Intel P4500 Entry NVMe PCIe 3.0 x4 SSDs
Product Guide

The Intel P4500 Entry NVMe SSDs are general-purpose yet high-performance drives with a PCIe 3.0 x4 interface. They are designed for greater performance and endurance in a cost-effective design, and to support a broader set of workloads.

The Intel P4500 SSDs are based on Intel-developed controller, firmware, and leading manufacturing process NAND flash memory. Rigorous qualification and compatibility testing by Lenovo ensures a highly reliable SSD.



Figure 1. Intel P4500 Entry NVMe PCIe 3.0 x4 SSDs

Did You Know?

NVMe (Non-Volatile Memory Express) is a technology that overcomes SAS/SATA SSD performance limitations by optimizing hardware and software to take full advantage of flash technology. Intel Xeon processors efficiently transfer data in fewer clock cycles with the NVMe optimized software stack compared to the legacy Advance Host Controller Interface (AHCI) stack, thereby reducing latency and overhead. These SSDs connect directly to the processor via the PCIe bus, further reducing latency and TCO.

Part number information

The following table lists the ordering part numbers and feature codes for the SSDs.

Table 1. Ordering information

Part number	Feature	Description
Drives for ThinkSystem servers		
7SD7A05777	B11E	ThinkSystem U.2 Intel P4500 4.0TB Entry NVMe PCIe3.0 x4 Hot Swap SSD

The part numbers for the drives include the following items:

- One drive with a hot-swap tray attached
- Publication package

Features

Non-Volatile Memory Express (NVMe) is new PCIe 3.0 high performance SSD technology that provides high I/O throughput and low latency. NVMe interfaces remove SAS/SATA bottlenecks and unleash all of the capabilities of contemporary NAND flash memory. Each NVMe PCI SSD has direct PCIe 3.0 x4 connection, which provides at least 2x more bandwidth and 2x less latency than SATA/SAS-based SSD solutions. NVMe drives are also optimized for heavy multi-threaded workloads by using internal parallelism and many other improvements, such as enlarged I/O queues.

The Intel P4500 NVMe drives have the following key characteristics:

- PCIe 3.0 connection for each NVMe drive
- Ultra-low I/O latency, with an typical read latency of 10 µs and write latency of 13 µs
- Suitable for read-intensive workloads
- Available in capacities up to 4 TB
- Variable sector size and end-to-end data-path protection
- Enhanced power-loss data protection
- Thermal throttling and monitoring
- SMART health reporting

The key metric for solid state drives is their endurance (life expectancy). SSDs have a huge, but finite, number of program/erase (P/E) cycles, which determines how long the drives can perform write operations and thus their life expectancy. Performance SSDs have better endurance than Mainstream SSDs, which in turn have better endurance than Entry SSDs.

SSD write endurance is typically measured by the number of program/erase cycles that the drive can incur over its lifetime, which is listed as TBW in the device specification. The TBW value that is assigned to a solid-state device is the total bytes of written data that a drive can be guaranteed to complete. Reaching this limit does not cause the drive to immediately fail; the TBW simply denotes the maximum number of writes that can be guaranteed.

A solid-state device does not fail upon reaching the specified TBW, but at some point after surpassing the TBW value (and based on manufacturing variance margins), the drive reaches the end-of-life point, at which time the drive goes into read-only mode. Because of such behavior, careful planning must be done to use SSDs in the application environments to ensure that the TBW of the drive is not exceeded before the required life expectancy.

For example, the 1.0 TB P4500 drive has an endurance of 1,380 TB of total bytes written (TBW). This means that for full operation over five years, write workload must be limited to no more than 756 GB of writes per day, which is equivalent to 0.75 full drive writes per day (DWPD). For the device to last three years, the drive write workload must be limited to no more than 1,260 GB of writes per day, which is equivalent to 1.3 full drive writes per day.

Technical specifications

The following table present technical specifications for the Intel P4500 drives.

Table 2. Technical specifications

Feature	**1.0 TB drive**	**2.0 TB drive**	**4.0 TB drive**
Form factor	2.5-inch hot-swap	2.5-inch hot-swap	2.5-inch hot-swap
Interface	PCIe 3.0 x4	PCIe 3.0 x4	PCIe 3.0 x4
Capacity	1.0 TB	2.0 TB	4.0 TB
Endurance (total bytes written)	1.38 PB	1.89 PB	4.84 PB
Endurance (drive writes per day over 5 years)	0.75 DWPD	0.5 DWPD	0.65 DWPD
Data reliability	< 1 in 10^{17} bits read	< 1 in 10^{17} bits read	< 1 in 10^{17} bits read
MTBF, hours	2,000,000	2,000,000	2,000,000
IOPS read (4 KB blocks)	279,500	490,000	645,000
IOPS write (4 KB blocks)	30,500	38,000	62,500
Sequential read rate	3.2 GBps	3.2 GBps	3.2 GBps
Sequential write rate	0.6 GBps	1.05 GBps	1.8 GBps
Read access latency sequential*	10 µs	10 µs	10 µs
Read access latency random*	85 µs	85 µs	115 µs
Write access latency sequential*	13 µs	13 µs	13 µs
Write access latency random*	20 µs	20 µs	20 µs
Shock, operating	1,000 G (Max) at 0.5 ms	1,000 G (Max) at 0.5 ms	1,000 G (Max) at 0.5 ms
Vibration, max, operating	2.17 G_{RMS} (5-700 Hz)	2.17 GRMS (5-700 Hz)	2.17 GRMS (5-700 Hz)
Average power (Active Read / Active Write)	9.6 / 11 W	9.5 / 13.8 W	10.7 / 20.5 W

* Latency measured using 4 KB transfer size with queue depth = 1 on a sequential workload using Windows Server 2012 R2 drivers. Power mode set at 25W.

Server support - ThinkSystem

The following tables list the ThinkSystem servers that are compatible.

Table 3. ThinkSystem server support (Part 1)

Part number	Description	Intel 2S								AMD			
		ST550 (7X09/7X10)	SR530 (7X07/7X08)	SR550 (7X03/7X04)	SR570 (7Y02/7Y03)	SR590 (7X98/7X99)	SR630 (7X01/7X02)	SR650 (7X05/7X06)	SR670 (7Y36/37/38)	SR635 (7Y98/7Y99)	SR655 (7Y00/7Z01)	SR645 (7D2Y/7D2X)	SR665 (7D2W/7D2V)
7SD7A05777	ThinkSystem U.2 Intel P4500 4.0TB Entry NVMe PCIe3.0 x4 Hot Swap SSD	Y	N	N	Y	Y	Y	Y	N	N	N	N	N

Table 4. ThinkSystem server support (Part 2)

Part number	Description	E	1S Intel				4S Intel				Dense/ Blade			
		SE350 (7Z46/7D1X)	ST50 (7Y48/7Y50)	ST250 (7Y45/7Y46)	SR150 (7Y54)	SR250 (7Y51/7Y52)	SR850 (7X18/7X19)	SR850P (7D2F/2D2G)	SR860 (7X69/7X70)	SR950 (7X11/12/13)	SD530 (7X21)	SD650 (7X58)	SN550 (7X16)	SN850 (7X15)
7SD7A05777	ThinkSystem U.2 Intel P4500 4.0TB Entry NVMe PCIe3.0 x4 Hot Swap SSD	N	N	N	N	N	Y	Y	Y	Y	Y	N	Y	Y

Operating system support

The following tables list the supported operating systems for the drives:

- ThinkSystem drives

Tip: These tables are automatically generated based on data from Lenovo ServerProven.

Table 5. Operating system support for ThinkSystem U.2 Intel P4500 1TB Entry NVMe PCIe3.0 Hot Swap SSD, 7SD7A05779 (Part 1 of 2)

Operating systems	SR250	SD530 (Gen 2)	SN550 (Gen 2)	SN850 (Gen 2)	SR570 (Gen 2)	SR590 (Gen 2)	SR630 (Gen 2)	SR650 (Gen 2)	SR850 (Gen 2)	SR860 (Gen 2)	SR950 (Gen 2)	ST550 (Gen 2)
Microsoft Windows Server 2012 R2	N	N	N	N	N	N	N	N	N	N	N	N
Microsoft Windows Server 2016	Y	N	N	N	Y	Y	Y	Y	Y	Y	Y	Y
Microsoft Windows Server 2019	Y	N	N	N	Y	Y	Y	Y	Y	Y	Y	Y
Microsoft Windows Server version 1709	N	N	N	N	N	N	N	N	N	N	N	N
Microsoft Windows Server version 1803	N	N	N	N	N	N	N	N	N	N	N	N
Red Hat Enterprise Linux 6.10	N	N	N	N	N	N	N	N	N	N	N	N
Red Hat Enterprise Linux 6.9	N	N	N	N	N	N	N	N	N	N	N	N
Red Hat Enterprise Linux 7.3	N	N	N	N	N	N	N	N	N	N	N	N
Red Hat Enterprise Linux 7.4	N	N	N	N	N	N	N	N	N	N	N	N
Red Hat Enterprise Linux 7.5	Y	N	N	N	N	N	N	N	N	N	N	N
Red Hat Enterprise Linux 7.6	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Red Hat Enterprise Linux 8.0	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Red Hat Enterprise Linux 8.1	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Red Hat Enterprise Linux 8.2	Y	N	Y	N	Y	Y	Y	Y	Y	N	N	Y
SUSE Linux Enterprise Server 11 SP4	N	N	N	N	N	N	N	N	N	N	N	N
SUSE Linux Enterprise Server 12 SP2	N	N	N	N	N	N	N	N	N	N	N	N
SUSE Linux Enterprise Server 12 SP3	Y	N	N	N	N	N	N	N	N	N	N	N
SUSE Linux Enterprise Server 12 SP4	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
SUSE Linux Enterprise Server 12 SP5	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
SUSE Linux Enterprise Server 12 SP5 with Xen	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
SUSE Linux Enterprise Server 15	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
SUSE Linux Enterprise Server 15 SP1	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
VMware vSphere Hypervisor (ESXi) 6.0 U3	N	N	N	N	N	N	N	N	N	N	N	N
VMware vSphere Hypervisor (ESXi) 6.5 U1	N	N	N	N	N	N	N	N	N	N	N	N
VMware vSphere Hypervisor (ESXi) 6.5 U2	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
VMware vSphere Hypervisor (ESXi) 6.7	Y	N	N	N	N	N	N	N	N	N	N	N
VMware vSphere Hypervisor (ESXi) 6.7 U1	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
VMware vSphere Hypervisor (ESXi) 6.7 U2	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y

Table 6. Operating system support for ThinkSystem U.2 Intel P4500 1TB Entry NVMe PCIe3.0 Hot Swap SSD, 7SD7A05779 (Part 2 of 2)

Operating systems	SD530 (Gen 1)	SN550 (Gen 1)	SN850 (Gen 1)	SR570 (Gen 1)	SR590 (Gen 1)	SR630 (Gen 1)	SR650 (Gen 1)	SR850 (Gen 1)	SR860 (Gen 1)	SR950 (Gen 1)	ST550 (Gen 1)
Microsoft Windows Server 2012 R2	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Microsoft Windows Server 2016	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Microsoft Windows Server 2019	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	Y
Microsoft Windows Server version 1709	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Microsoft Windows Server version 1803	Y	Y	N	N	N	Y	Y	Y	Y	Y	N
Red Hat Enterprise Linux 6.10	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Red Hat Enterprise Linux 6.9	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Red Hat Enterprise Linux 7.3	Y	Y	Y	N	N	Y	Y	Y	N	Y	Y
Red Hat Enterprise Linux 7.4	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Red Hat Enterprise Linux 7.5	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Red Hat Enterprise Linux 7.6	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Red Hat Enterprise Linux 8.0	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Red Hat Enterprise Linux 8.1	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Red Hat Enterprise Linux 8.2	N	Y	N	Y	Y	Y	Y	Y	N	N	Y
SUSE Linux Enterprise Server 11 SP4	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
SUSE Linux Enterprise Server 12 SP2	Y	N	Y	N	N	Y	Y	Y	N	Y	Y
SUSE Linux Enterprise Server 12 SP3	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
SUSE Linux Enterprise Server 12 SP4	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
SUSE Linux Enterprise Server 12 SP5	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
SUSE Linux Enterprise Server 12 SP5 with Xen	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
SUSE Linux Enterprise Server 15	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
SUSE Linux Enterprise Server 15 SP1	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
VMware vSphere Hypervisor (ESXi) 6.0 U3	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
VMware vSphere Hypervisor (ESXi) 6.5 U1	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
VMware vSphere Hypervisor (ESXi) 6.5 U2	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
VMware vSphere Hypervisor (ESXi) 6.7	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
VMware vSphere Hypervisor (ESXi) 6.7 U1	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
VMware vSphere Hypervisor (ESXi) 6.7 U2	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y

Warranty

The Intel P4500 SSDs carry a 1-year, customer-replaceable unit (CRU) limited warranty. When installed in a supported Lenovo server, these drives assume the system's base warranty and any warranty upgrade.

Solid State Memory cells have an intrinsic, finite number of program/erase cycles that each cell can incur. As a result, each solid state device has a maximum amount of program/erase cycles to which it can be subjected. The warranty for Lenovo solid state drives (SSDs) is limited to drives that have not reached the maximum guaranteed number of program/erase cycles, as documented in the Official Published Specifications for the SSD product. A drive that reaches this limit may fail to operate according to its Specifications.

Physical specifications

The Intel P4500 drives have the following physical dimensions and weight:

- Height: 15 mm (0.6 in.)
- Width: 70 mm (2.8 in.)
- Depth: 100 mm (4.0 in.)
- Weight: up to 131 g (4.62 oz)

Operating environment

The Intel P4500 drives are supported in the following environment:

- Temperature (operational): 0 - 35 °C (32 - 95 °F) at 0 - 3,048 m (0 - 10,000 ft)
- Relative humidity: 5 - 95% (non-condensing)
- Maximum altitude (operational): 3,048 m (10,000 ft)
- Shock: 1,000 G (Max) at 0.5 ms
- Vibration: 2.17 G_{RMS} (5-700 Hz)

Agency approvals

The Intel P4500 drives conform to the following regulations:

- FCC Title 47, Part 15B, Class B
- CA/CSA-CEI/IEC CISPR 22:02
- EN 55024: 1998
- EN 55022: 2006
- EN-60950-1 2nd Edition
- UL/CSA EN-60950-1 2nd Edition
- Low Voltage Directive 2006/95/EC
- C-Tick: AS/NZS3584
- BSMI: CNS 13438
- KCC Article 11.1
- RoHS DIRECTIVE 2011/65/EU
- WEEE Directive 2002/96/EC

Related publications and links

For more information, see the following documents:

- Storage Options for ThinkSystem Servers
  https://lenovopress.com/lp0761-storage-options-for-thinksystem-servers
- ServerProven
  http://www.lenovo.com/us/en/serverproven
- Intel P4500 specifications
  https://www.intel.com/content/www/us/en/products/memory-storage/solid-state-drives/data-center-ssds/dc-p4500-series.html
- Intel P4500 product brief
  https://www.intel.com/content/www/us/en/solid-state-drives/ssd-dc-p4500-brief.html

Related product families

Product families related to this document are the following:

- Drives

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