

Know More About NVMe & Why Use NVMe Storage?

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In brief

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There is a growing expectation among users today that apps and businesses will respond at an ever-faster rate, despite the complexity of apps and their resource requirements. The Non-Volatile Memory Express (NVMe) can help deliver low-latency and high-bandwidth experiences. It's a protocol for transferring and storing data efficiently through the PCIe bus. This article closely examines NVMe storage and why you should consider using it.

How NVMe Storage Works

The NVMe works by the host writing queues and doorbells for I/O commands. Then, the NVMe controller retrieves and processes these queues and returns them when completed by sending an interrupt back to the host. Finally, the host stores the queues of I/O completions and removes them from the door register.

The NVMe transfer protocols have significantly lower overhead, minimal power consumption, and latency. In addition, as a parallel I/O interface, NVMe can address CPU bottlenecks and improve performance.

The Benefits of the NVMe Storage

NVMe provides optimized performance for fast non-volatile storage devices like SSDs, so it is well-suited for high-performance computing environments. The NVMe interface can handle high workloads using less power and space. Here are more reasons why you should invest in NVMe storage:

1. Increased transfer speed

NVMe SSDs perform three to four times faster than SATA SSDs, and reach reading and writing speeds of 2000MB/s, compared to 600MB/s with SATA SSDs. You can boost your Read/Write Speed by upgrading your OS to an NVMe solid-state drive. For example, some NVMe SSDs with high storage of 1TB can deliver an impressive Read Speed of 7,000 MBps and Write Speed of 5,300MBps.

2. Protects the Operating System from overheating

NVMe SSDs can prevent your OS from overheating, even with heavy workloads. They provide thermal protection, unlike SATA SSDs, enabling your OS to run smoothly and efficiently. In addition, the SSD is directly connected to the motherboard as a chip, providing less heat when consuming power from the dedicated slot to deliver better performance.

3. Offer encryption

There is no built-in encryption on most consumer SATA SSDs unless you choose a high-end model. However, NVMe SSDs have in-built encryption, and this security feature makes them useful for users who want the best possible data security.

The NVMe vs. SATA SSDs

Although the NVMe and SATA SSDs are both fast, they have significant performance differences. And it is worth considering these differences when determining your needs so that you can benefit from the high-performance features provided by NVMe storage. Here's how NVMe storage differs from the SATA SSDs:

Uses

NVMe is specifically suitable for SSDs using flash storage technology, making it faster than SATA SSDs that use AHCI designed for spinning hard drives. As a result, the NVMe provides the fastest response times and highest throughput for all enterprise workloads.

Command Queues

There is only one queue for SATA SSD AHCI drivers, with 32 commands in each queue. The NVMe supports 65,535 queues, resulting in faster performance because it has a larger capacity to process more commands.

NVMe SSDs feature longer queues and more commands than SATA SSDs, which can simultaneously handle more input/output operations and drives. By doing this, storage controllers can run more commands and IOs, improving the system's scalability and performance.

Latency

By shortening and optimizing the Datapath, NVMe technology offers lower latency than SATA SSDs. An NVMe SSD has a latency of approximately 2.8 microseconds which translates to more rapid access to data and faster storage. In contrast to SATA SSDs, with a latency of around 6 microseconds, which is about three microseconds longer.

Speed

Through NVMe, SSDs can transfer data straight to the CPU through the PCIe bus. One PCIe lane supports data transfer speeds of up to 2,000 MBps, while NVMe SSDs can use up to four lanes. On the other hand, SATA has a single lane that can transfer up to 600 MBps, which is slower than NVMe storage.

Application

NVMe SSDs are ideal for enterprise workloads, large data transfers, machine learning projects, artificial intelligence, and DevOps. These devices are found in data centers, pre-built desktops, and premium laptops. While SATA SSDs work best for small data analytics and light storage workloads. In most cases, laptops and servers use them.

Standards and Form Factors of NVMe

The NVMe technology is continuously improving in terms of its specifications and features. The NVMe interface has been available in four different form factors since it first came out, and these form factors are compatible with PCIe-based SSDs. The following is a description of each NVMe form factor:

AIC

The AIC form factor allows manufacturers to design cards compatible with PCIe slots without worrying about storage bays. These cards feature additional processors and chips to enhance solid-state storage performance and cater to specific applications.

M.2

The M.2 form factor exploits the benefits of NAND flash's low heat discharge and compact size. Due to this design, you cannot install M.2 NVMe devices in traditional drive bays, but they are suitable for much smaller spaces. Usually compared to a stick of gum, the M.2 SSDs are about 80 mm long and 22 mm wide, but they can be longer or more compact.

U.2

In contrast to M.2 SSDs, the U.2 SSDs fit in standard SATA or SAS storage bays. They also resemble older media, using enclosures of 2.5-inches or 3.5-inches similar to those used for hard drives. The goal is to implement NVMe storage with minimal reengineering.

EDSFF

The enterprise and data center SSD form factor is another less popular NVMe form factor. The EDSFF aims to provide enterprise-class storage systems with higher performance and capacity. In addition, this form factor focuses on thermal efficiency to control the system's temperature.

The Bottom Line

When it comes to high-performance storage, NVMe leads the pack. Despite their similarities, NVMe and SATA are different in terms of performance. The NVMe drives are faster, have lower latency, and communicate directly with CPUs via PCIe data lanes. Take advantage of the NVMe storage technologies for real-time apps, analyzing data, and machine learning.

References

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