

# Supermicro Hot-Plug NVMe Performance

## 5.9x Bandwidth and 7.2x Latency Improvements Over Standard SSDs

### Introduction

This white paper summarizes the improvements in performance and latency achieved by a Supermicro SuperServer® supporting the latest NVMe SSD storage technology, over an identical system utilizing standard SSDs with a SAS3 or SATA3 interface. The SuperServer® selected for these tests was the 1U Ultra system. The configurations tested in this study are shown in Table 1 below:

### Test Configuration

	CPU	Memory	SSD	Benchmark
<b>1U Ultra SYS-1028U- TNR4T+</b>	2x Intel® Xeon® E5-2652 v3 (2.3GHz, 9.6 GT/s QPI, 10-Cores, 105W)	2x 8GB DDR4-2133 MHz	Intel® NVMe SSD DC P3600 2TB	Iometer v1.1.0
			Intel® SATA 3.0 6Gb/s SSD S3700 800GB	
			Toshiba SAS 3.0 (12Gb/s) SSD 1.6TB	

Table 1: Test Configuration

### Performance Measurements

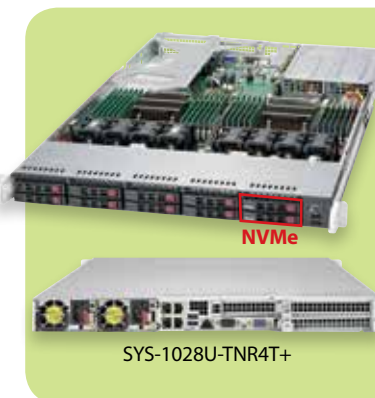
For the bandwidth test Supermicro ran the IOMeter benchmarking tool on two SYS-1028U-TNR4T+ Ultra 1U servers, the first with standard SATA3 SSDs, and the second with NVMe SSDs. As Table 2 shows, the upgraded configuration with NVMe delivered 5.9x the performance of the server with standard SSDs. While the base configuration delivered excellent performance, the dramatic performance improvement offered with the NVMe SSDs makes this upgrade an excellent investment for any business looking to improve its data center performance.

For the latency test Supermicro again ran the IOMeter benchmarking tool on the same two SYS-1028U-TNR4T+ Ultra 1U servers as before, the first server with standard SAS3 SSDs and the second with NVMe PCI-E SSDs. As Table 2 shows, the upgraded configuration with NVMe performed with 7.2x improved latency compared to the server with standard SAS3 SSDs. While the base configuration delivered excellent latency results the amazing improvement provided by the NVMe PCI-E SSDs makes this upgrade an excellent data center investment.

	Measurement	NVMe SSD	SATA3/SAS3 SSD*	NVMe Improvement
<b>Bandwidth</b>	128K Sequential Read	2788.77 MB/s	470.60 MB/s	5.93x
	128K Sequential Write	1838.98 MB/s	453.33 MB/s	4.06x
<b>Latency</b>	4K Sequential Read	15.9 µs	114.1 µs	7.18x
	4K Sequential Write	17.6 µs	109.853 µs	6.24x

Table 2: Performance Measurements and Results

\* Bandwidth measured with SATA3 SSD and Latency measured with SAS3 SSD



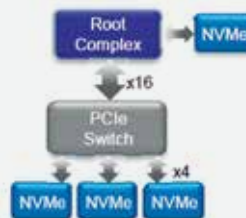
### NVMe Advantages:

- Large throughput gains (6x)
- Substantial latency improvements (7x)
- Shared common backplane improves flexibility of drive choice
- Improved serviceability vs. PCI-E Flash cards (hot-swap)
- Improved power efficiency

### NVMe Server Applications

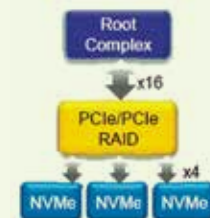
Supermicro SuperServer® systems with NVMe are optimized for many I/O intensive enterprise applications such as advanced data mining, online transaction processing (OLTP), and financial transactions that were previously not possible to achieve with standard SAS3 and SATA3 SSD storage. These NVMe enabled servers utilize the high bandwidth and low latency of NVMe SSDs to significantly improve the performance and storage efficiency of these applications. The following highlights some examples.

#### Server Caching



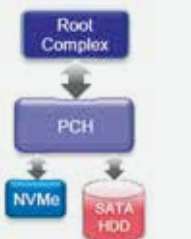
- Used for temporary data
- Non-redundant
- Used to reduce memory footprint

#### Server Storage



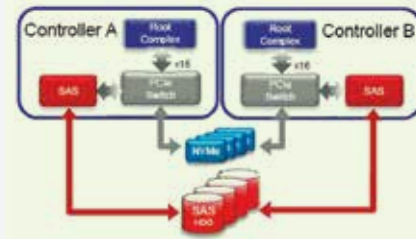
- Typically for persistent data
- Redundant (i.e. RAID'ed)
- Commonly used as Tier-0 storage

#### Client Storage



- Used for Boot/OS drive and/or HDD cache
- Non-redundant
- Power optimized

#### External Storage



- Used for Metadata or data
- Multi-ported device
- Redundancy based on usage

**NVMe Benefits**

The primary benefits of NVMe with PCI-E-based SSDs are reduced latency, increased Input/Output operations per second (IOPS) and lower power consumption, in comparison to SAS-based or SATA-based SSDs, through the streamlining of the I/O stack. The benefits of NVMe based SSDs are highlighted in Table 3:

<b>Performance</b>	8 Gb/s per lane (PCI-E Gen3 x1)
<b>With PCI-E Scalability</b>	4 GB/s per device (PCI-E Gen3 x4) or more
<b>Lower Latency</b>	Platform+Adapter: 10 µsec down to 3 µsec
<b>Lower Power</b>	No external SAS AOC saves 7-10 W
<b>Lower Cost</b>	No external SAS AOC cost
<b>PCI-E Lanes off the CPU</b>	40 Gen3 (80 in dual socket)

**Table 3: PCI-E 3.0 Based SSD Benefits.**

**Only Supermicro has Hot-plug NVMe**



Supermicro is the first to market with hot-plug capability for NVMe drives. This feature allows easy addition of storage capacity through the addition of SSDs, the replacement of existing SSDs with higher capacity units, or replacement of failed drives. Additionally, the hot-plug feature protects against surprise removals, random device failures, or operator errors. Software hardening from Supermicro on its NVMe server product line provides an excellent protection against these all too-common data center issues.

**Supermicro NVMe Solutions**



From its 1U and 2U Ultra, 2U Data Center Optimized (DCO), and 1U WIO, Supermicro offers many NVMe enabled models (as shown in Table 4) that deliver significant bandwidth and latency improvements over servers with standard SAS3 and SATA3 SSDs. Many more NVMe-capable SKUs are coming soon!

Supermicro SuperServer<sup>®</sup> NVMe enabled systems offer excellent Performance and Latency, provide unmatched hot-plug capability, and are available immediately in a variety of attractive models. With outstanding Global Services, International Logistics, Server Management Utilities, and Technical Support, Supermicro is the first choice for IT customers' server and storage solutions.

**Table 4: X10 SuperServers with NVMe Support, Available Now!**

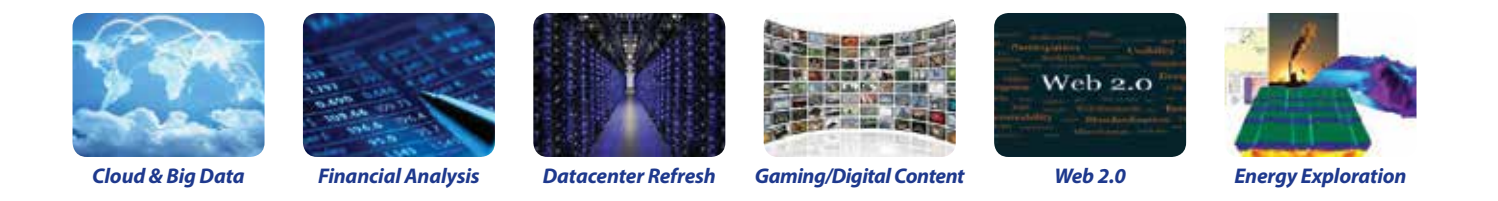



SKU	SYS-1028U-TNR4T+	SYS-1028U-TNR4T+	SYS-6028U-TNR4T+	SYS-6028U-TNR4T+
<b>Motherboard</b>	X10DRU-i+	X10DRU-i+	X10DRU-i+	X10DRU-i+
<b>Platform</b>	1U Ultra w/ 4x 10GBase-T	1U Ultra w/ 2x 10GBase-T	2U Ultra w/ 4x 10GBase-T	2U Ultra w/ 2x 10GBase-T
<b>NVMe Support</b>	Native	Native	Native	Native
<b># of 2.5" NVMe SSDs</b>	2 (NVMe/SATA3)	2 (NVMe/SATA3)	4 NVMe	4 NVMe
<b># of Additional Drive Bays</b>	8x 2.5" drive bays (SAS3 optional)	8x 2.5" drive bays (SAS3 optional)	8x 3.5" drive bays (SAS3 optional)	8x 3.5" drive bays (SAS3 optional)

SKU	SYS-6028R-TDWR	SYS-1028R-WC1R	SYS-1028R-WC1RT
<b>Motherboard</b>	X10DDW-iN	X10DRW-i	X10DRW-iT
<b>Platform</b>	2U DCO	1U WIO	1U WIO w/ 2x 10GBase-T
<b>NVMe Support</b>	Native	AOC Required	AOC Required
<b># of 2.5" NVMe SSDs</b>	4 NVMe	2 (NVMe/SATA3)	2 (NVMe/SATA3)
<b># of Additional Drive Bays</b>	8x 3.5" drive bays (SAS3 optional)	8x 2.5" SAS3 drive bays	8x 2.5" SAS3 drive bays

*Supermicro FatTwin™, TwinPro™, and SuperBlade® with NVMe support are coming soon!*



Contact your Supermicro sales representative for more information or visit [www.supermicro.com/NVMe](http://www.supermicro.com/NVMe)