Lenovo PX04PMC NVMe Performance Flash Adapters

Product Guide (withdrawn product)

The Lenovo PX04PMC NVMe Performance Flash Adapters in capacities of 1.6 TB and 3.2 TB are advanced data center PCIe Flash Storage Adapters optimized for write-intensive performance, endurance, and strong data protection for ThinkSystem servers. They are engineered for high performance and endurance in a cost-effective design, and to support a broader set of workloads.

Suggested uses: write-intensive applications, high performance computing (HPC), and online transaction processing (OLTP).

Figure 1. Lenovo PX04PMC NVMe Performance 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. The use of NVMe Flash Storage Adapters means data is transferred more efficiently from the processor to the storage compared to the legacy Advance Host Controller Interface (AHCI) stack, thereby reducing latency and overhead. These Flash Storage Adapters connect directly to the processor via the PCIe bus, further reducing latency and TCO compared to SAS/SATA SSDs.

Lenovo Performance Flash Storage Adapters are suitable for write-intensive data center workloads, and the PCIe form factor rather than a 2.5-inch drive form factor gives you an alternative way to add high performance storage to your server. Overall, these adapters provide outstanding IOPS/watt and cost/IOPS for enterprise solutions.

Part number information

The following tables list the part numbers to order the adapters.

Withdrawn: All adapters are now withdrawn from marketing.

Table 1. Part numbers and feature codes

Part number	Feature code	Description
7XB7A05925	AWG8	ThinkSystem HHHL PX04PMC 1.6TB Performance NVMe PCIe 3.0 x4 Flash Adapter
7XB7A05924	AWG9	ThinkSystem HHHL PX04PMC 3.2TB Performance NVMe PCIe 3.0 x4 Flash Adapter

The part numbers include the following items:

- One adapter with full-height (3U) PCIe bracket attached
- Separate low-profile (2U) PCIe bracket
- Publications flyer
- Support flyer for solid-state devices

Features

Non-Volatile Memory Express (NVMe) is new PCIe 3.0 high performance solid-state storage 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 Flash Storage Adapter has direct PCIe 3.0 x4 connection, which provides at least 2x greater bandwidth and 2x lower latency than SATA/SAS-based SSD solutions. NVMe Flash Storage Adapters are also optimized for heavy multi-threaded workloads by using internal parallelism and many other improvements, such as larger I/O queues.

The Lenovo NVMe Performance Flash Adapters have the following features:

- Half-high half-length PCIe adapter with PCIe 3.0 x4 host interface
- Based on the Toshiba PX04P Add-in Card (AIC), PX04PMCxxx
- 19nm MLC NAND (128 Gb/die)
- 10 drive-write-per-day (DWPD) endurance for write-intensive workloads
- Full Power-Loss-Protection and End-to-End Data Protection
- Low power consumption (maximum 18.5 W)

Enterprise Performance Flash Adapters and Enterprise Mainstream Flash Adapters have similar read IOPS performance, but the key difference between them is their endurance (or lifetime) (that is, how long they can perform write operations because Flash Adapters (like SSDs) have a finite number of program/erase (P/E) cycles). Enterprise Performance Flash Adapters have higher endurance compared to Enterprise Mainstream Flash Adapters. Write endurance is typically measured by the number of program/erase (P/E) cycles that the adapter incurs over its lifetime, listed as the total bytes of written data (TBW) in the device specification.

The TBW value assigned to a Flash Adapter is the total bytes of written data (based on the number of P/E cycles) that an adapter can be guaranteed to complete (% of remaining P/E cycles = % of remaining TBW). Reaching this limit does not cause the adapter to immediately fail. It simply denotes the maximum number of writes that can be guaranteed. A Flash Adapter will not fail upon reaching the specified TBW. At some point based on manufacturing variance margin, after surpassing the TBW value, the adapter will reach the end-of-life point, at which the adapter will go into a read-only mode.

Even though Enterprise Performance Flash Adapters have high endurance, careful planning must still be done to ensure that the total amount of data expected to be written to the drive over its life will not exceed the stated total bytes written (TBW) property of the drive.

For example, the 1.6 TB adapter has an endurance of 29,200 TB of total bytes written (TBW). This means that for full operation over five years, write workload must be limited to no more than 16 TB of writes per day, which is equivalent to 10.0 full "drive" writes per day (DWPD). For the device to last three years, the write workload must be limited to no more than 26,667 GB of writes per day, which is equivalent to 16.7 full drive writes per day.

Technical specifications

The following tables present technical specifications for the Lenovo PX04PMC NVMe Performance Flash Adapters.

Table 2. Technical specifications

Feature	**1.6 TB adapter**	**3.2 TB adapter**
Interface	PCIe 3.0 x4	PCIe 3.0 x4
Capacity	1.6 TB	3.2 TB
Endurance (total bytes written)	29,200 TB	58,400 TB
Endurance (drive writes per day for 5 years)	10.0 DWPD	10.0 DWPD
Data reliability (UBER)	< 1 in 10^{17} bits read	< 1 in 10^{17} bits read
MTBF	2,000,000 hours	2,000,000 hours
IOPS reads (4 KB blocks)	660,000	660,000
IOPS writes (4 KB blocks)	185,000	185,000
Sequential read rate (128 KB blocks)	3100 MBps	3100 MBps
Sequential write rate (128 KB blocks)	2350 MBps	2350 MBps
Latency (random read)	100 µs	100 µs
Latency (random write)	30 µs	30 µs
Maximum power	18.5 W	18.5 W

Server support

The following table lists the ThinkSystem servers that are compatible.

Table 3. ThinkSystem server support

Part number	Description	2S Rack & Tower							4S Rack			Dense/ Blade		
		ST550 (7X09/7X10)	SR530 (7X07/7X08)	SR550 (7X03/7X04)	SR570 (7Y02/7Y03)	SR590 (7X98/7X99)	SR630 (7X01/7X02)	SR650 (7X05/7X06)	SR850 (7X18/7X19)	SR860 (7X69/7X70)	SR950 (7X11/12/13)	SD530 (7X21)	SN550 (7X16)	SN850 (7X15)
7XB7A05925	ThinkSystem HHHL PX04PMC 1.6TB Performance NVMe PCIe 3.0 x4 Flash Adapter	N	N	N	N	N	Y	Y	Y	Y	Y	Y	N	N
7XB7A05924	ThinkSystem HHHL PX04PMC 3.2TB Performance NVMe PCIe 3.0 x4 Flash Adapter	N	N	N	N	N	Y	Y	Y	Y	Y	Y	N	N

Operating system support

The following table lists the supported operating systems:

Tip: This table is automatically generated based on data from Lenovo ServerProven.

Table 4. Operating system support for ThinkSystem HHHL PX04PMC 1.6TB Performance NVMe PCIe 3.0 x4 Flash Adapter, 7XB7A05925

Operating systems	SD530 (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)	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	Y	Y	Y	Y	Y	Y
Microsoft Windows Server 2016	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Microsoft Windows Server 2019	Y	Y	Y	Y	Y	Y	N	Y	N	N	N	Y
Microsoft Windows Server 2022	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Microsoft Windows Server version 1709	N	N	N	N	N	N	Y	Y	Y	Y	Y	Y
Microsoft Windows Server version 1803	N	N	N	N	N	N	Y	Y	Y	Y	Y	Y
Red Hat Enterprise Linux 6.10	N	N	N	N	N	N	Y	Y	Y	Y	Y	Y
Red Hat Enterprise Linux 6.9	N	N	N	N	N	N	Y	Y	Y	Y	Y	Y
Red Hat Enterprise Linux 7.3	N	N	N	N	N	N	Y	Y	Y	Y	N	Y
Red Hat Enterprise Linux 7.4	N	N	N	N	N	N	Y	Y	Y	Y	Y	Y
Red Hat Enterprise Linux 7.5	N	N	N	N	N	N	Y	Y	Y	Y	Y	Y
Red Hat Enterprise Linux 7.6	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y

Operating systems	SD530 (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)	SR630 (Xeon Gen 1)	SR650 (Xeon Gen 1)	SR850 (Xeon Gen 1)	SR860 (Xeon Gen 1)	SR950 (Xeon Gen 1)
Red Hat Enterprise Linux 7.7	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Red Hat Enterprise Linux 7.8	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Red Hat Enterprise Linux 7.9	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
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	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Red Hat Enterprise Linux 8.3	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Red Hat Enterprise Linux 8.4	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Red Hat Enterprise Linux 8.5	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Red Hat Enterprise Linux 9.0	Y	Y	Y	Y	Y	Y	N	N	N	N	N	N
SUSE Linux Enterprise Server 11 SP4	N	N	N	N	N	N	Y	Y	Y	Y	Y	Y
SUSE Linux Enterprise Server 12 SP2	N	N	N	N	N	N	Y	Y	Y	Y	N	Y
SUSE Linux Enterprise Server 12 SP2 with Xen	N	N	N	N	N	N	Y	Y	N	Y	N	Y
SUSE Linux Enterprise Server 12 SP3	N	N	N	N	N	N	Y	Y	Y	Y	Y	Y
SUSE Linux Enterprise Server 12 SP3 with Xen	N	N	N	N	N	N	Y	Y	Y	Y	Y	Y
SUSE Linux Enterprise Server 12 SP4	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
SUSE Linux Enterprise Server 12 SP4 with Xen	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
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	N	Y	Y	Y
SUSE Linux Enterprise Server 15 SP1	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
SUSE Linux Enterprise Server 15 SP2	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
SUSE Linux Enterprise Server 15 SP2 with Xen	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
SUSE Linux Enterprise Server 15 SP3	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
SUSE Linux Enterprise Server 15 SP3 with Xen	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
SUSE Linux Enterprise Server 15 SP4	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
SUSE Linux Enterprise Server 15 SP4 with Xen	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
SUSE Linux Enterprise Server 15 with Xen	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Ubuntu 22.04 LTS	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	Y	Y	Y	Y	Y	Y
VMware vSphere Hypervisor (ESXi) 6.5	N	N	N	N	N	N	Y	Y	Y	Y	N	Y
VMware vSphere Hypervisor (ESXi) 6.5 U1	N	N	N	N	N	N	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
VMware vSphere Hypervisor (ESXi) 6.7	N	N	N	N	N	N	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

Operating systems	SD530 (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)	SR630 (Xeon Gen 1)	SR650 (Xeon Gen 1)	SR850 (Xeon Gen 1)	SR860 (Xeon Gen 1)	SR950 (Xeon Gen 1)
VMware vSphere Hypervisor (ESXi) 7.0	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
VMware vSphere Hypervisor (ESXi) 7.0 U1	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
VMware vSphere Hypervisor (ESXi) 7.0 U2	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
VMware vSphere Hypervisor (ESXi) 7.0 U3	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
VMware vSphere Hypervisor (ESXi) 8.0	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y

Warranty

The adapters carry a one-year, customer-replaceable unit (CRU) limited warranty. When the adapters are installed in a supported server, these adapters assume the system's base warranty and any warranty upgrades.

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 adapters have the following physical specifications:

Dimensions and weight:

- Height: 69 mm (2.7 in.)
- Length: 168 mm (6.6 in.)
- Depth: 19 mm (0.74 in.)
- Weight: 220 g (7.8 oz)

Operating environment

The adapters are supported in the following environment:

- Temperature:
  - Operating: 0 to 50 °C (32 to 122 °F)
  - Non-operating: -40 to 70 °C (-40 to 158 °F)
  - Transport: -40 to 70 °C (-40 to 158 °F)
- Relative humidity: 5 to 95% (non-condensing)
- Maximum altitude:
  - Operating: 5,486 m (18,000 ft)
  - Non-operating: 12,192 m (40,000 ft)
- Shock: 400 G (Max) at 2 ms
- Vibration: 2.17 G_{RMS} (5-800 Hz)

Agency approvals

The adapters conform to the following regulations:

- Underwriters Laboratories: UL60950-1
- Canada: CAN/CSA-C22.2 No.60950-1
- TUV: EN 60950-1
- BSMI (Taiwan): CNS 13438 (CISPR Pub. 22 Class B): D33003
- MSIP: KN22, KN24 (CISPR Pub. 22 Class B)
- Australia/New Zealand: AS/NZS CISPR22
- EMC: EN55022 (2010) Class B
- EMC: EN55024 (2010)
- RoHS 2011/65/EU: EN50581 (2012) Category 3

Related publications and links

For more information, see the following documents:

- Lenovo ThinkSystem storage options product page
  https://lenovopress.com/lp0761-storage-options-for-thinksystem-servers
- Toshiba product page for PC04PMCxxx Flash Storage Adapters
  https://toshiba.semicon-storage.com/us/product/storage-products/enterprise-ssd/px04pmcxxx.html
- ServerProven compatibility for Flash Storage Adapters
  http://www.lenovo.com/us/en/serverproven/xseries/storage/mcmatrix.shtml
- ThinkServer Option Compatibility Matrix (OCM)
  http://www.lenovo.com/accessoriesguide

Related product families

Product families related to this document are the following:

- PCIe Flash Adapters

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