Dell EMC PowerEdge Enterprise HDD Overview

Purpose: The document is intended to outline the Dell EMC PowerEdge HDD portfolio and explain basic concepts and terminology.

Dell EMC offers a range of enterprise hard disk drives (HDDs) for the PowerEdge server line to meet the demands of enterprise workloads. These enterprise HDDs have been through a very stringent qualification and validation process and are thoroughly tested with PowerEdge platforms and OpenManage Systems Management tools.

The **Performance Optimized** drives (10K and 15K SAS) are used in those applications requiring high reliability and performance and only available in 2.5" small form factor and only SAS interface.
The **Capacity Optimized** drives (7.2K Nearline SAS and SATA) may provide much higher capacities, but reliability and performance are not as high when compared to Mission Critical drives. They are available in both 2.5" small form factor and 3.5" large form factor. Table 1 shown below has a complete listing of capacity points for each drive category.

Overtime, new larger capacities will be introduced in line with the pace of HDD technology development, with lower latency and increased area density (for example: 2.4TB and 12TB recently released in CY2017 and 14TB will be available in CY2018). Working with leading drive manufacturers, Dell EMC continually offers innovative technologies to drive efficiency in your data center. In fact, Dell EMC works with multiple vendors in each capacity/performance/interface to expedite order fulfillment.

Table 1: Enterprise HDD Options for PowerEdge 13th Generation & 14th Generation
(Capacities in grey text are not offered on 14G)

Form Factor	Interface	Category	RPM (revolution per minute)	Sector Format	Capacity Options
2.5"	SAS	Mission Critical	15K	4Kn	600GB / 900GB
				512e	**900GB**
				512n	**300GB / 600GB / 900GB** 900GB FIPS SED
			10K	4Kn	1.8TB
				512e	**1.8TB / 2.4TB** 1.8TB / **2.4TB FIPS SED**
				512n	300GB **/ 600GB / 1.2TB** **1.2TB FIPS SED**
		Business Critical (Nearline)	7.2K	4Kn	2TB
				512n	**1TB / 2TB** 2TB FIPS SED
	SATA		7.2K	512n	**1TB / 2TB**
3.5"	SAS		7.2K	4Kn	**8TB** / 10TB
				512e	**8TB / 10TB / 12TB** **8TB / 12TB FIPS SED**
				512n	**2TB / 4TB** **4TB FIPS SED**
	SATA		7.2K	512e	**8TB / 10TB / 12TB**
				512n	**1TB / 2TB / 4TB**

Please contact your Dell sales representative for the latest information of PowerEdge HDDs, including roadmaps, and capacity points offering. (You can also view the HDD performance specifications).

Sector Formats

There has been a fundamental transition occurring in the HDD industry. The standard size of a basic unit of data (a sector on the disk) is changing from 512 physical bytes to 4096 physical bytes (referenced as 4Kn Advanced Format by IDEMA - International Disk Drive Equipment and Materials Association). Customers have been using applications and operating systems / file systems built on 512 bytes (512 native) for decades. This move to 4K byte sector size will impact those software stacks and will result in additional validation work as well as possible structural changes to software as the transition is made. Recognizing that some organizations may be reluctant to make a change, an emulation model of these drives has been created – the drive is built from 4K native technology, but allows for 512-byte addressing and transfer at the interface. These drives are known as 512e (4096 physical bytes recognized by host as 512 logical bytes). Both 4Kn and 512e are categorized as Advanced Format.

There are many aspects of modern computing systems that continue to assume that sectors are always 512 bytes. The Dell EMC PowerEdge HDD offering contains 512n drives, 512e drives, and drives in the 4Kn format.

- The 512n format is available for customers interested in maintaining the same drive type they have used over time.
- The 512e drives provide a 512 logical-byte sector size for those larger capacities not available in 512n.
- The 4Kn formatted drives are for those customers interested in adopting the latest, highest capacity HDDs and for those getting prepared for the future direction of the HDD industry. The newest, highest capacity HDDs that 4Kn sector format offers are also available in 512e sector format.

Table 2: Sector Format Types of HDD

Format type	Bytes per sector value (logical bytes)	Bytes per physical sector value (physical bytes)
512n	512	512
512e	512	4,096
4Kn	4,096	4,096

Form Factors

In general, 2.5” drives provide higher I/O density per rack space unit, where 3.5” drives provide higher capacity per rack space unit.

Table 3: Form factor, interface and RPM speed

HDD	Interface	SATA		NLSAS		SAS	
	Form Factor	2.5”	3.5”	2.5”	3.5”	2.5”	3.5”
Speed	7.2K	X	X	X	X		
	10K					X	
	15K					X	

HDD Interface and Speed

Three interface types (ranging from fastest to slowest):

- Serial Attached SCSI (SAS)
- Near Line SAS (NL-SAS)
- Serial ATA (SATA)

Drive speed, referencing the rotational speed of the drive spindles, is measured in revolutions per minute (RPM) and affects how quickly data can be accessed on a drive. For example, a 15K RPM drive can deliver faster seek times and subsequently greater IOPS performance compared to a slower 10K or 7.2K RPM drive. Maximum drive speeds vary across the interface types, as explained below.

SAS drives use a serial-attached SCSI interface for connecting to the server which provides a full bandwidth connection to each drive. This point-to-point controller interface delivers a speed advantage compared to SATA drives, which share the same interface among all drives on the bus. Additionally, a second advantage for SAS drives is that they are available in faster rotational speeds (up to 15K RPM) than NL-SAS or SATA drives (up to 7.2K RPM) which gives the SAS drives up to 2 times better seek times.

The next-fastest interface type is NL-SAS drives. NL-SAS drives also use the SAS interface, providing gains of up to 30% performance over traditional enterprise-class Serial ATA (SATA). NL-SAS drives, however, use a different media size to be able to offer greater overall capacity than SAS drives, but are limited to a rotational speed of 7.2K RPM. The primary benefit of NL-SAS drives is the ability to have large-capacity drives, while maintaining the faster speed of the SAS interface.

SATA drives are the slowest but also the most cost-efficient of the three interface options. The primary benefit of SATA drives is that they can provide large capacities of storage at lower cost when compared to SAS or even NL-SAS drives. Using an all-SATA drive configuration, Dell EMC PowerEdge servers can hold vast amounts of internal, low cost storage. Table 4 shows estimated IOPS performance and max capacity information for the three interface drive types.

Table 4: HDD characteristics and max capacity

	HDD 3.5”		HDD 2.5”			
	6Gbps SATA 7.2K RPM	12Gbps NLSAS 7.2K RPM	6Gbps SATA 7.2K RPM	12Gbps NLSAS 7.2K RPM	12Gbps SAS 10K RPM	12Gbps SAS 15K RPM
Random 8K transfer per command 70% Read/ 30% Write (Q depth = 4)	118	118	115	115	220	300
Max Size in GB (as of Feb 2018)	12TB	12TB	2TB	2TB	2.4TB	900GB

Today’s IT infrastructures are demanding and complex. They encompass many application profiles—including virtualization, email, file and print, collaboration platforms, other standard workloads, mixed workloads, virtual desktop infrastructure (VDI), and both online transaction processing (OLTP) and reporting (OLAP) for databases—each with unique storage requirements and budget. Having the optimal types and amounts of storage improves application performance and lets you take advantage of new technologies while simultaneously reducing capital and operating expenditures (CAPEX and OPEX).

In terms of use cases, HDDs provide a lower price-to-capacity ratio, which can be most beneficial for large-capacity workloads/applications requiring large amounts of storage used for data such as archives, disk backups, image libraries, or logs. Various types of HDDs can also be integrated as part of a multi-tiered storage strategy. For example, a Web store that includes a transactional database might have its less active Web content on an HDD tier and then utilize tiers of faster drives to house the more active database-driven content.

Depending on your workload type, you will prioritize storage device capabilities differently. Below, we discuss several capabilities and the media you would select for each.

- **Better performance measured in IOPS**- Storage performance for random workloads is usually measured in IOPS. When ordered in terms of general IOPS performance, choose SAS HDDs, NL-SAS HDDs, and SATA HDDs.
- **Better performance measured in throughput, or gigabytes per second (GB/s)-** Unless dealing with very heavy sequential workloads that would benefit from flash technology, HDDs are a good choice for most sequential workloads, such as media viewing or database logging. NAND caching can further boost the performance of HDD storage as necessary.
- **Lower latency**- If your workloads are sensitive to latency, internal storage on the server itself typically has less latency than storage on external arrays where longer fetch times over the network can greatly add to existing storage latency. It is important to note that SSDs present much lower latency than mechanical HDDs.
- **Greater capacity**-For capacity-driven workloads, such as email archives, disk-based backup, and object storage applications, high IOPS or throughput performance may be less of a priority as compared to capacity. In this case, choose cost-efficient HDDs, which can offer the greatest capacity at the lowest cost.

While HDDs generally provide lower performance and higher latency than SSDs, they are still an excellent option when used as part of a complete storage strategy that balances cost per GB, capacity, application needs, and performance.

Table 5: Example of mapping workloads to drive selection

Application	Example block size	Example Rd/Wr mix	Example Rnd/Seq mix	Example Storage Selection
Web server	4K, 8KB	95/5	75/25	RI SSD or Performance HDD
Email	32KB	50/50	100/0	MU SSD or Performance HDD
Web server logging	64KB	0/100	0/100	HDD
Media streaming	64KB	95/5	0/100	HDD
File server	8KB	90/10	75/25	RI SSD or Performance HDD
Transactional database (OLTP)	8KB	70/30	100/0	RI-MU SSD or Performance HDD
Decision Support System (DSS) database (OLAP)	1MB	100/0	0/100	HDD
Database transaction logging	64KB	0/100	0/100	HDD

Drives Security Overview

We added new levels of security on the enterprise drives for the 14th generation of servers. All drives have the capability to crypto erase data-at-rest with Instant Scramble Erase (ISE), complementing the System Erase server feature. For deeper levels of security, you can choose self-encrypting drives (SED) with Federal Information Processing Standard (FIPS). There is no performance delta between SSD/HDD with and without FIPS. Dell EMC recommends that you use FIPS-certified SEDs with a tamper-evident coating/sealing for maximum security to protect against unauthorized physical access. Certain regions may prohibit the sale of SEDs.

ISE (Instant Scramble Erase)

For the purposes of retiring or repurposing system or array, capabilities in 14G exist to optionally permanently erase customer content from HDDs/ SSDs within seconds. The System Erase feature is intended to be a solution to retire or repurpose a system. Drives are selected by erase category. The most secure form of erase method available is used to wipe content from each drive. Non-functional drives cannot be erased. Individual drive selection is not supported. Only drives within the system can be erased. Drives in external enclosures are not supported. System Erase offers these key benefits:

- **Speed** – executes fast, compared to a single-pass full disk write of 8 hours or more for a 4TB HDD
- **Thoroughness** – even physical locations of reassigned logical blocks are scrambled

Conclusion

With a thorough validation process, Dell EMC PowerEdge HDDs deliver seamless performance, optimal stability and easy lifecycle management integration. Dell EMC offers a broad selection of HDDs for the PowerEdge line to meet your workload requirements. New features include Instant Scramble Erase (ISE) and System Erase that allow you to safely retire or repurpose drives or servers.

Resources

Direct from Development- Why Choose Dell EMC Enterprise Class Drives?

Direct from Development- Dell EMC PowerEdge Security in Server Design

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