Overview

HPE MSA 2050 Storage

The flash-ready HPE MSA 2050 Storage system is designed for affordable application acceleration that is ideal for small and remote office deployments. But do not let the low cost fool you. The HPE MSA 2050 Storage system gives you the combination of simplicity, flexibility to grow now and into the future, and advanced features you may not expect to find in an entry-priced array. Start small and scale as needed with any combination of solid state disks (SSD), high-performance enterprise, or lower-cost midline SAS-based drives.

HPE MSA Storage has been the industry-leading entry storage Fibre Channel platform for the past eight years, with nearly 500,000 storage systems sold worldwide. Now the HPE MSA 2050 Storage system delivers 2x higher performance [1] than the previous generation at the same price, delivering in excess of 200,000 IOPS starting at under $10,000 USD for affordable application acceleration. It's seriously simple and affordable flash-ready storage to help you get the most performance for the lowest cost.

- **200,000+ IOPS starting at under $10K for affordable application acceleration**
  - Flexible base model delivers 2x IOPS performance than the previous generation MSA for the same price.
- **Advanced data services with no experience required**
  - Easy to install, easy to use, easy to maintain—no storage expertise necessary
  - Automated tiering dynamically responds to workload changes, so you don't have to
- **Keep your business running with expanded data protection features**
  - New virtualized snapshot technology makes data protection and instant recovery a snap
  - Remote replication with FC and iSCSI supports affordable disaster recovery
- **Grow flexibly now and into the future**
  - Data-in-place upgrades protect drive investments and eliminate data migrations
  - Start small and scale as needed with any combination of SSD, Enterprise or Midline SAS drives

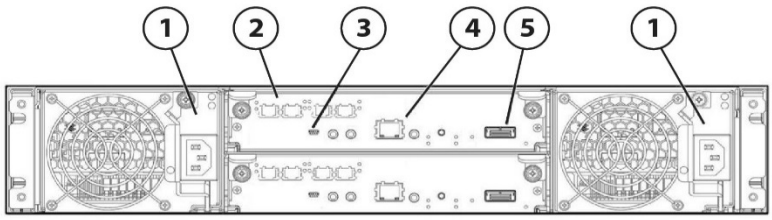
What's New in the MSA 2050 array family

- Introducing new MSA 800GB and 1.6TB 12G SAS Self Encrypting Solid State Drives (SSD SEDs).
- New I/O Workload tool in the User Interface to help users benefit from tiering on the MSA.
- New LDAP Support.

Overview

	HPE MSA 2050 Storage
Array	
Access Type	Block
Form Factor	2U, SFF or LFF
Number of controllers per array	2
Number of host ports per array	8
FC host connectivity	8/16Gb
iSCSI host connectivity	1Gb or 10Gb
SAS host connectivity	6Gb or 12Gb
Cache, per array	
Max Read cache per array	8TB
Data (read/write) cache + system memory per array	16GB
Pool Capacity (with Large Pool Support)	562 TB (512 TiB)
RAID Levels supported: Virtual mode	RAID 1, 5, 6, 10
Enclosures	
Expansion Drive Enclosures	0-7 enclosures
LFF/SFF array/enclosure mixing	Supported
Maximum number of drives per array enclosure	24 SFF/12 LFF
Maximum number of drives per drive enclosure	24 SFF/12 LFF
Drive enclosure interface type	6Gb SAS
Drives	
Maximum total HDDs per array	192 SFF / 96 LFF
Maximum total SSDs per array	192 SFF / 96 LFF
Max raw capacity per array enclosure	76.8 TB SFF / 144TB LFF
Max raw capacity per drive enclosure	76.8 TB SFF / 144TB LFF
Max raw capacity per array	614.4TB SFF / 1152TB LFF
Drive Capacities	
SFF SSDs (Mixed Use)	400GB, 800GB, 1.6TB, 3.2TB
LFF SSDs (Mixed Use)	400GB, 800GB
SFF HDDs	15K: 300GB, 600GB, 900GB 10K: 300GB, 600GB, 1.2TB, 1.8TB, 2.4TB 7.2K: 1.0TB, 2.0TB
LFF HDDs	7.2K: 2TB, 4TB, 6TB, 8TB, 10TB, 12TB
SEDs	SSDs: 800GB, 1.6TB 10K HDDs: SFF: 1.2TB 7.2K HDDs: LFF: 4TB
Software Features	
Thin Technologies	Thin Provisioning, Space Reclamation, Thin Rebuild
Tiering	Performance Tier, Standard Tier, Archive Tier
Replication	Snapshots (512), Volume Copy, Remote Snaps
Quality of Service	Virtual Tier Affinity
Additional Features	
Maximum number of volumes	512
Maximum number of snapshots	512
Maximum number of hosts	512
Maximum number of initiators	1024
Customer self-installable	Yes
Customer self-repairable	Yes
Customer self-upgradeable	Yes

Overview



HPE MSA 2050 Storage

1. AC or DC Power supplies
2. Host connection ports
   8 and/or 16Gb FC,
   1 and/or 10GbE iSCSI or
   6 and/or 12Gb SAS
3. CLI port (mini-USB)
4. Management Ethernet port
5. Expansion port

MSA 2050 Storage Models	Descriptions	Part Number
	HPE MSA 2050 SAN Dual Controller LFF Storage	Q1J00A
	NOTE: Includes an LFF or SFF Array Chassis depending on model, two MSA 2050 SAN or SAS controllers, two AC power supplies, no drives. **NOTE:** SFPs not included.	
	HPE MSA 2050 SAN Dual Controller SFF Storage	Q1J01A
	NOTE: Includes an LFF or SFF Array Chassis depending on model, two MSA 2050 SAN or SAS controllers, two AC power supplies, no drives. **NOTE:** SFPs not included.	
	HPE MSA 2050 SAN NEBS Certified DC Power SFF Storage	Q1J04A
	NOTE: Includes an LFF or SFF Array Chassis depending on model, two MSA 2050 SAN or SAS controllers, two DC power supplies, no drives. **NOTE:** SFPs not included.	
	HPE MSA 2050 SAN DC Power LFF Storage	Q1J79A
	NOTE: Includes an LFF or SFF Array Chassis depending on model, two MSA 2050 SAN or SAS controllers, two DC power supplies, no drives. **NOTE:** SFPs not included.	
	HPE MSA 2050 SAS Dual Controller LFF Storage	Q1J28A
	NOTE: Includes an LFF or SFF Array Chassis depending on model, two MSA 2050 SAN or SAS controllers, two AC power supplies, no drives. **NOTE:** SFP not required with SAS controllers.	
	HPE MSA 2050 SAS Dual Controller SFF Storage	Q1J29A
	NOTE: Includes an LFF or SFF Array Chassis depending on model, two MSA 2050 SAN or SAS controllers, two AC power supplies, no drives. **NOTE:** SFP not required with SAS controllers.	
	HPE MSA 2050 SAS NEBS Certified DC Power SFF Storage	Q1J32A
	NOTE: Includes an LFF or SFF Array Chassis depending on model, two MSA 2050 SAN or SAS controllers, two DC power supplies, no drives. **NOTE:** SFP not required with SAS controllers.	

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	HPE MSA 2050 SAS DC Power LFF Storage	Q2P39A

ENERGY STAR Certification

The HPE MSA 2050 Storage systems are ENERGY STAR certified. ENERGY STAR certified products are energy efficient which result in cost savings via reduced energy consumption and regulatory rebates. Please refer to the US EPA website for details on ENERGY STAR certification criteria and process. MSA 2050 ENERGY STAR Certification is listed on the EPA website.

Carrier-Grade Storage System (NEBS)

The HPE MSA 2050 SAN and SAS NEBS Certified DC-Power Storage systems are designed for network equipment providers (NEPs) and communication service providers. Suited for those customers who need a robust telecom infrastructure. The NEBS compliant MSA 2050 Storage system (Q1J04A and Q1J32A) supports configurations with up to 7 compliant disk enclosures for a maximum of 192 SFF HDDs or SSDs.

The HPE MSA 2050 SAN and SAS DC-power LFF Storage systems (Q179A and Q2P39A) include two (DC) power supplies, but is not NEBS certified. The two power supplies are designed to operate over the input range of -40VDC to -75VDC.

The HPE MSA 2050 DC-power Carrier Grade SFF Disk Enclosure (Q1J05A) is a special model disk enclosure designed for use with NEBS compliant MSA 2050 configurations. This drive enclosure has 24 drive bays and has dual -48VDC-power supplies. It is only sold with carrier grade arrays.

When used in conjunction with specific Storage SFF SAS drives, the solution is NEBS certified (GR-63-Core and GR-1089-Core) and Seismic Zone 4 rated. NEBS level-3 certification provides the assurance that the equipment is safe to operate and sturdy enough to withstand certain physical and environmental (for example, fire, earthquakes) conditions. For Seismic Zone 4 rating, the MSA 2050 must be mounted in an HPE Seismic Rack (AH335A).

SKU Description	NEBs Certified SKUs
HPE MSA 2050 SAN NEBS Certified DC Power SFF Storage	Q1J04A
HPE MSA 2050 SAS NEBS Certified DC Power SFF Storage	Q1J32A
HPE MSA 2050 DC Power Carrier Grade SFF Disk Enclosure	Q1J05A
HPE MSA 300GB 12G SAS 15K SFF(2.5in) Dual Port Enterprise 3yr Warranty Hard Drive	J9F40A
HPE MSA 450GB 12G SAS 15K SFF(2.5in) Dual Port Enterprise 3yr Warranty Hard Drive	J9F41A
HPE MSA 600GB 12G SAS 15K SFF(2.5in) Dual Port Enterprise 3yr Warranty Hard Drive	J9F42A
HPE MSA 900GB 12G SAS 15K SFF (2.5in) Enterprise 3yr Warranty Hard Drive	Q1H47A
HPE MSA 300GB 12G SAS 10K SFF(2.5in) Dual Port Enterprise 3yr Warranty Hard Drive	J9F44A
HPE MSA 600GB 12G SAS 10K SFF(2.5in) Dual Port Enterprise 3yr Warranty Hard Drive	J9F46A
HPE MSA 1.2TB 12G SAS 10K SFF(2.5in) Dual Port Enterprise 3yr Warranty Hard Drive	J9F48A
HPE MSA 400GB 12G SAS Mixed Use SFF (2.5in) 3yr Warranty Solid State Drive	N9X95A
HPE MSA 800GB 12G SAS Mixed Use SFF (2.5in) 3yr Warranty Solid State Drive	N9X96A
HPE MSA 1.6TB 12G SAS Mixed Use SFF (2.5in) 3yr Warranty Solid State Drive	N9X91A
HPE MSA 3.2TB 12G SAS Mixed Use SFF (2.5in) 3yr Warranty Solid State Drive	N9X92A
HPE MSA 1.2TB 12G SAS 10K rpm SFF (2.5in) Enterprise Self Encrypted 3yr Wty Hard Drive	P9M81A

Overview

All MSA 2050 models offer a common set of valuable features:

- MSA 2050 storage system architecture maximizes performance
  - Includes SFF or LFF array chassis, depending on model
  - Two MSA SAS or SAS controllers, depending on model
    - Four host ports per controller
    - Each SAN controller supports 8 Gb FC, 16 Gb FC, 1GbE iSCSI or 10GbE iSCSI. host connectivity
    - Each SAS controller supports 12Gb SAS host connectivity
  - 8 GB cache per controller.
  - Battery-free cache backup with super capacitors and compact flash
- MSA 2050 SAN controller allows customers to create their own Combo Controller by mixing FC and iSCSI SFPs. Below are the valid configurations for mixing SFPs:

Configuration Table for mixing SFPs

Configuration	Controller	Host Port 1 SFP[1]	Host Port 2 SFP[1]	Host Port 3 SFP[2]	Host Port 4 SFP[2]
Dual SAN Controller	Controller A	16Gb FC	16Gb FC	None	None
				16Gb FC	16Gb FC
				8Gb FC	8Gb FC
				10GbE iSCSI	10GbE iSCSI
				1GbE iSCSI	1GbE iSCSI
		8Gb FC	8Gb FC	None	None
				16Gb FC	16Gb FC
				8Gb FC	8Gb FC
				10GbE iSCSI	10GbE iSCSI
				1GbE iSCSI	1GbE iSCSI
		10GbE iSCSI	10GbE iSCSI	None	None
				10GbE iSCSI	10GbE iSCSI
				1GbE iSCSI	1GbE iSCSI
		1GbE iSCSI	1GbE iSCSI	None	None
				10GbE iSCSI	10GbE iSCSI
				1GbE iSCSI	1GbE iSCSI
	Controller B	Match Controller A	Match Controller A	Match Controller A	Match Controller A

NOTES: [1] SFP in Host Port 1 must match SFP in Host Port 2
[2]SFP in Host Port 3 must match SFP in Host Port 4

All MSA 2050 models offer a common set of valuable features (cont):

- Storage Management Utility V3 (SMU). The MSA management GUI brings a new modern look and feel to array management.
- Thin Provisioning allows storage allocation of physical storage resources only once they are consumed by an application. Thin Provisioning also allows over-provisioning of physical storage pool resources allowing ease of growth for volumes without predicting storage capacity upfront.
- All models feature a wide variety of drives: High-performance SSD drives, enterprise-class SAS, and SAS Midline drives.
- The MSA 2050 will support a maximum of 7 disk enclosures (either LFF and/or SFF). Add-on enclosures can either be HPE MSA 2050 LFF Disk Enclosure or HPE MSA 2050 SFF Disk Enclosure.
- The MSA 2050 can grow incrementally to a maximum of 96 LFF, 192 SFF drives, or a combination of SFF and LFF enclosures up to the maximum of 8 total enclosures.
- Virtual Storage Disks Groups can be spanned across multiple enclosures.
- Virtual Storage RAID levels supported: 1, 5, 6, 10.
- Maximum hard drive counts vary by RAID levels: 2 drive max for RAID level 1; max of 16 drives for RAID levels 5, 6, and 10.

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- Multiple Disk Groups can be aggregated into a single Storage Pool.
- Storage Pools allow data on a given LUN to span across all drives in a pool. When capacity is added to a system, the user is also getting a performance benefit of the additional spindles.
- The maximum LUN size is 140TB (128TiB)
- Snapshot enhancements for virtual storage, including performance improvements, hierarchical snapshots, and simplified resource management. Administrators can monitor and optionally control snapshot space usage.
- Prioritize data by assigning appropriate affinity level (Performance, No Affinity or Archive)
- Customers can configure 512 TiB capacity per virtual pool by enabling large pool support.
- Non-disruptive on-line controller code upgrade. Requires Multi-pathing software.
- Upgradable by design. Owners of an MSA 2040, MSA 2042 and MSA 1040 array are able to do data-in-place upgrades to the new MSA 2050 array. This unique ability protects the earlier investments in drives, and JBODs.
    - Certain limitations are applicable. Please review the Upgrading to the HPE MSA 1050/2050/2052 Technical Whitepaper before upgrading your MSA 2040, MSA 2042 or MSA 1040 systems

Application Solutions	The HPE MSA 2050 Storage is the ideal solution for customers running Oracle, Microsoft, SAP environments and those customers who are deploying virtual server technologies like VMware and Hyper-V. The MSA 2050 delivers enterprise functionality that enhances virtual environments, simplifies management, and reduces costs. Easy to deploy, scale and maintain, HPE MSA 2050 Arrays ensure that crucial business data remains available. Hewlett Packard Enterprise has developed best-in-class expertise in Oracle, Microsoft, SAP, and Virtualization Hypervisor technology through extensive testing with the HPE MSA 2050, HPE servers, and management software; high availability and disaster recovery solutions; and backup and recovery on the Oracle, Microsoft, and SAP application platforms.
Learn more	To learn more about specific HPE Storage Solutions that are built with Oracle, Microsoft, SAP and Virtualization environments in mind, visit the solution sites supporting each of these applications. HPE MSA Storage hyperlink to: **http://www.hpe.com/storage/MSA**

Standard Features

Product Technology

SAN controller MSA 2050 SAN controller supports 8Gb FC, 16Gb FC, 1GbE iSCSI or 10GbE iSCSI host connectivity.

SAS controller MSA 2050 SAS controller supports 6Gb and/or 12Gb SAS host connectivity.

Modular Chassis 2U rack height. 12 LFF or 24 SFF drive bays. All MSA 2050 Storage Systems come standard with 2 SAN or SAS controllers, depending on model.
NOTE: The MSA 2050 does not support single controller configurations. Single-controller support is provided only when a controller fails over to its partner controller.

Drives available The MSA 2050 SAN or SAS Storage systems support both the MSA 3.5-inch LFF drives, and the MSA 2.5-inch SFF drives.

- Solid State Drives (SSDs) deliver exceptional performance for applications requiring high random read IOPs performance.
- Serial Attached SCSI (SAS) enterprise-class drives are designed for high demand, 24x7 usage.
- SAS Midline drives are usually reserved for archival of data as they are relatively inexpensive and are available in very large capacities.

Optional Disk Enclosures Just as the user has a choice of chassis for the array enclosure (LFF or SFF drive bays), they also have a choice of expansion disk enclosures accommodating either drive size. Both the MSA 2050 LFF Disk Enclosure and MSA 2050 SFF Disk Enclosure can be hot-added to an operating array. SFF and LFF Array enclosures and Disk Enclosures can be mixed without limitations.

MSA 2050 LFF Disk Enclosure. This 2U enclosure is designed to support twelve HPE Storage LFF drives and accepts MSA dual-ported 12Gb SSD and SAS Midline hard drives. The pre-configured MSA 2050 LFF Disk Enclosure has two I/O modules and supports the MSA 2050 dual controller arrays.

- The MSA 2050 LFF Disk Enclosure can be attached to the MSA 2050 LFF or SFF storage models.
- Each MSA 2050 LFF Disk Enclosure ships standard with two .5m mini-SAS to mini-SAS cables for connection to the MSA 2050 array expansion port or existing disk enclosure cascade port.
- LFF and/or SFF Disk Enclosures can be mixed up to the maximum of 7 total Disk Enclosures

HPE MSA 2050 LFF Disk Enclosure Q1J06A

HPE MSA 2050 SFF Disk Enclosure. This 2U enclosure is designed to support twenty four HPE Storage 2.5-inch SFF drive bays and accepts MSA dual ported 12Gb SSD, Enterprise SAS, or SAS Midline hard drives. The pre-configured MSA 2050 SFF Disk Enclosure has two I/O modules and supports the MSA 2050 dual controller arrays.

- The MSA 2050 SFF Disk Enclosure can be attached to the MSA 2050 LFF or SFF storage models
- Each MSA 2050 SFF Disk Enclosure ships standard with a two .5m mini-SAS to mini-SAS cables for connection to the MSA 2050 array expansion port or existing disk enclosure cascade port.
- LFF and/or SFF Disk Enclosures can be mixed up to the maximum of 7 total Disk Enclosures.

HPE MSA 2050 SFF Disk Enclosure Q1J07A

Scalability The MSA 2050 array configurations are designed to allow an installation to begin with smaller capacity and be able to grow gradually as needed. The flexibility of SSD, Enterprise SAS or SAS Midline drives technology, form factors, sizes, speeds, and costs per GB allows a system to easily fit in almost any budget.

- Large Form Factor configurations can scale up to 144TB SAS Midline per array enclosure, expandable to 1152TB SAS Midline with the addition of a maximum of seven MSA 2050 LFF Disk Enclosure.
- Small Form Factor configurations can scale up to 76.8 TB SAS SSDs per array enclosure, expandable to 614.4 TB SAS with the addition of a maximum of seven MSA 2050 SFF Disk Enclosure.
- Users may configure an MSA 2050 SFF array enclosure with MSA 2050 LFF Disk Enclosure. This is an excellent option for a configuration that supports high-speed SFF SSDs or fast SFF enterprise-class SAS

Standard Features

drives in the array enclosure, combined with economical LFF drives staged for archival purposes, all in the same array.

Disk Group A Disk Group is a collection of disks in a given redundancy mode (RAID 1, 5, 6, 10). Disk Group RAID level and size can be created based on performance and/or capacity requirements. Multiple Disk Groups can be allocated into a Storage Pool for use with the Virtual Storage features.

LUNs The MSA 2050 arrays support 512 volumes and up to 512 snapshots in a system. All of these volumes can be mapped to LUNs. Maximum LUN sizes up to 140TB (128 TiB). Thin Provisioning allows the user to create the LUNs independent of the physical storage.

Storage Pools Storage Pools are comprised of one or more Disk Groups. A volume's data on a given LUN can now span all disk drives in a pool. When capacity is added to a system, users will benefit from the performance of all spindles in that pool.

The MSA 2050 supports large, flexible Volumes with sizes up to 128TiB and facilitates seamless capacity expansion. As pools are expanded data automatically reflows to balance capacity utilization on all drives.

RAID 1, 5, 6, 10 The MSA 2050 features several important additional RAID levels. RAID 6 offers the highest level of RAID protection. It allocates two sets of parity data across drives and allows simultaneous write operations. It can withstand two simultaneous drive failures without downtime or data loss. RAID 10 is mirroring and striping without parity and allows large Disk Groups to be created with high performance and mirroring for fault tolerance. RAID 5 combines the block striping and parity. Because data and parity are striped across all of the disks, no single disk is a bottleneck. Striping also allows users to reconstruct data in case of a disk failure.

Performance The performance figures provided here are for reference as many variables exist between array configurations, workloads, hard drive types, disk group setup parameters and host system setup. Hewlett Packard Enterprise has traditionally published a set of end-to-end MSA performance specifications that are fed into HPE Sizer tools which are based on conservative real-world configurations. For consistency, the MSA performance numbers have been documented in both Benchmark and End-to-End Performance tables. Complete End-to-End Performance results will be provided for the MSA 2050 in a subsequent publication. These numbers are subject to change without notice.

MSA 2050 End-to-End Performance Results:

MSA 2050 Array Performance [1]	**HPE MSA 2050 Converged SAN Controller with HDDs**	**HPE MSA 2050 Converged SAN Controller with Mixed Use SSDs**
Protocol (host connect)	16 Gb Fibre Channel	16 Gb Fibre Channel
MSA 2050 RAID 1 SSD Performance Results [2]		
Random Reads (IOPs)		220,800
Random Writes (IOPs)		103,000
MSA 2050 RAID 5 Performance Results [3,4]		
Segmented Sequential Reads (MB/s)	5,290	
Segmented Sequential Writes (MB/s)	4,650	

End-to-End performance notes

1 Performance results were generated using internal HPE test tools. Number and type of applications, drive type and number of drives, operating system used, and the number of hosts will affect overall performance. This table is provided strictly as a test-lab comparison

Standard Features

2 Dual Controller configuration, (8) 400GB Mixed Use SSDs, RAID: 1, two drives per Disk Group; two Disk Groups per Pool, 2 volumes per Pool, block size: 8k, average latency under 5ms, Windows Server 2012 host, 16Gb FC direct connect to array

3 Dual Controller configuration, (72) 15k HDD, RAID: 5, nine drives per Disk Group, 4 Disk Groups per Pool, 32 volumes per Pool, block size: 256k, average latency under 30ms, Windows Server 2012 host, 16Gb FC direct connect to array

4 Sequential performance numbers were generated using segmented sequential workloads. For segmented sequential workloads with a queue depth greater than 1, each sequential stream is targeted to operate on a separate LBA range. Other types of sequential workloads that target specific LBA ranges may achieve higher results.

End-to-End Performance Figures using Virtual Storage

HPE MSA 2050 End-to-End Performance Figures [1]								
Controller Model	HPE MSA 2050 SAN						HPE MSA 2050 SAS	
Host Protocol [2]	16 Gb FC		10 GbE iSCSI		1 GbE iSCSI		12 Gb SAS	
Drive Technology	HDD	SSD	HDD	SSD	HDD	SSD	HDD	SSD
MSA 2050 RAID 10 Performance Results [3,4,5,11] ** **NOTE:** RAID 1 was used for SSD testing.								
Random Reads IOPS	63,600	220,800	63,500	208,400	63,200	103,700	50,800	219,100
Random Writes IOPS	37,300	103,000	37,300	94,300	37,200	93,300	37,100	97,500
Random Mix 60/40 IOPS	47,600	142,100	46,600	133,000	46,800	130,500	44,500	138,800
Sequential Reads MB/s	5,350		5,350		880		5,350	
Sequential Writes MB/s	3,110		3,110		880		3,120	
MSA 2050 RAID 5 Performance Results [6,7,12]								
Random Reads IOPS	56,300	219,200	55,800	201,400	56,000	103,400	47,300	209,600
Random Writes IOPS	18,100	43,400	18,000	41,400	18,300	40,600	18,000	43,100
Random Mix 60/40 IOPS	29,100	80,000	29,200	75,400	28,700	73,900	28,000	78,700
Sequential Reads MB/s	5,290		5,280		880		5,290	
Sequential Writes MB/s	4,650		3,870		880		4,710	
MSA 2050 RAID 6 Performance Results [8,9,10,13]								
Random Reads IOPS	56,100	219,000	55,700	201,300	55,700	105,000	47,400	209,800
Random Writes IOPS	13,000	36,000	13,000	35,600	13,200	35,300	13,000	36,700
Random Mix 60/40 IOPS	21,400	72,200	21,200	68,500	21,300	67,300	21,300	71,500
Sequential Reads MB/s	5,550		5,530		880		5,560	
Sequential Writes MB/s	4,440		3,680		880		4,600	

NOTE: Number and type of applications, drive type and number of drives, operating system used, and the number of hosts will affect overall performance. This table is provided strictly as a test-lab comparison. These numbers reflect a full array configuration with the maximum number of front-end ports and controllers. The test results shown for the HPE MSA 2050 are designed to give a conservative reference point for comparisons.

1. Sequential tests (MB/s) are based on 256K block sizes and random tests (IOPS) are based on 8K block sizes run against the storage. For sequential workloads with a queue depth greater than 1, each sequential stream is targeted to operate on a separate LBA range. Other types of sequential workloads that target specific LBA ranges may achieve higher results. Results cannot be expected with a single host.

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2. Fibre Channel results were measured using 16 Gb FC Host Bus Adapters. SAS results were measured using 12 Gb SAS Host Bus Adapters. 10 GbE iSCSI results were measured using 10GbE iSCSI Host Bus Adapters. 1 GbE iSCSI results were measured using 1GbE network interface controllers (NICs). Hosts were directly attached to the HPE MSA 2050 array.

3. MSA 2050 RAID 10 Hard Disk Drive (HDD) random results: Dual Controller configuration, (192) 15K HDD, 12 drives per disk group, 8 disk groups per pool, 8 volumes per pool.

4. MSA 2040 RAID 10 Hard Disk Drive (HDD) sequential read results: Dual Controller configuration, (96) 15K SAS HDDs, 12 drives per disk group, 4 disk groups per pool, 4 volumes per pool.

5. MSA 2040 RAID 10 Hard Disk Drive (HDD) sequential write results: Dual Controller configuration, (48) 15K SAS HDDs, 12 drives per disk group, 2 disk groups per pool, 4 volumes per pool.

6. MSA 2050 RAID 5 Hard Disk Drive (HDD) random results: Dual Controller configuration, (180) 15K HDD, 9 drives per disk group, 10 disk groups per pool, 10 volumes per pool.

7. MSA 2050 RAID 5 Hard Disk Drive (HDD) sequential results: Dual Controller configuration, (72) 15K HDD, 9 drives per disk group, 4 disk groups per pool, 4 volumes per pool.

8. MSA 2050 RAID 6 Hard Disk Drive (HDD) random results: Dual Controller configuration, (180) 15K HDD, 10 drives per disk group, 9 disk groups per pool, 9 volumes per pool.

9. MSA 2050 RAID 6 Hard Disk Drive (HDD) sequential read results: Dual Controller configuration, (80) 15K HDD, 10 drives per disk group, 4 disk groups per pool, 4 volumes per pool.

10. MSA 2050 RAID 6 Hard Disk Drive (HDD) sequential write results: Dual Controller configuration, (40) 15K HDD, 10 drives per disk group, 2 disk groups per pool, 4 volumes per pool.

11. MSA 2050 RAID 1 Solid State Drives (SSD) results: Dual Controller configuration, (8) SSDs, 2 SSDs per disk group, 2 disk groups per pool, 4 volumes per pool.

12. MSA 2050 RAID 5 Solid State Drives (SSD) results: Dual Controller configuration, (6) SSDs, 3 SSDs per disk group, 1 disk group per pool, 4 volumes per pool.

13. MSA 2050 RAID 6 Solid State Drives (SSD) results: Dual Controller configuration, (8) SSDs, 4 SSDs per disk group, 1 disk group per pool, 4 volumes per pool.

Standard Features

Configuration and Management Tools	Management access, out-of-band, Storage Management Utility (SMU), CLI. Interface Types: USB 100/1000 Ethernet. Protocols Supported SNMP, SMI-S, SSH, SMTP, FTP, SFTP, HTTP, HTTPS, Telnet
Web Browser support	The MSA 2050 arrays come integrated with web browser and CLI based software for storage and RAID management, setup, configuration, and troubleshooting. The MSA 2050 management supports Microsoft Internet Explorer, Mozilla Firefox, and Google Chrome.
Hot Plug Expansion and Replacement Support	All MSA 2050 models support hot plug expansion and replacement of redundant controllers, enclosures, fans, power supplies, and I/O modules for simple, fast installation and maintenance. Hot add expansion of disk enclosures is also supported.
HPE Server Compatibility	The MSA 2050 supports most HPE ProLiant, BladeSystems and Integrity servers including • HPE ProLiant DL, ML Servers • HPE c-Class Blade Servers • Integrity servers, IA64 • Compatibility must be confirmed at: **http://www.hpe.com/storage/spock** **NOTE:** depends on protocol.
3rd Party server support	The MSA 2050 supports most multi-vendor industry standard Intel and AMD based (x86) servers. Hewlett Packard Enterprise requires the Third-Party Server to be logged and listed on the Microsoft Windows Server Catalog. • Hewlett Packard Enterprise recommends that the Third-Party Server Vendor is an active member of TSANet. Refer to the TSANet website for details: **http://www.tsanet.com** • Non-HPE servers will generally be supported if the HPE storage stack is used. This includes supported HPE branded HBAs and drivers, and supported FC switches.
OS Support	Refer to the Hewlett Packard Enterprise support statements for complete current OS version support: **http://www.hpe.com/storage/spock** • Microsoft Windows Server 2016 • Microsoft Windows Server 2012 • VMware • HP-UX • Red Hat Linux • SuSE SLES Linux • Solaris • Oracle Linux • Citrix XenServer **NOTE:** depends on protocol.

Software

Advanced Data Services Suite

The HPE MSA Advanced Data Services Suite can be purchased as an option on the MSA 2050 Storage systems. The Advanced Data Service Suite is included as a standard feature on the MSA 2052 at no extra charge. See the MSA 2052 QuickSpecs for more information.

The optional Advanced Data Services Suite includes the following functionality:

- Performance Tiering and Archive Tiering
- 512 Snapshots and Volume Copy
- Remote Snaps

HPE MSA Advanced Data Services Suite LTU	Q0H99A
HPE MSA Advanced Data Services Suite E-LTU	Q0H99AAE

Performance Tiering and Archive Tiering

Disk tiers are comprised of aggregating 1 or more Disk Groups of similar physical disks. The MSA 2050 supports 3 distinct tiers:

1. A Performance tier with SSDs
2. A Standard SAS tier with Enterprise SAS HDDs
3. An Archive tier utilizing Midline SAS HDDs.

The MSA 2050 supports sub-LUN tiering and automated data movement between tiers. The MSA 2050 automated tiering engine moves data between available tiers based on the access characteristics of that data. Frequently accessed “pages” will migrate to the highest available tier delivering maximum I/O´s to the application.

Configurations which have a mixture of both SSDs and HDDs within the same system being used as a capacity Tier (excluding SSD Read Cache), will require the Advanced Data Service Suite LTU. This rule applies to the system level and therefore the license is required regardless of whether the drives are configured for auto-tiering within the same Pool. All SSD configurations and SSD Read Cache extension do not require a license on the MSA2050 array.

Snapshot and Volume Copy

- All MSA 2050 arrays come standard with 64 snaps.
- A 512 Snapshot license is available as an option on the MSA 2050
- Snapshots create up to 512 point-in-time copies of data
- Volume Copies create up to 128 point-in-time copies of data
- Volume copies become standard volumes when they are complete
- Recovery is instant - revert data from any previous Snapshot or Volume Copy
- Backup 'snapped' data to disk, virtual tape, or physical tape without a backup window
- If telephone support and software updates are desired for bundled software functionalities like 64 snapshots and volume copy software, a combination HW + SW support care pack must be purchased.
- Hewlett Packard Enterprise does not provide warranty assistance for software products included with our base hardware products. Support is available with either the SupportPlus or SupportPlus24 Service options the hardware warranty component of these services is accounted for in the pricing of the SP and SP24 care packs.

Remote Snap

- HPE MSA Remote Snap Software is array based software that provides remote replication on the HPE MSA 2050 array products. MSA Remote Snap is a form of asynchronous replication which consists of replication of block-level data from a volume on a local system to a volume on a second independent system. This second system may be co-located with the first system or may be located at a remote site.
- HPE Remote Snap functionality is based on existing Snapshot technology offered by HPE MSA array products. Snapshots are used to track the data to be replicated as well as to determine the differences in data updated on the master volume, minimizing the amount of data to be transferred.

Software

- HPE Remote Snap replication technology provides the ability to accomplish key data management and protection capabilities. First, because Remote Snap uses snapshots as the underlying technology it creates multiple local recovery points which can be used for such tasks as to complement daily backups; second, replication provides the ability to access data in a remote site which could be used for dispersed operations; and third but definitely not least important replication allows for business continuance in the event of a failure on the primary site.
- In order to perform a replication, a snapshot of the volume to be replicated is taken, creating a point-in-time image of the data. This point-in-time image is then replicated to the destination volume by copying the data represented by the snapshot via a transport medium such as TCP/IP (iSCSI) or Fibre Channel. The amount of data transferred is minimized though the use of snapshots whenever possible.
  NOTE: One Advanced Data Services Suite License per array is required for replication. For example, if you have two MSA arrays performing replication (from Primary system to Remote System), you will need a total of 2 licenses.

Product Features

- Storage based asynchronous snapshot replication
- Support of both Ethernet and Fibre Channel interconnects provides flexible options to the application environments.
- Snapshot based replication technology means only changed data will be replicated to alternate site
- Many to 1 replication (up to 4 nodes) - primary use case is to replicate from "many" branch offices to the home office for the purpose of backing up data from the branches
- Advanced scheduler provides several options to IT administrators for business continuance
- Flexible architecture allows remote replication between MSA 2050 and MSA 2040 or MSA 1040 arrays using the virtual storage architecture and licensed for Remote Snap. Protects existing investments and enhances business continuity planning objectives.
- Snapshot based replication enables both local and remote recovery depending on the need. Snapshot replication isolates problems to a specific point in time which can be selected by the administrator. Additionally snapshot replication supports longer distance replication.
- Multiple relationships provide greater storage flexibility and utilization.
- 512 Snapshots and Volume Copy integration provides better efficiencies by combining the management and array technologies to create local copies.
- Fast application recovery with minimal or no transaction loss
- Creation of disaster tolerant copies of your critical business data
- No-single-point-of-failure solution to increase the availability of your data

HPE OneView for VMware vCenter

HPE OneView for VMware vCenter is a component within the HPE OneView plug-in for vCenter. It provides VMware administrators that are using VMware's vSphere management console (vCenter) with the ability to see how virtual machines are mapped to datastores and individual MSA 2050 volumes. By providing these clear relationships between VM's, datastores and storage, the VMware administrator's productivity increases, as does the ability to ensure quality of service. Roles for administrators can be defined on an individual basis, providing the ability to apply specific permissions for both view and control functions.

HPE OneView for VMware vCenter supports mixed array environments including MSA 2050/2052, MSA 2040/2042, MSA 1040, P2000, EVA, P4000, and the XP array series including the P9500.

When deployed with the MSA 2050 array, HPE OneView provides the following:

- Active Management functionality for the MSA 2050 array:
  - Create/Expand/Delete a Datastore
  - Create a Virtual Machine from a template
- Monitors the health and status of the MSA 2050
- Displays LUN / volume connections from VMs and ESX servers to the arrays and provides the location and attributes of the MSA 2050 within the SAN

Software

- Identifies what storage features are available to allow administrators to match the features available on the MSA 2050 to their requirements
- Provide a cluster-level view of the storage

HPE OneView for VMware vCenter is downloadable from Software Depot:
https://h20392.www2.hpe.com/portal/swdepot/displayProductInfo.do?productNumber=HPVPR

For more information on HPE OneView for VMware vCenter visit:
http://h22168.www2.hpe.com/us/en/partners/vmware/

HPE StoreFront Manager for Microsoft

HPE StoreFront Manager for Microsoft enables management and monitoring of HPE MSA Storage running in Microsoft Hyper-V environment with a single pane-of-glass view to events/alerts, capacity and health dashboards and detailed virtual infrastructure information. It integrates seamlessly with Microsoft System Center Operations Manager (SCOM) and provides Microsoft administrators the following:

It supports heterogeneous HPE Storage environment including HPE MSA, HPE StoreVirtual, HPE 3PAR StoreServ, HPE StoreOnce, HPE StoreEasy, HPE XP, HPE EVA and HPE StoreEver Storage.

When deployed with the MSA 2050 array, HPE StoreFront Manager provides the following:

- Monitors the health, events and alerts for the MSA 2050 – virtual Pools, and volumes
- Provides detailed information on the VMs provisioned through MSA Storage
- Effortless installation and configuration using Powershell

HPE StoreFront Manager for Microsoft for MSA Storage is downloadable from Software Depot:
https://h20392.www2.hpe.com/portal/swdepot/displayProductInfo.do?productNumber=System_Center

vStorage API for Array Integration (VAAI)

The vStorage API for Array Integration (VAAI) is one of the storage application programming interface (API) sets in vSphere. VAAI is an API storage partners can leverage to enhance performance of virtual machine (VM) management operations by delegating these operations to the storage array. With hardware offload, ESX/ESXi hosts perform certain operations faster and consume less server CPU and memory resources, and also storage port and storage fabric bandwidth. VAAI includes high performance and scalable VM data path primitives.

Storage Hardware Primitives for VAAI

- Full Copy or Hardware Assisted Move
- Block Zeroing or Hardware Assisted Zeroing
- Hardware Assisted Locking or Atomic Test and Set (ATS)

UNMAP reclaims space that is no longer on a thinly provisioned VMFS volume

LDAP Support

LDAP (Lightweight Directory Access Protocol) is an industry standard application protocol for accessing and maintaining distributed directory information services over an IP network. LDAP provides the ability to authenticate MSA users with a central directory.

- Domain or Directory Credentials are not stored on the MSA for authentication – avoids a security issue
- Once user groups are configured on all MSAs in your organization, users can be authenticated on any MSA through the Active Directory
- Uses an LDAP implementation to authenticate users with a Windows Active Directory
- The MSA CLI and SMU will allow the configuration of new LDAP users groups into the MSA security scheme (manage vs monitor users, interface restrictions Web/CLI/FTP)
- Ability to authenticate Local or LDAP users

I/O Workload Functionality

A new user interface element called "I/O Workload" has been added to the main screen on MSA's WBI home screen for GL270 or later firmware. The MSA array controllers keep track of a substantial amount of data pertaining to the I/O dynamics at a logical page level (4MB chunks). From this data, it is possible to provide some visibility to what percent (%) of I/O's are being processed by what percent (%) of the overall array's capacity across a 7 day timeline. While some workloads have "transient" data access patterns, many workloads have steady access patterns on small portions of the array's

Software

capacity. This produces "hot" pages in the array which remain hot a large amount of the array's uptime. Users would see substantial benefits if these pages could be served from the fastest media in the array (ideally SSDs). As has been described in the MSA's tiering functionality, the MSA array's tiering engine will work to position the hottest pages on the fastest media at any given time.

The new I/O Workload graph will show a line labeled Capacity and a line plot for each selected workload percentage (100%, 80%, or Other% value). Below are two examples of user scenarios where the I/O Workload Graph might be useful and how to utilize the data the graph provides.

1) New User or SSD Installation
    a. Once the MSA array is installed and has had workloads running against it for a week's time, the I/O Workload data will give a representation of what Capacity is servicing 100% of I/O and 80% of I/O. Users may select a custom % value if desired. In a new installation or in an installation with no SSD tier installed, the 80% line is a reasonable starting point for an SSD tier. Based on SSD RAID settings, customers can then calculate a good starting point with regard to SSD tier sizing based on that week's workload. While not a hard fast rule, it is a good starting point. These values should also be compared to the Best Practices "rule of thumb" which suggest that 5-15% of the array's capacity should be SSDs for tiered solutions.
2) Users with existing SSD tiering or read caching installed and running
    a. For arrays running with SSDs installed (tiered or read cache), the I/O Workload graph will have a dotted line which shows the installed SSD capacity. The I/O Workload graphs can be checked periodically to see where the 80% I/O line is with regard to the SSD capacity line. While there are no hard and fast rules which indicate good/bad situations, users can use the graph with other system performance tools to better understand specific dynamics of their installation and the normal dynamics of a system in the day-to-day activities for a specific environment.

Interpreting the I/O Workload graphs allow users to strike a balance between the SSD costs versus performance benefits. For example, some customers may be willing to have a couple of days where peak usage is far above the SSD capacity line as it may be acceptable to have slower performance as the system uses HDDs for a larger percentage of the workload I/O. This may be perfectly acceptable for systems sized to optimize $/TB due to budget constraints. Other users may want to optimize the system such that a sizeable percentage of daily I/O have the opportunity to reside on SSD media (sized to 80% or 90%). When combined with other performance monitoring tools, the new I/O Workload function gives users some representation as to how the workloads and the MSA are working together in a user's real-world environment.

Warranty, Service and Support Information

Warranty	Three-year limited warranty, parts exchange Next Business day delivery Enclosures, Hard drives, and Options for the MSA 2050 carry their own warranty. Refer to **Hewlett Packard Enterprise Limited Warranty Statement** for more information. The MSA 2050 has been designed with customer self-repairable parts to minimize repair time and provide greater flexibility in performing defective parts replacement. Please refer to Hewlett Packard Enterprise limited warranty Statement and parts replacement instructions for further details. **NOTE:** The warranty of the hard drive options purchased with the MSA 2050 models is different for SAS hard drives versus SAS Midline. SAS hard drive options have a three year warranty and SAS Midline have a one year warranty.
Solid State Drives (SSD) Warranty	3/0/0 warranty; Customer Self Repair (CSR) subject to maximum usage and or maximum supported lifetime limitations, whichever occurs first. Maximum Supported Lifetime is the period in years set to equal the warranty for the device. Maximum usage limit is the maximum amount of data that can be written to the device before reaching the device's write endurance limit.
Service and Support	**Protect your business beyond warranty with HPE Support Services** HPE Pointnext provides a comprehensive portfolio including Advisory and Transformational, Professional, and Operational Services to help accelerate your digital transformation. From the onset of your transformation journey, Advisory and Transformational Services focus on designing the transformation and creating a solution roadmap. Professional Services specializes in creative configurations with flawless and on-time implementation, and on-budget execution. Finally, operational services provides innovative new approaches like Flexible Capacity and Datacenter Care, to keep your business at peak performance. HPE is ready to bring together all the pieces of the puzzle for you, with an eye on the future, and make the complex simple.
Connect your devices	Unlock all of the benefits of your technology investment by connecting your products to Hewlett Packard Enterprise. Achieve up to 77%[1] reduction in down time, near 100%[2] diagnostic accuracy and a single consolidated view of your environment. By connecting, you will receive 24x7monitoring, pre-failure alerts, automatic call logging, and automatic parts dispatch. HPE Proactive Care Service and HPE Datacenter Care Service customers will also benefit from proactive activities to help prevent issues and increase optimization. All of these benefits are already available to you with your server storage and networking products, securely connected to HPE support [1] IDC [2] HP CSC reports 2014-2015 Learn more about getting connected at **http://www.hpe.com/services**
Optimized Care	**HPE Proactive Care with 6 hour call-to-repair commitment, three year Support Service** HPE Proactive Care gives customers an enhanced call experience. When your products are connected to HPE, Proactive Care helps prevent problems and maintains IT stability by utilizing personalized proactive reports with recommendations and advice. This Service combines three years' proactive reporting and advice with our highest level of hardware support; HPE's 24x7, six hour hardware call-to-repair. HPE is the only leading manufacturer who makes this level of coverage available as a standard service offering for your most valuable servers and storage, including the HPE MSA 2050/2052 Storage. **https://www.hpe.com/h20195/v2/GetPDF.aspx/4AA3-8855ENW.pdf**

Warranty, Service and Support Information

Standard Care	**HPE Proactive Care with 24x7 coverage, three year Support Service** HPE Proactive Care gives customers an enhanced call experience. When your products are connected to HPE, Proactive Care helps prevent problems and maintains IT stability by utilizing personalized proactive reports with recommendations and advice This Service combines three years proactive reporting and advice with our 24x7 coverage, four hour hardware response time when there is a problem. **https://www.hpe.com/h20195/v2/GetPDF.aspx/4AA3-8855ENW.pdf**
Basic Care	**HPE Foundation Care 24x7, three-year Support Service** HPE Foundation Care 24x7 gives you access to HPE 24 hours a day, seven days a week for assistance on resolving issues. This service includes need based Hardware onsite response within four hours. Simplify your support experience and make HPE your first call to help resolve hardware or software problems. **https://www.hpe.com/h20195/V2/GetDocument.aspx?docname=4AA4-8876ENW&cc=us&lc=en**
Foundation Care	**HPE Foundation Care 24x7, three-year Support Service** HPE Foundation Care 24x7 gives you access to HPE 24 hours a day, seven days a week for assistance on resolving issues. This service includes need based Hardware onsite response within four hours. In addition, collaborative software support is included in this service that provides troubleshooting assistance on industry leading software running on your HPE server. Simplify your support experience and make HPE your first call to help resolve hardware or software problems. **https://www.hpe.com/h20195/V2/GetDocument.aspx?docname=4AA4-8876ENW&cc=us&lc=en**
Parts and Materials	HPE will provide HPE-supported replacement parts and materials necessary to maintain the covered hardware product in operating condition, including parts and materials for available and recommended engineering improvements. Parts and components that have reached their maximum supported lifetime and/or the maximum usage limitations as set forth in the manufacturer's operating manual, product quick-specs, or the technical product data sheet will not be provided, repaired, or replaced as part of these services. The defective media retention service feature option applies only to Disk or eligible SSD/Flash Drives replaced by HPE due to malfunction.
Related Services	**HPE Hardware Installation** Provides for the basic hardware installation of HPE branded servers, HPE storage including the MSA 2050/2052 devices and networking options to assist you in bringing your new hardware into operation in a timely and professional manner. **https://www.hpe.com/h20195/V2/GetPDF.aspx/5981-9356EN.pdf** **HPE Installation and Startup Service** Provides for the installation and startup of HPE technology including BladeSystems, C-Class enclosure, HPE ProLiant c-Class and Integrity server blades, storage blades, SAN switch blades, HPE Virtual Connect modules (Ethernet and Fibre Channel), Ethernet network interconnects, and InfiniBand, as well as the installation of one supported operating system type (Windows® or Linux). Included the HPE MSA 2050/2052. **HPE Datacenter Care service**

Warranty, Service and Support Information

Helps improve IT stability and security, increase the value of IT, and enable agility and innovation. It is a structured framework of repeatable, tested, and globally available services "building blocks." You can deploy, operate, and evolve your datacenter wherever you are on your IT journey. With HPE Datacenter Care, you benefit from a personalized relationship with HPE via a single point of accountability for HPE and others' products.

For more information, visit **http://www.hpe.com/services**

HPE Flexibly Capacity,
With Flexible Capacity, you get the speed, scalability, and economics of the public cloud in the privacy of your data center. Gain the advantages of the public cloud—consumption-based payment, rapid scalability without worrying about capacity constraints. Reduce the "heavy lifting" needed to operate a data center. And retain the advantages that IT provides the business (i.e., control, security). Deliver the right user experience, choose the right technology for the business, manage privacy and compliance, and manage the cost of IT. And, you have the option to use the public cloud when needed.

HPE Factory Express for Servers and Storage
HPE Factory Express offers configuration, customization, integration and deployment services for HPE servers and storage products. Customers can choose how their factory solutions are built, tested, integrated, shipped and deployed.

Factory Express offers service packages for simple configuration, racking, installation, complex configuration and design services as well as individual factory services, such as image loading, asset tagging, and custom packaging. HPE products supported through Factory Express include a wide array of servers and storage: HPE Integrity, HPE ProLiant, HPE Apollo, HPE ProLiant Server Blades, HPE BladeSystem, HPE 9000 servers as well as the HPE MSA Storage, HPE 3PAR Storage, HPE XP, rackable tape libraries and configurable network switches.

HPE Education Services
Keep your IT staff trained making sure they have the right skills to deliver on your business outcomes. Book on a class today and learn how to get the most from your technology investment.
http://www.hpe.com/ww/learn

HPE Support Center
The HPE Support Center is a personalized online support portal with access to information, tools and experts to support HPE business products. Submit support cases online, chat with HPE experts, access support resources or collaborate with peers.

Learn more http://www.hpe.com/support/hpesc
HPE Insight Remote Support and HPE Support Center are available at no additional cost with a HPE warranty, HPE Support Service or HPE contractual support agreement.

For more information: **http://www.hpe.com/services**

Configuration Information

Configuration Information

Step 1 - MSA 2050 - Base Configurations

NOTE: Single controller options are not supported.

Pre-Configured Systems	**MSA 2050 Base System (AC Powered)**	
	HPE MSA 2050 SAN Dual Controller LFF Storage	Q1J00A
	NOTE: Includes an LFF or SFF Array Chassis depending on model, two MSA 2050 SAN or SAS controllers depending on model, two AC power supplies, no drives. **NOTE:** SFPs not included.	
	HPE MSA 2050 SAN Dual Controller SFF Storage	Q1J01A
	NOTE: Includes an LFF or SFF Array Chassis depending on model, two MSA 2050 SAN or SAS controllers depending on model, two AC power supplies, no drives. **NOTE:** SFPs not included.	
	HPE MSA 2050 SAS Dual Controller LFF Storage	Q1J28A
	NOTE: Includes an LFF or SFF Array Chassis depending on model, two MSA 2050 SAN or SAS controllers depending on model, two AC power supplies, no drives. **NOTE:** SFPs not included. **NOTE:** SFPS are not required with SAS Storage.	
	HPE MSA 2050 SAS Dual Controller SFF Storage	Q1J29A
	NOTE: Includes an LFF or SFF Array Chassis depending on model, two MSA 2050 SAN or SAS controllers depending on model, two AC power supplies, no drives. **NOTE:** SFPs not included. **NOTE:** SFPS are not required with SAS Storage.	
	MSA 2050 Base System (DC Powered)	
	HPE MSA 2050 SAN NEBS Certified DC Power SFF Storage	Q1J04A
	NOTE: Includes an LFF or SFF Array Chassis depending on model, two MSA 2050 SAN or SAS controllers depending on model, two DC power supplies, no drives. **NOTE:** SFPs not included.	
	HPE MSA 2050 SAN DC Power LFF Storage	Q1J79A
	NOTE: Includes an LFF or SFF Array Chassis depending on model, two MSA 2050 SAN or SAS controllers depending on model, two DC power supplies, no drives. **NOTE:** SFPs not included.	
	HPE MSA 2050 SAS NEBS Certified DC Power SFF Storage	Q1J32A
	NOTE: Includes an LFF or SFF Array Chassis depending on model, two MSA 2050 SAN or SAS controllers depending on model, two DC power supplies, no drives. **NOTE:** SFPs not included. **NOTE:** SFPS are not required with SAS Storage.	
	HPE MSA 2050 SAS DC Power LFF Storage	Q2P39A
	NOTE: Includes an LFF or SFF Array Chassis depending on model, two MSA 2050 SAN or SAS controllers depending on model, two DC power supplies, no drives. **NOTE:** SFPs not included. **NOTE:** SFPS are not required with SAS Storage.	

Step 2 – Choose Your SFP+ Module

SFP+ Modules	HPE MSA 8Gb Short Wave Fibre Channel SFP+ 4-pack Transceiver	C8R23B
	HPE MSA 16Gb Short Wave Fibre Channel SFP+ 4-pack Transceiver	C8R24B

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	HPE MSA 10Gb Short Range iSCSI SFP+ 4-pack Transceiver	C8R25B
	HPE MSA 1Gb RJ-45 iSCSI SFP+ 4-pack Transceiver	C8S75B

NOTE:

- MSA SFPs are for use only with MSA 2050 SAN Controllers.
- MSA SAS controllers do not require SFP modules.
- MSA 2050 SAN Controllers do not ship with any SFPs.
- Customer must select at least one of the above SFP options.
- Each MSA 2050 SAN controller can be configured with 2 or 4 SFPs.
- Controllers must be configured identically. Number and type of transceivers in each controller must be the same.
- For MSA 2050 10Gb iSCSI configuration user can use DAC cables instead of SFPs.

Step 3 – Select Your Drives

MSA HDDs and SSDs drives are for use with MSA Storage Systems only.
Customers can mix SSD, Enterprise SAS, and SAS Midline (MDL) drives in the same array enclosure and disk enclosure

SFF SSDs	**12G SFF SAS SSDs (Mixed Use)**	
	HPE MSA 400GB 12G SAS Mixed Use SFF (2.5in) 3yr Warranty Solid State Drive	N9X95A
	HPE MSA 800GB 12G SAS Mixed Use SFF (2.5in) 3yr Warranty Solid State Drive	N9X96A
	HPE MSA 1.6TB 12G SAS Mixed Use SFF (2.5in) 3yr Warranty Solid State Drive	N9X91A
	HPE MSA 3.2TB 12G SAS Mixed Use SFF (2.5in) 3yr Warranty Solid State Drive	N9X92A
SFF HDDs	**12G SFF 15K SAS HDDs**	
	HPE MSA 300GB 12G SAS 15K SFF(2.5in) Dual Port Enterprise 3yr Warranty Hard Drive	J9F40A
	HPE MSA 600GB 12G SAS 15K SFF(2.5in) Dual Port Enterprise 3yr Warranty Hard Drive	J9F42A
	HPE MSA 900GB 12G SAS 15K SFF (2.5in) Enterprise 3yr Warranty Hard Drive	Q1H47A
	12G SFF 10K SAS HDDs	
	HPE MSA 300GB 12G SAS 10K SFF(2.5in) Dual Port Enterprise 3yr Warranty Hard Drive	J9F44A
	HPE MSA 600GB 12G SAS 10K SFF(2.5in) Dual Port Enterprise 3yr Warranty Hard Drive	J9F46A
	HPE MSA 1.2TB 12G SAS 10K SFF(2.5in) Dual Port Enterprise 3yr Warranty Hard Drive	J9F48A
	HPE MSA 1.8TB 12G SAS 10K SFF (2.5in) 512e Enterprise 3yr Warranty Hard Drive	J9F49A
	HPE MSA 2.4TB 12G SAS 10K SFF (2.5in) Enterprise 512e 3yr Warranty Hard Drive	Q2R41A
	12G SFF 7.2K SAS MDL HDDs	
	HPE MSA 1TB 12G SAS 7.2K SFF (2.5in) 512e Midline 1yr Warranty Hard Drive	J9F50A
	HPE MSA 2TB 12G SAS 7.2K SFF (2.5in) 512e Midline 1yr Warranty Hard Drive	J9F51A

NOTE:

- SAS MDL drives are designed for archival or reference data.
- SAS MDL drives should not be used in a heavy or intense I/O environment.
- Intense I/O environments require the use of enterprise-class SSD or SAS drives.

LFF SSDs	**12G LFF SAS SSDs (Mixed Use)**	
	HPE MSA 400GB 12G SAS Mixed Use LFF (3.5in) Converter Carrier 3yr Wty Solid State Drive	P9M79A
	HPE MSA 800GB 12G SAS Mixed Use LFF (3.5in) Converter Carrier 3yr Wty Solid State Drive	P9M80A
LFF HDDs	**12G LFF 7.2K SAS Midline Drives**	
	HPE MSA 2TB 12G SAS 7.2K LFF (3.5in) Midline 512n 1yr Warranty Hard Drive	N9X93A
	HPE MSA 4TB 12G SAS 7.2K LFF (3.5in) Midline 1yr Warranty Hard Drive	K2Q82A

Configuration Information

	HPE MSA 6TB 12G SAS 7.2K LFF(3.5in) Midline 1yr Warranty Hard Drive	J9F43A
	HPE MSA 8TB 12G SAS 7.2K LFF (3.5in) 512e Midline 1yr Warranty Hard Drive	M0S90A
	HPE MSA 10TB 12G SAS 7.2K rpm LFF (3.5in) Midline 512e 1yr Wty Hard Drive	P9M82A
	HPE MSA 12TB 12G SAS 7.2K LFF (3.5in) Midline 512e 1yr Warranty Hard Drive	Q2R42A
SFF SEDs	**MSA Small Form Factor (SFF) SAS DP Self-Encrypted Drives**	
	HPE MSA 1.6TB 12G SAS Mixed Use SFF (2.5in) Self Encrypted 3yr Warranty Solid State Drive	Q9D46A
	HPE MSA 800GB 12G SAS Mixed Use SFF (2.5in) Self Encrypted 3yr Warranty Solid State Drive	Q9D47A
	HPE MSA 1.2TB 12G SAS 10K rpm SFF (2.5in) Enterprise Self Encrypted 3yr Wty Hard Drive	P9M81A
LFF SED	**MSA Large Form Factor (LFF) SAS DP Self-Encrypted Drives**	
	HPE MSA 4TB 12G SAS 7.2K LFF (3.5in) Midline Self Encrypted 1yr Warranty Hard Drive	Q1H48A

NOTE:

- All drives within the MSA 2050 array must be self-encrypted drives (SEDs) to enable the encryption feature.
- There cannot be a mixture of encrypted and non-encrypted drives within the same array.
- SEDs can be used in a non-SED environment, but will not be encrypted unless all drives in the array are SEDs.
- All MSA SEDs are FIPS 140-2 compliant FIPS 140-2 Validated Self-Encrypting Drives (SEDs) have been certified by the U.S. National Institute of Standards and Technology (NIST) and Canadian Communications Security Establishment (CSE) as meeting the Level 2 security requirements for cryptographic modules as defined in the Federal Information Processing Standards (FIPS) 140-2 Publication.
- Configurations which have a mixture of both SED SSDs and SED HDDs within the same system being used as a capacity Tier (excluding SSD Read Cache), will require the Advanced Data Service Suite LTU. This rule applies to the system level and therefore the license is required regardless of whether the drives are configured for auto-tiering within the same Pool. All SSD configurations and SSD Read Cache extension do not require a license on the MSA2050 array.

Step 4 – Options

Drive Enclosures	HPE MSA 2050 LFF Disk Enclosure	Q1J06A
	HPE MSA 2050 SFF Disk Enclosure	Q1J07A

NOTE:

- Each drive enclosure includes two 0.5m MiniSAS to MiniSAS cables.
- Add up to 7 additional drive enclosures.
- MSA 2050 LFF Disk Enclosure can be connected to either the MSA 2050 SFF or LFF dual controller systems.
- HPE MSA 2050 SFF Disk Enclosure can be connected to either the MSA 2050 SFF or LFF dual controller systems.

SAS Cables	HPE External Mini SAS 1m Cable ALL	407337-B21
	HPE External Mini SAS 2m Cable	407339-B21

NOTE:

- When connecting a MSA 2050 controller to a drive enclosure if a longer cable is needed.

Power Cords	HPE C13 - C14 WW 250V 10Amp 2.0m Jumper Cord	A0K02A
	HPE C13 - C14 WW 250V 10Amp Flint Gray 2.0m Jumper Cord	AF573A

Configuration Information

HPE C13 - AS3112-3 AU 250V 10Amp 2.5m Power Cord	AF569A
HPE C13 - BS-1363A UK/HK/SG 250V 10Amp 1.83m Power Cord	AF570A
HPE C13 - C14 WW 250V 10A Gray 0.7m Jumper Cord	A0K03A
HPE C13 - C14 WW 250V 10A Gray 1.37m Jumper Cord	A0K04A
HPE C13 - CEE-VII EU 250V 10Amp 1.83m Power Cord	AF568A
HPE C13 - CEI-23-50 IT/CL 250V 10Amp 1.83m Power Cord	AF571A
HPE C13 - CNS-690 TW 110V 13Amp 1.83m Power Cord	AF561A
HPE C13 - DK-2.5A DK 250V 10Amp 1.83m Power Cord	AF566A
HPE C13 - GB-1002 CN 250V 10Amp 1.83m Power Cord	AF557A
HPE C13 - IRAM -2073 AR 250V 10A 2.5m Power Cord	AF558A
HPE C13 - IS-1293 IN 240V 6Amp LV 2.0m Power Cord	AF562A
HPE C13 - JIS C8303 JP 100V 12Amp 2.0m Power Cord	AF572A
HPE C13 - KSC- 8305 KR 250V 10Amp 1.83m Power Cord	AF560A
HPE C13 - NBR-14136 BR 250V 10Amp 1.83m Power Cord	AF591A
HPE C13 - Nema 5-15P US/CA 110V 10Amp 1.83m Power Cord	AF556A
HPE C13 - SABS-164 ZA 250V 10Amp 2.5m Power Cord	AF567A
HPE C13 - SEV 1011 CH 250V 10Amp 1.83m Power Cord	AF565A
HPE C13 - SI-32 IL 250V 10Amp 1.83m Power Cord	AF564A
HPE C13-NEMA 6-15P 10A/250V 3.6m Black Power Cord	A0N33A
HPE OEM C13 - C14 WW 250V 10A Gray 3m Jumper Cord	A0K06A

NOTE:

- Two PDU cables: one 142263-008 (Black) and one 1422633-013 (Grey), ship standard with all AC-powered enclosures

Step 5a - Choose Supported Options For Fibre Channel Infrastructure

PremierFlexOM4 type cables	HPE Premier Flex LC/LC Multi-mode OM4 2 fiber 1m Cable	QK732A
	HPE Premier Flex LC/LC Multi-mode OM4 2 fiber 2m Cable	QK733A
	HPE Premier Flex LC/LC Multi-mode OM4 2 fiber 5m Cable	QK734A
	HPE Premier Flex LC/LC Multi-mode OM4 2 fiber 15m Cable	QK735A
	HPE Premier Flex LC/LC Multi-mode OM4 2 fiber 30m Cable	QK736A
	HPE Premier Flex LC/LC Multi-mode OM4 2 fiber 50m Cable	QK737A
OM3 FC LC-LC cables	HPE LC to LC Multi-mode OM3 2-Fiber 0.5m 1-Pack Fiber Optic Cable	AJ833A
	HPE LC to LC Multi-mode OM3 2-Fiber 1.0m 1-Pack Fiber Optic Cable	AJ834A
	HPE LC to LC Multi-mode OM3 2-Fiber 2.0m 1-Pack Fiber Optic Cable	AJ835A
	HPE LC to LC Multi-mode OM3 2-Fiber 5.0m 1-Pack Fiber Optic Cable	AJ836A
	HPE LC to LC Multi-mode OM3 2-Fiber 15.0m 1-Pack Fiber Optic Cable	AJ837A
	HPE LC to LC Multi-mode OM3 2-Fiber 30.0m 1-Pack Fiber Optic Cable	AJ838A
	HPE LC to LC Multi-mode OM3 2-Fiber 50.0m 1-Pack Fiber Optic Cable	AJ839A

Step 5b - Choose Supported Options For 10GbE Infrastructure

Direct Attach Copper Cables	HPE BladeSystem c-Class 10GbE SFP+ to SFP+ 1m Direct Attach Copper Cable	487652-B21
	HPE BladeSystem c-Class 10GbE SFP+ to SFP+ 3m Direct Attach Copper Cable	487655-B21
	HPE BladeSystem c-Class 10GbE SFP+ to SFP+ 5m Direct Attach Copper Cable	537963-B21
	HPE FlexNetwork X240 10G SFP+ to SFP+ 0.65m Direct Attach Copper Cable	JD095C
	HPE FlexNetwork X240 10G SFP+ to SFP+ 1.2m Direct Attach Copper Cable	JD096C
	HPE FlexNetwork X240 10G SFP+ to SFP+ 3m Direct Attach Copper Cable	JD097C

Configuration Information

HPE FlexNetwork X240 10G SFP+ to SFP+ 5m Direct Attach Copper Cable	JG081C
HPE FlexNetwork X240 10G SFP+ SFP+ 7m Direct Attach Copper Cable	JC784C

Step 5c - Choose Supported Options For SAS Infrastructure

Supported options

Mini SAS Cables

HPE 1.0m External Mini SAS High Density to Mini SAS Cable	716189-B21
HPE 2.0m External Mini SAS High Density to Mini SAS Cable	716191-B21
HPE 4.0m External Mini SAS High Density to Mini SAS Cable	716193-B21

NOTE: These cables are used to connect 6Gb SAS initiator to MSA 2050 SAS controller. These are not used for connecting to a disk enclosure.

HPE External 1.0m (3ft) Mini-SAS HD 4x to Mini-SAS HD 4x Cable	716195-B21
HPE External 2.0m (6ft) Mini-SAS HD 4x to Mini-SAS HD 4x Cable	716197-B21
HPE External 4.0m (13ft) Mini-SAS HD 4x to Mini-SAS HD 4x Cable	716199-B21

NOTE: These cables are used to connect 12Gb SAS initiator to MSA 2050 SAS controller. These are not used for connecting to a disk enclosure.

SAS Controllers/HBAs

HPE Smart Array E208e-p SR Gen10 (8 External Lanes/No Cache) 12G SAS PCIe Plug-in Controller	804398-B21
HPE Smart Array P408e-p SR Gen10 (8 External Lanes/4GB Cache) 12G SAS PCIe Plug-in Controller	804405-B21
HPE Smart Array P408e-m SR Gen10 (8 External Lanes/2GB Cache) 12G SAS Mezzanine Controller	804381-B21
HPE Smart Array P441/4GB FBWC 12Gb 2-ports Ext SAS Controller	726825-B21
HPE Smart Array P741m/2GB FBWC 12Gb 4-ports Ext Mezzanine SAS Controller	726782-B21
HPE H241 12Gb 2-ports Ext Smart Host Bus Adapter	726911-B21

Switches

HPE 6Gb SAS Switch Single Pack for HPE BladeSystem c-Class	BK763A
HPE 6Gb SAS Switch Dual Pack for HPE BladeSystem c-Class	BK764A

Step 6 – Software

NOTE: The MSA Advanced Virtualization software is available as an option on the MSA 2050.

HPE MSA Advanced Data Services Suite LTU	Q0H99A
HPE MSA Advanced Data Services Suite E-LTU	Q0H99AAE

NOTE:

- The Advanced Data Services Suite includes a Performance Tiering LTU, 512 Snapshot Software LTU, and the Remote Snap Software LTU.
- Individual Software titles are not available for sale on the MSA 2050.

Technical Specifications

MSA 2050	**POWER REQUIREMENTS**	
	Input Power Requirements (typical-running I/O) SFF/LFF arrays	110VAC 3.32A, 344-390 W; 220VAC 1.61A,374-432W
	Max Input Power	100-240 VAC, 50/60 Hz., 4.5-1.9A; 48-60 VDC 10.4A/8.3A
	Heat Dissipation	1622 BTU/hr
	TEMPERATURE AND HUMIDITY RANGES	
	Operating Temperature	41°F to 104°F (5°C to 40°C)
	Shipping Temperature	-40°F to 158°F (-40°C to 70°C)
	Operating Humidity	10% to 90% RH @ 104°F (40°C) non-condensing
	Non-Operating Humidity	Up to 93% RH @ 104°F (40°C)
	DECLARED ACOUSTIC NOISE LEVELS	
	Sound Power	A weighted sound power LWAd=6,75 B
	Sound Pressure	A weighted sound pressure LpAm - 55dB
	SHOCK AND VIBRATION	
	Shock, Operational	3G's for 11 milliseconds
	Shock, Non-Operational	15G 11ms half sine
	Vibration, Operational	5-500Hz, 0.14 Grms shaped
	Vibration, Non-Operational	3-365-3Hz, 1.22 Grms,z-axis,0.85 Grms, X&Y axis shaped spectrum
	PHYSICAL	
	Height	3.5 in/ 8.9 cm
	Depth (excluding cables) (back of ear to back of controller handle)	SFF 24-bay array: 19.5 in / 49.5 cm LFF 12-bay array: 22.5in. / 57.2 cm
	Width (body only)	17.6 in / 44.7 cm (w/ ears 19 in / 48.26 cm)
	Weight (Includes chassis and 2 controllers. No drives)	LFF chassis: 40.6 lbs. (18.4 kg) SFF chassis: 38.7 lbs (17.6 kg)
MSA 2050 Regulatory Info	**Safety**	UL 60950-1 (USA)
		CAN/CSA-C22.2 No.60950-1-03 (Canada)
		EN 60950-1 (European Union)
		GS mark (Germany)
		IEC 60950-1 (International)
		CCC Mark (power supply only, China PRC)
	Electromagnetic Compatibility	VCCI:2008-04 Class A (Japan)
		FCC 15:109(g) Class A (USA)
		ICES-003:2004 Class A (Canada)
		EN55022 : (European Union Class A); CISPR 22 (International Class A)
		EN61000-3-2 : (Harmonics) (European Union)
		EN61000-3-3 : (Flicker) (European Union)
		EN 55024 (European Union, Immunity, Class A);CISPR 24 (International Immunity, Class A)
		AS/NZS CISPR 22, Class A (Australia, New Zealand)
		CNS 13438 Taiwan, Class A (Taiwan)

Technical Specifications

	KN22 Class A (Emissions Class A); KN24 (Immunity) (S Korea)
RoHS and WEEE	RoHS-6/6 Compliance, China RoHS, WEEE
Country Approvals	United States ,Australia/New Zealand, Canada, China (PRC), European Union, Germany (GS Mark), Japan, South Korea, Taiwan

Summary of Changes

Date	Version History	Action	Description of Change
06-Aug-2018	From Version 8 to 9	Changed	Added I/O Workload Functionality.
02-Jul-2018	From Version 7 to 8	Added	Added SED SSDs and LDAP Support.
05-Mar-2018	From Version 6 to 7	Added	Added End-to-End Performance Metrics.
05-Feb-2018	From Version 5 to 6	Changed	Standard Features, Software, Configuration Information, and Technical Specifications were revised.
06-Nov-2017	From Version 4 to 5		Changes made throughout the QuickSpecs.
02-Oct-2017	From Version 3 to 4	Changed	Changes made to the Standard Features Section.
25-Sept-2017	From Version 2 to 3	Changed	Changes made throughout the QuickSpecs.
11-Jul-2017	From Version 1 to 2	Changes	Fixed Typos.
05-Jun-2017	Version 1	Created	Document Created.

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