

Intel P4500 Entry NVMe PCIe Flash Adapter Product Guide (withdrawn product)

The Intel P4500 Entry NVMe Flash Adapters are general-purpose yet high-performance flash storage adapters 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 adapters 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. ThinkSystem HHHL Intel P4500 Entry NVMe PCIe 3.0 x4 Flash Adapter

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 adapters 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 adapters.

Withdrawn from marketing: The Intel P4500 adapters are now withdrawn from marketing.

Table 1. Ordering information

Part number	Feature	Description
7SD7A05776	B11Z	ThinkSystem HHHL Intel P4500 4.0TB Entry NVMe PCIe3.0 x4 Flash Adapter
7SD7A05775	B120	ThinkSystem HHHL Intel P4500 8.0TB Entry NVMe PCIe3.0 x4 Flash Adapter

The part numbers for the adapters include the following items:

- One adapter with full-height (3U) PCIe bracket attached
- Separate low-profile (2U) PCIe bracket
- Documentation

Features

Non-Volatile Memory Express (NVMe) is new PCIe 3.0 high performance flash technology that provides high I/O throughput and low latency. NVMe interfaces remove SAS/SATA bottlenecks found in solid-state drives and unleash all of the capabilities of contemporary NAND flash memory. The flash adapter has a PCIe 3.0 x4 connection which provides at least 2x more bandwidth and 2x less latency than SATA/SAS-based solid-stage drive solutions. NVMe adapters 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 adapters have the following key characteristics:

- PCIe 3.0 x4 host connection
- Ultra-low I/O latency, with an typical read latency of 10 μ s and write latency of 13 μ s
- Suitable for read-intensive workloads
- Available in 4 TB and 8 TB capacities
- 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 flash storage adapters, like solid-state drives, is their endurance (life expectancy). Flash adapters have a huge, but finite, number of program/erase (P/E) cycles, which determines how long the devices can perform write operations and thus their life expectancy. Performance flash adapters have better endurance than Mainstream flash adapters, which in turn have better endurance than Entry flash adapters like the P4500.

Flash adapter write endurance is typically measured by the number of program/erase cycles that the adapter 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 device can be guaranteed to complete. Reaching this limit does not cause the device 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 adapter reaches the end-of-life point, at which time the adapter goes into read-only mode. Because of such behavior, careful planning must be done to use flash adapters in the application environments to ensure that the TBW of the adapter is not exceeded before the required life expectancy.

For example, the P4500 Entry 4 TB adapter has an endurance of 4.84 PB of total bytes written (TBW). This means that for full operation over five years, write workload must be limited to no more than 2.65 TB of writes per day, which is equivalent to 0.65 full drive writes per day (DWPD). For the device to last three years, the drive write workload must be limited to no more than 4.42 TB of writes per day, which is equivalent to 1.1 full drive writes per day.

Technical specifications

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

Table 2. Technical specifications

Feature	4.0 TB adapter	8.0 TB adapter
Form factor	Low profile (HHHL) adapter	Low profile (HHHL) adapter
Interface	PCIe 3.0 x4	PCIe 3.0 x4
Capacity	4.0 TB	8.0 TB
Endurance (total bytes written)	4.84 PB	7.08 PB
Endurance (drive writes per day over 5 years)	0.65 DWPD	0.5 DWPD
Data reliability	< 1 in 10 ¹⁷ bits read	< 1 in 10 ¹⁷ bits read
MTBF, hours	2,000,000	2,000,000
IOPS read (4 KB blocks)	645,000	605,000
IOPS write (4 KB blocks)	62,500	53,000
Sequential read rate	3.2 GBps	3.2 GBps
Sequential write rate	1.8 GBps	1.875 GBps
Read access latency sequential*	10 µs	10 µs
Read access latency random*	85 µs	85 µs
Write access latency sequential*	13 µs	13 µs
Write access latency random*	20 µs	20 µs
Shock, operating	50 G Trapezoidal, 170 in/s	50 G Trapezoidal, 170 in/s
Vibration, max, operating	2.17 G _{RMS} (5-700 Hz)	2.17 G _{RMS} (5-700 Hz)
Average power (Active Read / Active Write)	10.7 / 20.5 W	10.0 / 20.0 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

The following table lists the ThinkSystem servers that are compatible.

Table 3. ThinkSystem server support

Part number	Description	1S Rack & Tower				2S Rack & Tower							4S Rack			Dense/ Blade				
		ST50 (7Y48/7Y50)	ST250 (7Y45/7Y46)	SR150 (7Y54)	SR250 (7Y51/7Y52)	ST550 (7X09/7X10)	SR530 (7X07/7X08)	SR550 (7X03/7X04)	SR570 (7Y02/7Y03)	SR590 (7X98/7X99)	SR630 (7X01/7X02)	SR650 (7X05/7X06)	SR670 (7Y36/7Y37/7Y38)	SR850 (7X18/7X19)	SR860 (7X69/7X70)	SR950 (7X11/12/13)	SD530 (7X21)	SD650 (7X58)	SN550 (7X16)	SN850 (7X15)
7SD7A05776	ThinkSystem HHHH Intel P4500 4.0TB Entry NVMe PCIe3.0 x4 Flash Adapter	N	N	N	N	N	N	N	Y	Y	Y	Y	N	Y	Y	Y	Y	N	N	N
7SD7A05775	ThinkSystem HHHH Intel P4500 8.0TB Entry NVMe PCIe3.0 x4 Flash Adapter	N	N	N	N	N	N	N	Y	Y	Y	Y	N	Y	Y	Y	Y	N	N	N

Operating system support

The adapters support the following operating systems:

Tip: These tables are automatically generated based on data from [Lenovo ServerProven](#).

Table 4. Operating system support for ThinkSystem HHHL Intel P4500 4.0TB Entry NVMe PCIe3.0 x4 Flash Adapter, 7SD7A05776

Operating systems	SD530 (Xeon Gen 2)	SR570 (Xeon Gen 2)	SR590 (Xeon Gen 2)	SR630 (Xeon Gen 2)	SR650 (Xeon Gen 2)	SR850 (Xeon Gen 2)	SR860 (Xeon Gen 2)	SR950 (Xeon Gen 2)	SD530 (Xeon Gen 1)	SR570 (Xeon Gen 1)	SR590 (Xeon Gen 1)	SR630 (Xeon Gen 1)	SR650 (Xeon Gen 1)	SR850 (Xeon Gen 1)	SR860 (Xeon Gen 1)	SR950 (Xeon Gen 1)	x3550 M5 (5463)
Microsoft Windows Server 2012 R2	N	N	N	N	N	N	N	N	Y	Y	Y	Y	Y	Y	Y	Y	N
Microsoft Windows Server 2016	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	N
Microsoft Windows Server 2019	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	N
Microsoft Windows Server version 1709	N	N	N	N	N	N	N	N	Y	Y	Y	Y	Y	Y	Y	Y	N
Microsoft Windows Server version 1803	N	N	N	N	N	N	N	N	Y	N	N	Y	Y	Y	Y	Y	N
Red Hat Enterprise Linux 6.9	N	N	N	N	N	N	N	N	Y	Y	Y	Y	Y	Y	Y	Y	N
Red Hat Enterprise Linux 7.3	N	N	N	N	N	N	N	N	Y	N	N	Y	Y	Y	N	Y	N
Red Hat Enterprise Linux 7.4	N	N	N	N	N	N	N	N	Y	Y	Y	Y	Y	Y	Y	Y	N
Red Hat Enterprise Linux 7.5	N	N	N	N	N	N	N	N	Y	Y	Y	Y	Y	Y	Y	Y	N
Red Hat Enterprise Linux 7.6	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	N
Red Hat Enterprise Linux 8.0	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	N
Red Hat Enterprise Linux 8.1	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	N
Red Hat Enterprise Linux 8.2	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	N
SUSE Linux Enterprise Server 11 SP4	N	N	N	N	N	N	N	N	Y	Y	Y	Y	Y	Y	Y	Y	N
SUSE Linux Enterprise Server 12 SP2	N	N	N	N	N	N	N	N	Y	N	N	Y	Y	Y	N	Y	N
SUSE Linux Enterprise Server 12 SP3	N	N	N	N	N	N	N	N	Y	Y	Y	Y	Y	Y	Y	Y	N
SUSE Linux Enterprise Server 12 SP4	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	N
SUSE Linux Enterprise Server 12 SP5	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	N
SUSE Linux Enterprise Server 12 SP5 with Xen	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	N
SUSE Linux Enterprise Server 15	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	N
SUSE Linux Enterprise Server 15 SP1	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	N
SUSE Linux Enterprise Server 15 SP1 with Xen	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	N
SUSE Linux Enterprise Server 15 SP2	N	N	Y	N	Y	N	N	N	N	N	Y	N	Y	N	N	N	N
VMware vSphere Hypervisor (ESXi) 6.0 U3	N	N	N	N	N	N	N	N	Y	Y	Y	Y	Y	Y	Y	Y	N
VMware vSphere Hypervisor (ESXi) 6.5	N	N	N	N	N	N	N	N	Y	N	N	Y	N	Y	N	Y	Y
VMware vSphere Hypervisor (ESXi) 6.5 U1	N	N	N	N	N	N	N	N	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	Y	Y	Y	Y	Y	Y
VMware vSphere Hypervisor (ESXi) 6.7	N	N	N	N	N	N	N	N	Y	Y	Y	Y	Y	Y	Y	Y	N
VMware vSphere Hypervisor (ESXi) 6.7 U2	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	N

Table 5. Operating system support for ThinkSystem HHHL Intel P4500 8.0TB Entry NVMe PCIe3.0 Flash Adapter, 7SD7A05775

Operating systems	SD530 (Xeon Gen 2)	SR590 (Xeon Gen 2)	SR630 (Xeon Gen 2)	SR650 (Xeon Gen 2)	SR850 (Xeon Gen 2)	SR860 (Xeon Gen 2)	SR950 (Xeon Gen 2)	SD530 (Xeon Gen 1)	SR570 (Xeon Gen 1)	SR590 (Xeon Gen 1)	SR630 (Xeon Gen 1)	SR650 (Xeon Gen 1)	SR850 (Xeon Gen 1)	SR860 (Xeon Gen 1)	SR950 (Xeon Gen 1)
Microsoft Windows Server 2012 R2	N	N	N	N	N	N	N	Y	N	Y	Y	Y	Y	Y	Y
Microsoft Windows Server 2016	Y	Y	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	Y	Y
Microsoft Windows Server 2019	Y	Y	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	Y	Y
Microsoft Windows Server version 1709	N	N	N	N	N	N	N	Y	Y	Y	Y	Y	Y	Y	Y
Microsoft Windows Server version 1803	N	N	N	N	N	N	N	Y	N	N	Y	Y	Y	Y	Y
Red Hat Enterprise Linux 6.9	N	N	N	N	N	N	N	Y	N	Y	Y	Y	Y	Y	Y
Red Hat Enterprise Linux 7.3	N	N	N	N	N	N	N	Y	N	N	Y	Y	Y	N	Y
Red Hat Enterprise Linux 7.4	N	N	N	N	N	N	N	Y	N	Y	Y	Y	Y	Y	Y
Red Hat Enterprise Linux 7.5	N	N	N	N	N	N	N	Y	N	Y	Y	Y	Y	Y	Y
Red Hat Enterprise Linux 7.6	Y	Y	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	Y	Y
Red Hat Enterprise Linux 8.0	Y	Y	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	Y	Y
Red Hat Enterprise Linux 8.1	Y	Y	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	Y	Y
Red Hat Enterprise Linux 8.2	Y	Y	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	Y	Y
SUSE Linux Enterprise Server 11 SP4	N	N	N	N	N	N	N	Y	N	Y	Y	Y	Y	Y	Y
SUSE Linux Enterprise Server 12 SP2	N	N	N	N	N	N	N	Y	N	N	Y	Y	Y	N	Y
SUSE Linux Enterprise Server 12 SP3	N	N	N	N	N	N	N	Y	N	Y	Y	Y	Y	Y	Y
SUSE Linux Enterprise Server 12 SP4	Y	Y	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	Y	Y
SUSE Linux Enterprise Server 12 SP5	Y	Y	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	Y	Y
SUSE Linux Enterprise Server 12 SP5 with Xen	Y	Y	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	Y	Y
SUSE Linux Enterprise Server 15	Y	Y	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	Y	Y
SUSE Linux Enterprise Server 15 SP1	Y	Y	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	Y	Y
SUSE Linux Enterprise Server 15 SP1 with Xen	Y	Y	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	Y	Y
SUSE Linux Enterprise Server 15 SP2	N	Y	N	Y	N	N	N	N	N	Y	N	Y	N	N	N
VMware vSphere Hypervisor (ESXi) 6.0 U3	N	N	N	N	N	N	N	Y	N	Y	Y	Y	Y	Y	Y
VMware vSphere Hypervisor (ESXi) 6.5	N	N	N	N	N	N	N	Y	N	N	Y	Y	Y	N	Y
VMware vSphere Hypervisor (ESXi) 6.5 U1	N	N	N	N	N	N	N	Y	N	Y	Y	Y	Y	Y	Y
VMware vSphere Hypervisor (ESXi) 6.5 U2	Y	Y	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	Y	Y
VMware vSphere Hypervisor (ESXi) 6.7	N	N	N	N	N	N	N	Y	N	Y	Y	Y	Y	Y	Y
VMware vSphere Hypervisor (ESXi) 6.7 U2	Y	Y	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	Y	Y

Warranty

The Intel P4500 adapters carry a 1-year, customer-replaceable unit (CRU) limited warranty. When installed in a supported Lenovo server, these adapters assume the server'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 flash storage adapters is limited to adapters that have not reached the maximum guaranteed number of program/erase cycles, as documented in the Official Published Specifications for the product. An adapter that reaches this limit may fail to operate according to its Specifications.

Physical specifications

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

- Height: 68 mm (2.67 in.)
- Length: 168 mm (6.6 in.)
- Thickness: 19 mm (0.74 in.)
- Weight: up to 182 g (6.42 oz)

Operating environment

The Intel P4500 adapters 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)

Agency approvals

The Intel P4500 adapters 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:

- [PCIe Flash Adapters](#)

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This document, LP0850, was created or updated on March 18, 2019.

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