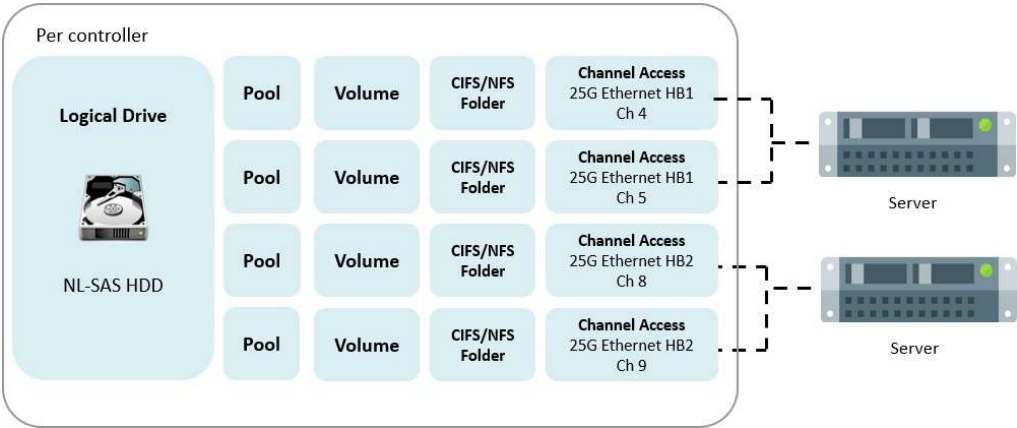
5.1 7.2K NL-SAS HDD Drive

- 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 32G	PS 5090	2	8
iSCSI 25G	PS 5090	2	8
iSCSI 100G	PS 5090	2	4
File-level	Model	# of Host Board per controller	# of Channel per controller
Ethernet 25G	PS 5090	2	8
Ethernet 100G	PS 5090	2	4
Ethernet 200G	PS 5090	2	2

6. System Configurations

6.1 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 HDD**

Model	# of Drive	# of LD	# of Pool	# Volume	# of Client
PS 5090	240	16	16	16	4

- **File-Level HDD**

Model	# of Drive	# of LD	# of Pool	# Volume	# of Folder	# of Client
PS 5090	240	16	16	16	16	4

6.2 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 PAC Storage software, please refer to PAC Storage software software manual.

RAM (per system)	256GB
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

6.3 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

6.4 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