Supermicro Offers Exactly The Best NVMe Solutions

Supermicro offers a comprehensive portfolio of All-Flash NVMe Superservers® system 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); Balanced Throughput and Capacity (2U 24 NVMe); and Capacity Optimized (2U 48 NVMe), part of Supermicro’s Simply Double family providing double the physical storage capacity of traditional form factors.

The All-Flash NVMe Superservers represent a massive improvement in performance over system based on traditional hard disk drives (HDD) and SAS3 solid state drives (SSD). These servers are more power efficient than the traditional systems and have hot-plug capability for improved serviceability and availability.

This paper provides an analysis of the new All-Flash NVMe Superservers® architecture and an in-depth comparison of the new All-Flash NVMe Superservers versus SAS3 SSD systems, including comparisons of performance, power and price. The conclusion is that the All-Flash NVMe Superservers 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.

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. The benefits of NVMe based SSDs are highlighted in Table 3:

<table>
<thead>
<tr>
<th>Benefit</th>
<th>Description</th>
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</thead>
<tbody>
<tr>
<td>PCI-E Scalability</td>
<td>4 GB/s per device (PCI-E Gen3 x4) or more</td>
</tr>
<tr>
<td>Lower Latency</td>
<td>Platform + Adapter: 10µsec down to 3µsec</td>
</tr>
<tr>
<td>Lower Power</td>
<td>No SAS HBA/AOC required; saves 7-10W</td>
</tr>
<tr>
<td>Lower Cost</td>
<td>No SAS HBA/AOC required; reduces system cost</td>
</tr>
</tbody>
</table>

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

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 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), and 1U WIO, Supermicro offers many NVMe enabled models 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® 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.

Three of Supermicro’s All Flash NVMe SuperServers® were put to the test to see how each would stack up against three comparable industry standard all flash SAS3 12Gb/s SSD servers. To measure IOPS performance of these systems, we used fio-2.1.7, an I/O tool used for benchmark and stress/hardware verification.

**Test Configuration**

<table>
<thead>
<tr>
<th>Product / Description</th>
<th>Storage Configuration*</th>
<th>CPU, Memory</th>
</tr>
</thead>
<tbody>
<tr>
<td>SYS-1028U-TN10RT+ 1U 10 NVMe “Ultra” System</td>
<td>10 NVMe SSDs</td>
<td>Dual Intel® Xeon® ES-2699 v4 processor, 256GB of DDR4-2400MHz memory</td>
</tr>
<tr>
<td>Industry Standard Server 1U 10-Bay Server</td>
<td>10 SAS3 SSDs, SAS3 Expander + 8-port SAS3 HBA</td>
<td></td>
</tr>
<tr>
<td>SYS-2028U-TN24RT+ 2U 24 NVMe “Ultra” System</td>
<td>24 NVMe SSDs</td>
<td></td>
</tr>
<tr>
<td>Industry Standard Server 2U 24-Bay Server</td>
<td>24 SAS3 SSDs, SAS3 Expander + 8-port SAS3 HBA</td>
<td></td>
</tr>
<tr>
<td>SSG-2028R-NR48N 2U “Simply Double” System</td>
<td>48 NVMe SSDs</td>
<td></td>
</tr>
<tr>
<td>Industry Standard Server 2U 48-Bay Server</td>
<td>48 SAS3 SSDs, SAS3 Expander + 8-port SAS3 HBA</td>
<td></td>
</tr>
</tbody>
</table>

**Table 1: Hardware test configuration**

* NVMe SSDs: Samsung PM1725 NVMe SSDs
  SAS3 SSDs: Seagate 1200.2 SAS SSDs
With these IOPS numbers we are able to create a price comparison based on the system cost. Chart 2 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+.

Power was also monitored during the performance testing and as shown in Chart 3, when compared to SYS-1028U-TN10RT+, we found that the 10x SAS3 SSD system uses 15x more power for every 1K read IOPS and 14x more power for every 1K write IOPS.

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 Dual 10GbE, 2x 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.

Chart 1 compares the SYS-1028U-TN10RT+ with 10 NVMe SSDs to the Industry Standard 1U 10 Bay Server with 10 SAS3 SSDs and we found a 12x performance gain in read IOPS and a 10x performance gain in write IOPS.

Chart 2: SYS-1028U-TN10RT+ vs. Industry Standard 1U 10 Bay Server Cost per 1K IOPS Comparison

Chart 3: SYS-1028U-TN10RT+ vs. Industry Standard 1U 10 Bay Server Watts per 1K IOPS Comparison
24 NVMe SSDs in 2U

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 Quad 10GbE, 2x PCI-E 3.0 x16 slots 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, two PCI-E switches are designed in to provide enough PCI-E lanes for each NVMe SSD as shown in Figure 2.

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

Test Results

Chart 4 compares the SYS-2028U-TN24R4T+ with 24 NVMe SSDs to the Industry Standard 2U 24 Bay Server with 24 SAS3 SSDs and we found a 7x performance gain in read IOPS and a 8x performance gain in write IOPS.

Power was also monitored during the performance testing and as shown in Chart 6, when compared to SYS-2028U-TN24R4T+, we found that the 24x SAS3 SSD system uses 5x more power for every 1K read IOPS and 5x more power for every 1K write IOPS.
Test Results

Chart 7 compares the SSG-2028R-NR48N with 48 NVMe SSDs to the Industry Standard 2U 48 Bay Server with 48 SAS3 SSDs and we found a 8x performance gain in read IOPS and a 8x performance gain in write IOPS.

With these IOPS numbers we are able create a price comparison based on the system cost. Chart 8 shows the 48 SAS3 SSD system has 5x higher cost for every 1K read IOPS and 5x higher cost for every 1K write IOPS than the SSG-2028R-NR48N.

Chart 8: 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 Chart 9, when compared to SSG-2028R-NR48N, we found that the 48x SAS3 SSD system uses 6x more power for every 1K read IOPS and 7x more power for every 1K write IOPS.

Chart 9: SSG-2028R-NR48N vs. Industry Standard 2U 48 Bay Server Watts per 1K IOPS Comparison

Conclusion

Each Supermicro All Flash NVMe SuperServers™ will greatly outperform the standard all-flash SAS SSD systems on the market today. In the case of the 1U/10 NVMe, SYS-1028U-TN10RT+, we see great scalability. In the 2U/24 NVMe, SYS-2028U-TN24R4T+ we have a balance of performance and storage density. For maximum storage density with great performance, the 2U/48 NVMe, SSG-2028R-NR48N.

The density optimized design of Supermicro’s all flash SuperServers™ provides higher read and write performance compared to Industry Standard SAS3 SSD Servers at a lower cost and power consumption. To meet the equivalent SuperServer performance, one needs to add more Industry Standard SAS3 SSD’s Servers to the rack which increases the overall power consumption and TCO.