Intel P4600 Mainstream NVMe PCIe 3.0 x4 Flash Adapters

Product Guide (withdrawn product)

The Intel P4600 Mainstream NVMe Flash Adapters are advanced server storage adapters optimized for mixed read-write performance, endurance, and strong data protection for Lenovo ThinkSystem servers. They are designed for greater performance and endurance in a cost-effective design, and to support a broader set of workloads.

The Intel P4600 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 storage adapter.

Figure 1. ThinkSystem HHHL Intel P4600 Mainstream NVMe PCIe3.0 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Withdrawn: P4600 Mainstream NVMe Flash Adapters are now withdrawn from marketing.

Table 1. Ordering information

Part number	Feature	Description
7SD7A05769	B11X	ThinkSystem HHHL Intel P4600 2.0TB Mainstream NVMe PCIe3.0 x4 Flash Adapter
7SD7A05768	B11Y	ThinkSystem HHHL Intel P4600 4.0TB Mainstream 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 P4600 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 µs and write latency of 13 µs
- Suitable for mixed read-write workloads
- 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 like the P4600, which in turn have better endurance than Entry flash adapters.

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 2.0 TB P4600 drive has an endurance of 11,080 TB of total bytes written (TBW). This means that for full operation over five years, write workload must be limited to no more than 6,071 GB of writes per day, which is equivalent to 3.0 full drive writes per day (DWPD). For the device to last three years, the drive write workload must be limited to no more than 10,119 GB of writes per day, which is equivalent to 5.1 full drive writes per day.

Technical specifications

The following table present technical specifications for the Intel P4600 adapters.

Table 2. Technical specifications

Feature	**2.0 TB adapter**	**4.0 TB adapter**
Interface	PCIe 3.0 x4	PCIe 3.0 x4
Capacity	2.0 TB	4.0 TB
Endurance (total bytes written)	11.08 PB	23.23 PB
Endurance (drive writes per day over 5 years)	3.0 DWPD	3.2 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)	610,850	617,500
IOPS write (4 KB blocks)	196,650	225,000
Sequential read rate	3.2 GBps	3.2 GBps
Sequential write rate	1.575 GBps	1.9 GBps
Read access latency sequential*	10 µs	10 µs
Read access latency random*	85 µs	115 µs
Write access latency sequential*	13 µs	13 µs
Write access latency random*	15 µs	15 µs
Shock, operating	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 G_{RMS} (5-700 Hz)
Average power (Active Read / Active Write)	9.4 / 17.0 W	9.6 / 22.2 W

* Latency measured using 4 KB transfer size with queue depth = 1

Server support

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)
7SD7A05769	ThinkSystem HHHL Intel P4600 2.0TB Mainstream NVMe PCIe3.0 x4 Flash Adapter	N	N	N	Y	Y	Y	Y	N	N	N	N	N
7SD7A05768	ThinkSystem HHHL Intel P4600 4.0TB Mainstream NVMe PCIe3.0 x4 Flash Adapter	N	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)
7SD7A05769	ThinkSystem HHHL Intel P4600 2.0TB Mainstream NVMe PCIe3.0 x4 Flash Adapter	N	N	N	N	N	Y	Y	Y	Y	Y	N	N	N
7SD7A05768	ThinkSystem HHHL Intel P4600 4.0TB Mainstream NVMe PCIe3.0 x4 Flash Adapter	N	N	N	N	N	Y	N	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 5. Operating system support for ThinkSystem HHHL Intel P4600 2.0TB Mainstream NVMe PCIe3.0 Flash Adapter, 7SD7A05769

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)	SR850P (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	N	N	Y	Y	Y	Y	Y	Y	Y	N
Microsoft Windows Server 2016	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	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	Y
Microsoft Windows Server version 1709	N	N	N	N	N	N	N	N	N	Y	Y	N	Y	Y	Y	N	N
Microsoft Windows Server version 1803	N	N	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	N	N	Y	Y	Y	Y	Y	Y	Y	Y
Red Hat Enterprise Linux 7.3	N	N	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	N	N	Y	Y	Y	Y	Y	Y	Y	Y
Red Hat Enterprise Linux 7.5	N	N	N	N	N	N	N	N	N	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	Y	Y	Y	Y	Y	Y
Red Hat Enterprise Linux 8.0	Y	Y	Y	Y	Y	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	Y	Y	Y	Y	Y
Red Hat Enterprise Linux 8.2	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
SUSE Linux Enterprise Server 11 SP4	N	N	N	N	N	N	N	N	N	Y	Y	Y	Y	Y	Y	Y	Y
SUSE Linux Enterprise Server 12 SP2	N	N	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	Y	N	N	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	Y	Y	Y	Y	Y	Y
SUSE Linux Enterprise Server 12 SP5	Y	Y	Y	Y	Y	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	Y	Y	Y	Y	Y
SUSE Linux Enterprise Server 15	Y	Y	Y	Y	Y	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	Y	Y	Y	Y	Y
SUSE Linux Enterprise Server 15 SP1 with Xen	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
SUSE Linux Enterprise Server 15 SP2	N	N	Y	N	Y	N	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	N	N	Y	Y	Y	N	Y	Y	Y	N
VMware vSphere Hypervisor (ESXi) 6.5	N	N	N	N	N	N	N	N	N	Y	N	N	N	Y	Y	N	N
VMware vSphere Hypervisor (ESXi) 6.5 U1	N	N	N	N	N	N	N	N	N	Y	Y	Y	N	Y	Y	Y	N
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	N	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	Y	Y	Y	Y	Y

Table 6. Operating system support for ThinkSystem HHHL Intel P4600 4.0TB Mainstream NVMe PCIe3.0 Flash Adapter, 7SD7A05768

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)
Microsoft Windows Server 2012 R2	N	N	N	N	N	N	N	N	Y	Y	Y	Y	Y	Y	Y	N
Microsoft Windows Server 2016	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	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
Microsoft Windows Server version 1709	N	N	N	N	N	N	N	N	Y	Y	N	Y	Y	Y	N	N
Microsoft Windows Server version 1803	N	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	N	Y	Y	Y	Y	Y	Y	Y	Y
Red Hat Enterprise Linux 7.3	N	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	N	Y	Y	Y	Y	Y	Y	Y	Y
Red Hat Enterprise Linux 7.5	N	N	N	N	N	N	N	N	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	Y	Y	Y	Y	Y
Red Hat Enterprise Linux 8.0	Y	Y	Y	Y	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	Y	Y	Y	Y
Red Hat Enterprise Linux 8.2	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
SUSE Linux Enterprise Server 11 SP4	N	N	N	N	N	N	N	N	Y	Y	Y	Y	Y	Y	Y	Y
SUSE Linux Enterprise Server 12 SP2	N	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	N	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	Y	Y	Y	Y	Y
SUSE Linux Enterprise Server 12 SP5	Y	Y	Y	Y	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	Y	Y	Y	Y
SUSE Linux Enterprise Server 15	Y	Y	Y	Y	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	Y	Y	Y	Y
SUSE Linux Enterprise Server 15 SP1 with Xen	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
SUSE Linux Enterprise Server 15 SP2	N	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	N	Y	Y	Y	N	Y	Y	Y	N
VMware vSphere Hypervisor (ESXi) 6.5	N	N	N	N	N	N	N	N	Y	N	N	N	Y	Y	N	N
VMware vSphere Hypervisor (ESXi) 6.5 U1	N	N	N	N	N	N	N	N	Y	Y	Y	N	Y	Y	Y	N
VMware vSphere Hypervisor (ESXi) 6.5 U2	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
VMware vSphere Hypervisor (ESXi) 6.7 U2	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y

Warranty

The Intel P4600 adapters carry a 1-year, customer-replaceable unit (CRU) limited warranty. When installed in a supported Lenovo server, these adapters 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 P4600 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 P4600 adapters are supported in the following environment:

- Temperature (operational): 0 - 55 °C (32 - 131 °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 P4600 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 P4600 specifications
  https://www.intel.com/content/www/us/en/products/memory-storage/solid-state-drives/data-center-ssds/dc-p4600-series.html
- Intel P4600 product brief
  https://www.intel.com/content/www/us/en/solid-state-drives/ssd-dc-p4600-brief.html

Related product families

Product families related to this document are the following:

- PCIe Flash Adapters

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