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ALL FLASH NVME SYSTEMS DELIVER ORDER OF MAGNITUDE PERFORMANCE AND EFFICIENCY IMPROVEMENTS

Supermicro Ultra SuperServers and Simply Double SuperStorage solutions with all-flash NVMe solid-state drives deliver the best IOPS, energy-efficiency, and cost profiles.



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SUPERMICRO OFFERS EXACTLY THE BEST NVMe SOLUTIONS

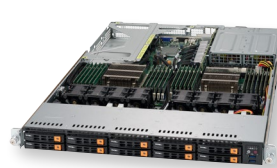
Supermicro offers a comprehensive portfolio of all-flash NVMe SuperServer® and SuperStorage systems that support the latest Intel® Xeon® processor E5-2600 v4 product family. The portfolio provides three fundamental design choices for customers,

- **Throughput/IOPS optimized** (1U 10 NVMe Ultra SuperServer)
- **Balanced Throughput and Capacity** (2U 24 NVMe Ultra SuperServer)
- **Capacity Optimized** (2U 48 NVMe Simply Double SuperStorage, Supermicro's innovative design that doubles the physical storage capacity in a standard 2U space).

NVMe BENEFITS

The primary benefits of NVMe with PCI-E-based SSDs are improved scalability and latency, lower power consumption and low cost, in comparison to SAS-based or SATA-based SSDs, through the streamlining of the I/O stack. In summary,

- **PCI-E Scalability**
4 GB/s bandwidth per device (PCI-E 3.0 x4) or more
- **Lower Latency**
Platform + adapter: from 10µsec down to 3µsec
- **Lower Power**
No SAS HBA/AOC required; saves 7-10W
- **Lower Cost**
No SAS HBA/AOC required; reduces system cost and complexity



1U 10 NVMe SuperServer



2U 24 NVMe SuperServer



2U 48 NVMe SuperStorage

The all-flash NVMe SuperServer and SuperStorage systems deliver a massive improvement in storage performance over systems based on traditional hard disk drives (HDD) and solid state drives (SSD) using legacy storage interfaces including SAS3 and SATA3. The new servers are also more power efficient than the traditional systems and have hot-plug capability for improved serviceability and availability.

This paper provides an overview of the system architecture on Supermicro's new all-flash NVMe SuperServer and SuperStorage systems, and a performance analysis of the new all-flash server systems with NVMe SSDs versus traditional systems using SAS3 SSDs, including comparisons of performance, power and price. The conclusion is that the all-flash NVMe SuperServer provide significant performance improvements and energy efficiency at a comparable cost and that All-Flash NVMe systems deliver a significant TCO improvement for performance critical applications.

Supermicro is the Hot-plug NVMe Leader

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 2.5" U.2 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 has the Broadest and Most Optimized Line of NVMe Solutions

From its 1U and 2U Ultra, 2U Data Center Optimized (DCO), to 4U SuperStorage systems, Supermicro offers many NVMe enabled models that deliver significant bandwidth and

latency improvements over servers with traditional SAS3 and SATA3 SSDs. Many more NVMe-capable SKUs are coming soon! Supermicro SuperServer® NVMe enabled systems offer excellent performance and latency, provide unmatched hot-plug capability, and are available immediately in a variety of models and form-factors. With Supermicro Global Services, International Logistics, Server Management Utilities, and Technical Support, Supermicro is the first choice for IT customers' server and storage solutions.

TEST CONFIGURATIONS

Three of Supermicro's all-flash NVMe server systems were chosen for the test to study how each would stack up against three comparable industry standard servers equipped with SAS3 12Gb/s SSDs. To measure IOPS performance of these systems, we used fio-2.1.7, an I/O tool used for benchmark and stress/hardware verification.

PRODUCT / DESCRIPTION	STORAGE CONFIGURATION*	CPU, MEMORY
SYS-1028U-TN10RT+ 1U 10 NVMe "Ultra" System	10 NVMe SSDs	Dual Intel® Xeon® E5-2699 v4 processor, 256GB of DDR4-2400MHz memory
Industry Standard Server 1U 10-Bay Server	10 SAS3 SSDs SAS3 Expander + 8-port SAS3 HBA	
SYS-2028U-TN24R4T+ 2U 24 NVMe "Ultra" System	24 NVMe SSDs	
Industry Standard Server 2U 24-Bay Server	24 SAS3 SSDs SAS3 Expander + 8-port SAS3 HBA	
SYS-2028R-NR48N 2U "Simply Double" System	48 NVMe SSDs	
Industry Standard Server 2U 48-Bay Server	48 SAS3 SSDs SAS3 Expander + 8-port SAS3 HBA	

Table 1. *Hardware configuration*
 * NVMe SSDs: Samsung PM1725 NVMe SSDs
 SAS3 SSDs: Seagate 1200.2 SAS SSDs

TEST 1: SYS-1028U-TN10RT+

The SYS-1028U-TN10RT+ is a 1U/10 NVMe server that belongs to the Ultra SuperServer product family, which is known for providing ultimate flexibility along with enterprise class performance. Additional features include 2x 10GbE, 3x PCI-E 3.0 x8 slots and redundant 1000W Titanium power supplies. This server supports 10 NVMe SSDs using a total of 40 PCI-E 3.0 lanes from two CPUs to provide full bandwidth (PCI-E x4) to each NVMe SSD as shown in Figure 1.

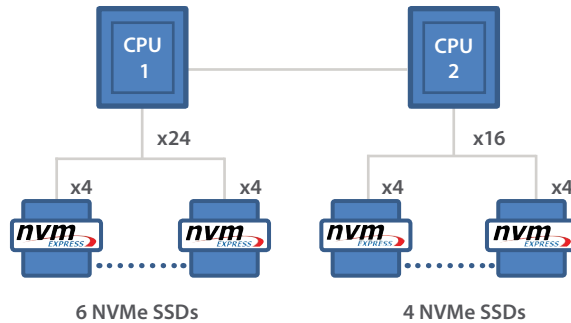


Figure 1. SYS-1028U-TN10RT+ PCI-E Lane Diagram for NVMe



Figure 2. SYS-1028U-TN10RT+ supporting 10 hot-swap U.2 NVMe SSDs in 1U

TEST RESULTS

Figure 3 compares the SYS-1028U-TN10RT+ with 10 NVMe SSDs to an industry standard 1U 10-bay rackmount server with 10 SAS3 SSDs. We found a 12x performance gain in read IOPS and a 10x performance gain in write IOPS.

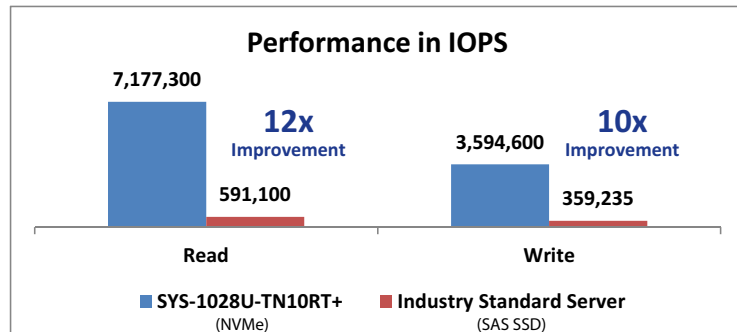


Figure 3. SYS-1028U-TN10RT+ vs. Industry Standard 1U Server Performance Results

With these IOPS numbers we are able to create a price comparison based on the system cost. Figure 4 shows the 10 SAS3 SSD system has 9x higher cost for every 1K read IOPS and 7x higher cost for every 1K write IOPS than the SYS-1028U-TN10RT+.

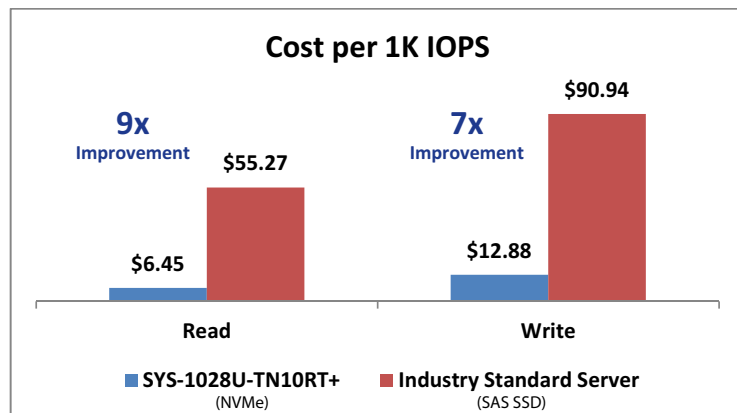


Figure 4. SYS-1028U-TN10RT+ vs. Industry Standard 1U 10 Bay Server Cost per 1K IOPS Comparison

Power was also monitored during the performance testing and as shown in Figure 5, when compared to SYS-1028U-TN10RT+, we found that the 10x SAS3 SSD system uses 17x more power for every 1K read IOPS and 31x more power for every 1K write IOPS.

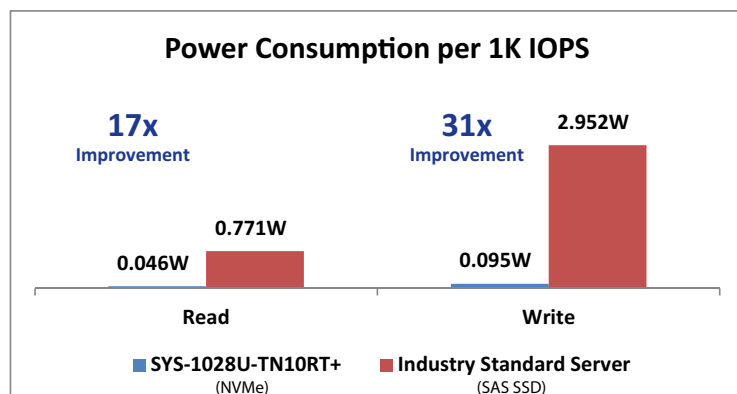


Figure 5. SYS-1028U-TN10RT+ vs. Industry Standard 1U 10 Bay Server Watts per 1K IOPS Comparison

TEST 2: SYS-2028U-TN24R4T+

The SYS-2028U-TN24R4T+ is a 2U/24 NVMe server that also belongs to the Ultra SuperServer product family. Additional features include 4x 10GbE, 2 PCI-E 3.0 x16 slots and 1 PCI-E 3.0 x8 low-profile slot, and redundant 1600W Titanium power supplies. This server supports 24 NVMe SSDs using a total of 32 PCI-E 3.0 lanes from two CPUs. In order to address all 24 NVMe SSDs, 2 PCI-E switches are designed in to provide enough PCI-E lanes for each NVMe SSD as shown in Figure 6.

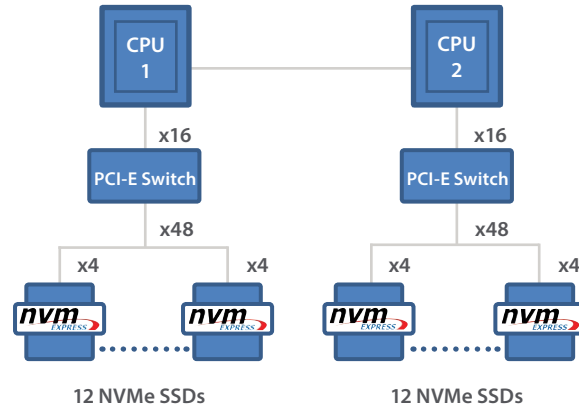


Figure 6. SYS-2028U-TN24R4T+ PCI-E Lane Diagram for NVMe



Figure 7. SYS-2028U-TN24R4T+ supporting 24 hot-swap U.2 NVMe SSDs in 2U

TEST RESULTS

Figure 10 compares the SYS-2028U-TN24R4T+ with 24 NVMe SSDs to an industry standard 2U 24-bay rackmount server with 24 SAS3 SSDs. We found a 7x performance gain in read IOPS and a 17x performance gain in write IOPS.

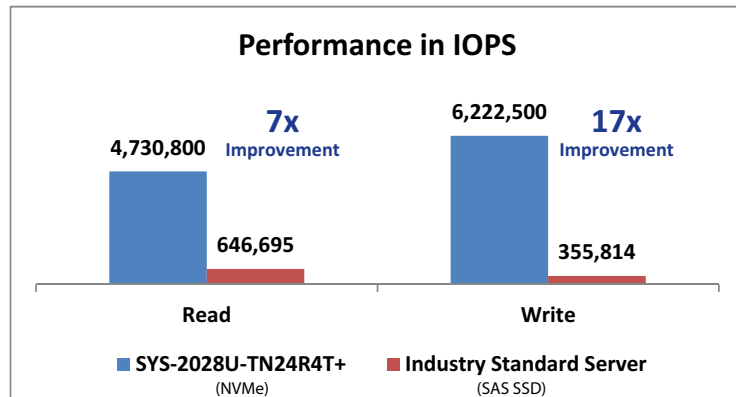


Figure 10. SYS-2028U-TN24R4T+ vs. Industry Standard 2U 24 Bay Server Performance Results

With these IOPS numbers we are able to create a price comparison based on the system cost. Figure 8 shows the 24 SAS3 SSD system has 5x higher cost for every 1K read IOPS and 11x higher cost for every 1K write IOPS than the SYS-2028U-TN24R4T+.

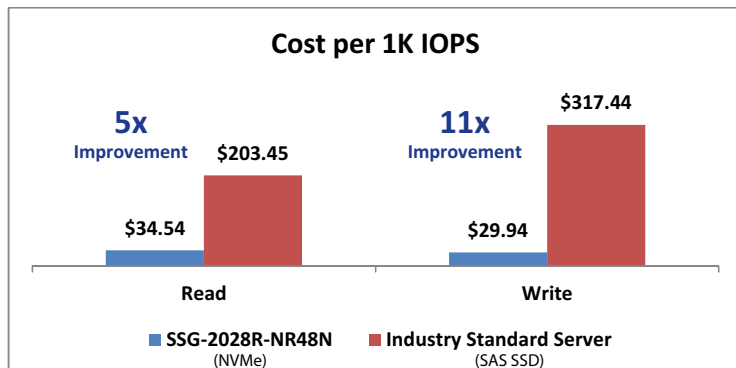


Figure 8. SYS-2028U-TN24R4T+ vs. Industry Standard 2U 24 Bay Server Cost per 1K IOPS Comparison

Power was also monitored during the performance testing and as shown in Figure 9, when compared to SYS-2028U-TN24R4T+, we found that the 24x SAS3 SSD system uses 6x more power for every 1K read IOPS and 11x more power for every 1K write IOPS.

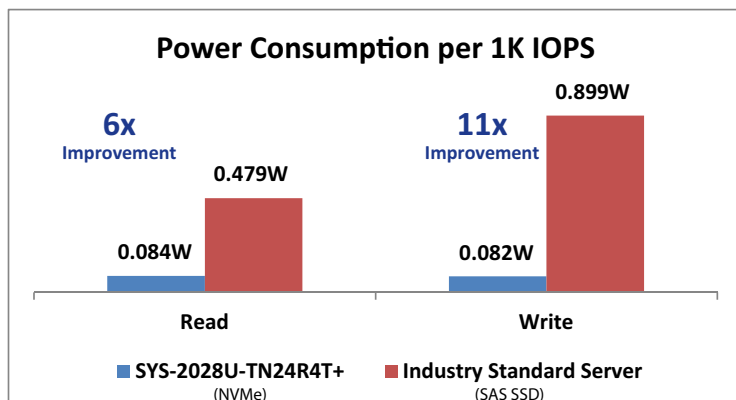


Figure 9. SYS-2028U-TN24R4T+ vs. Industry Standard 2U 24 Bay Server Watts per 1K IOPS Comparison

TEST 3: SSG-2028R-NR48N

The SSG-2028R-NR48N is a 2U/48 NVMe server that belongs to the Simply Double SuperStorage product family. With its patented Riser Bay design you get double the density in a 2U, providing you cost savings on power, cooling, and rack-space. Additional features include 1x SIOM networking slot, 2x PCI-E 3.0 slots (x16, x8), and redundant 1600W Titanium power supplies. This server supports 48 NVMe SSDs using a total of 32 PCI-E 3.0 lanes from two CPUs. In order to address all 48 NVMe SSDs, four PCI-E switches are designed in to provide enough PCI-E lanes for each NVMe SSD as shown in Figure 11.

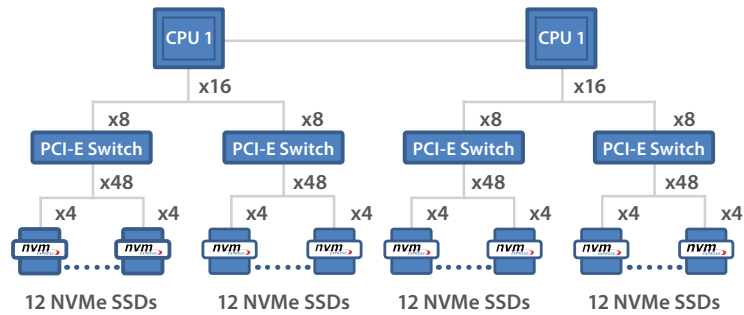


Figure 11. SSG-2028R-NR48N PCI-E Lane Diagram for NVMe



Figure 12. SYS-2028U-NR48N supporting 48 hot-swap U.2 NVMe SSDs in 2U

TEST RESULTS

Figure 15 compares the SSG-2028R-NR48N with 48 NVMe SSDs to an industry standard 2U 48-bay server with 48 SAS3 SSDs. We found a 9x performance gain in read IOPS and a 16x performance gain in write IOPS.

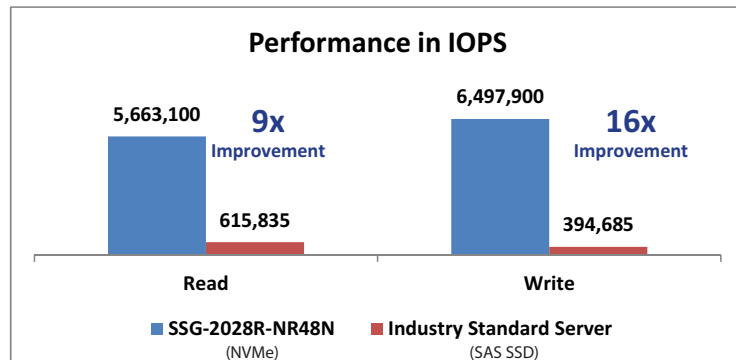


Figure 15. SSG-2028R-NR48N vs. Industry Standard 2U 48 Bay Server Performance Results

With these IOPS numbers we are able to create a price comparison based on the system cost. Figure 13 shows the 48 SAS3 SSD system has 5x higher cost for every 1K read IOPS and 12x higher cost for every 1K write IOPS than the SSG-2028R-NR48N.

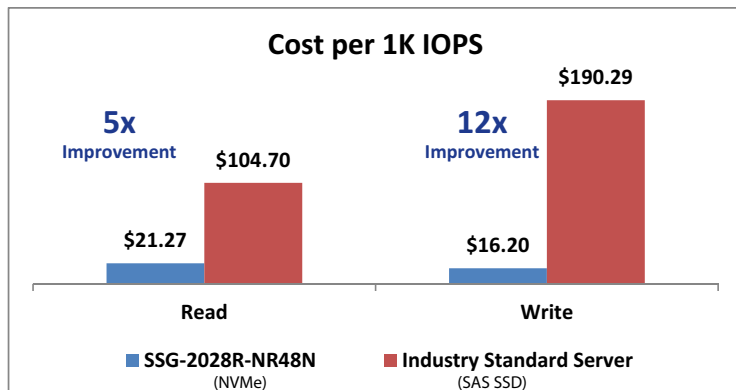


Figure 13. SSG-2028R-NR48N vs. Industry Standard 2U 48 Bay Server Cost per 1K IOPS Results

Power was also monitored during the performance testing and as shown in Figure 14, when compared to SSG-2028R-NR48N, we found that the 48x SAS3 SSD system uses 6x more power for every 1K read IOPS and 14x more power for every 1K write IOPS.

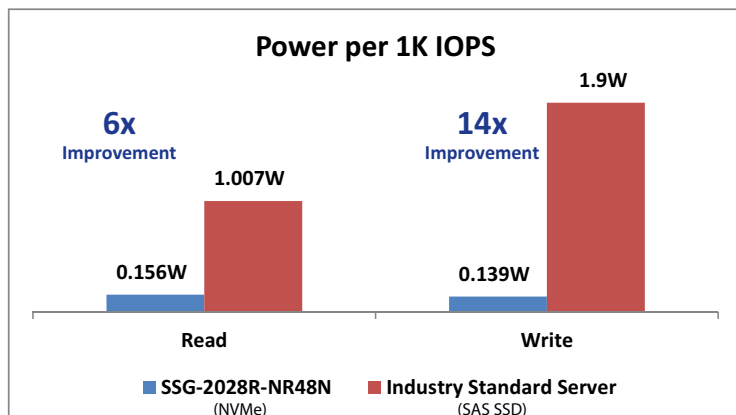


Figure 14. SSG-2028R-NR48N vs. Industry Standard 2U 48 Bay Server Watts per 1K IOPS Comparison



FOR MORE INFORMATION

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CONCLUSIONS

We found that all-flash NVMe SSDs based SuperServer and SuperStorage systems greatly outperformed the standard all-flash SAS3 SSDs based systems on the market today. The 1U/10 NVMe, SYS-1028U-TN10RT+ exhibited greater scalability, 2U/24 NVMe, SYS-2028U-TN24R4T+ showed a better balance of performance and storage density. Lastly, the 2U/48 NVMe, SSG-2028R-NR48N provided maximum storage capacity with highest density.

The density optimized design of Supermicro's all-flash server systems provides higher read and write performance compared to industry standard SAS3 SSD based servers at a lower cost and power consumption. To meet the equivalent Supermicro performance, one needs to add more industry standard SAS3 SSD's servers to a rack which increases the overall power consumption and TCO.

About Super Micro Computer, Inc.

Supermicro® (NASDAQ: SMCI), the leading innovator in high-performance, high-efficiency server technology is a premier provider of advanced server Building Block Solutions® for Data Center, Cloud Computing, Enterprise IT, Hadoop/Big Data, HPC and Embedded Systems worldwide. Supermicro is committed to protecting the environment through its “We Keep IT Green™” initiative and provides customers with the most energy-efficient, environmentally-friendly solutions available on the market.

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