SMART®
Modular Technologies

Flash Memory

SATA SSD vs. PCIe NVMe SSD

White Paper F-WP003

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Introduction

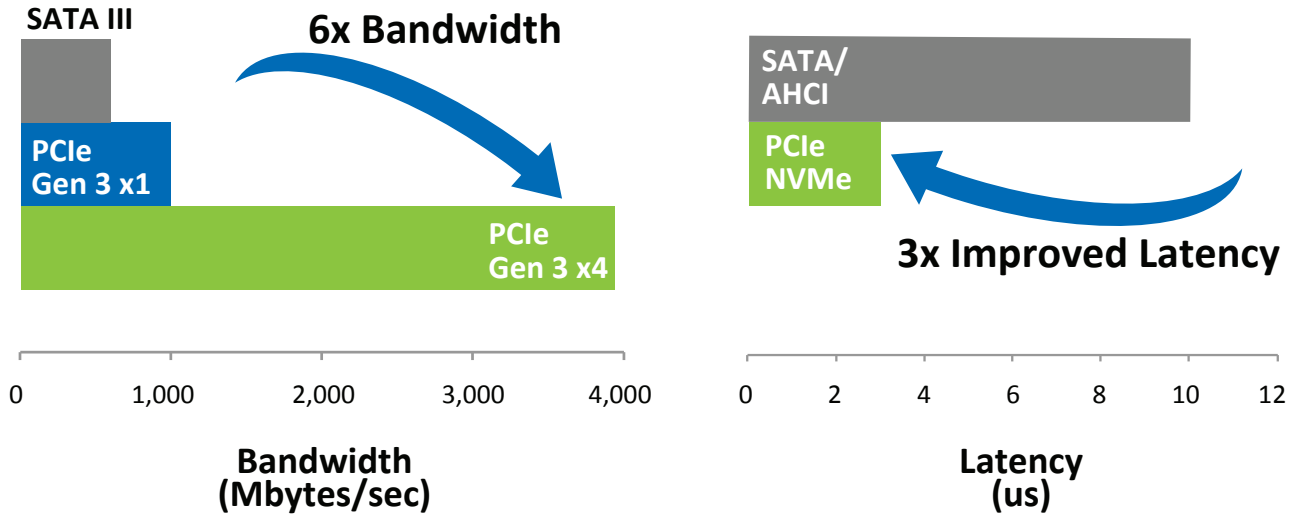
Storage devices have significantly improved in the past decades since the SSD (Solid State Drive) was invented to replace the HDD (Hard Disk Drive). The enhancements to SSDs from HDDs were not only developed to increase the density of a drive, but also to improve its performance.

With the latest SATA III (Serial Advanced Technology Attachment) interface and the AHCI (Advanced Host Controller Interface) communication protocol, the maximum speed that a SATA III can achieve is 600MB/s. With the higher demand on data storage, people expect SSD products to perform faster and faster. Because of those expectations, the new technology, PCe NVMe, was developed and has arrived on the market in the early years of the 2010s. PCIe (Peripheral Component Interconnect express) supersedes SATA as the latest high bandwidth data bus. With the first-generation PCIe NVMe SSD, it is almost three times faster than a SATA III SSD. NVMe (Non-Volatile Memory express) supersedes AHCI and compliments PCIe technology, and can manage up to 64 command queue depths, compared to 32 for SATA, which is an important factor for providing higher device speed.

SATA vs. PCIe NVMe SSD Technology Overview

SATA I SSD was created in the early 2000s and provides a maximum speed of 150MB/s. Shortly after that, SATA II SSD was developed with a higher speed of 300MB/s. It was the predominant SATA technology until late 2008 when SATA III SSD was introduced. SATA III SSD now dominates the SSD market and can provide up to 600MB/s speed.

PCIe devices can support 1x, 4x, 8x, or 16x lanes and a typical PCIe 3.0 SSD transfer speed is up to 985 MB/s per lane. Theoretically a PCIe 3.0 SSD with 16x lanes device can provide a speed up to 25 times faster than SATA III SSD. A typical PCIe NVMe SSD on the market now is 2x and 4x lanes and it can provide a maximum transfer speed closer to 3.94 GB/s.



Source: Flash Memory Summit 2016

PCIe NVMe SSD Advantages and Limitations

Advantages

- Much faster
- Higher density
- Suitable for higher performance or enterprise applications such as computing, data centers, etc.

Limitations

- Higher cost
- Higher power needs do not support small form factor SSDs, such as M.2 2242, slim SATA, mSATA, etc.

SMART Modular Technologies' PCIe NVMe Migration Plan

SMART is vigorously developing both SATA III SSD and PCIe NVMe SSD products using the newest 3D NAND technology. The plan is for SMART to work with different NAND vendors and controller vendors to provide the best state-of-the-art 3D-NAND based PCIe NVMe SSDs. SMART expects to launch the first series of qualified 3D NAND PCIe NVMe SSD products, including M.2 2280, and U.2 by the end of 2018. Some of these products offer the PLP (Power Loss Protection) feature, which combines unique power loss detection and hold-up circuitries. Drives will also include an advanced controller firmware algorithm to flush in-flight data from volatile cache to Flash memory which safeguards data against data corruption.

SMART also plans to produce Gen3x2 SSDs, which cover M.2 2230, M.2 2242 and M.2 2280 for customers who need a quick transition from SATA III to PCIe.

Conclusion

There is no doubt that PCIe NVMe is a future technology for SSDs and will definitely replace SATA drives. It is too early to predict that PCIe NVMe will dominate SSD market over SATA technology in the next 10 years. As the demand of data storage increased, the need of PCIe NVMe is unavoidable. Although there are still some limitations to PCIe NVMe SSD technology, its advantages over SATA are clearly proven in storage application. SMART Modular Technologies is a pioneer in migrating PCIe NVMe technology for its Enterprise SSD product line-ups. Check applications at SMART Modular Technologies at https://www.smartm.com for upcoming information.

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