PRODUCT BRIEF

SUPERMICRO DATA CENTER ONE-SOCKET SYSTEMS ADDRESS GROWING NEED TO FIT WORKLOADS WITHIN COST AND POWER CONSTRAINTS

Powerful New Single-Socket Servers Feature Up to 136 PCIe 5.0 Lanes to Support a Multitude of Expansion and Storage Devices with an Increase in Performance Over Older Dual-Socket Servers

Supermicro Families of Single-Socket Servers

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Executive Summary

The latest generation of Intel CPUs (Intel® Xeon® 6) is ideal for a variety of workloads, particularly those where compute and memory capacity or bandwidth requirements fit within a single processor's capabilities. With the enhanced capabilities of these new processors, numerous web-based and enterprise applications will achieve the necessary performance using a single-socket server. Single-socket servers can outperform dual-socket servers from just a few generations ago and often

demonstrate greater efficiency (more work per watt), leading to reduced operating expenses.

Benefits of Single-Socket Systems

There are several benefits for single-socket systems for many workloads that only need the capabilities and capacities of 1 processor. These include:

- Lower Costs – A single-socket system will be less expensive than a dual-socket system due to reduced complexity on the motherboard, a single processor, fewer channels of memory, and the capability to be designed into smaller form factors, as less heat needs to be managed by the system.

- Form Factor & Environmental factors—A single-socket system can use a physically smaller motherboard than a dual-socket system and produces less heat.

- Energy Efficiency – When a workload can be managed by the resources of a new single-socket system, energy savings are achieved as only one CPU needs to be powered instead of two. For instance, a server equipped with dual 3rd Gen Intel Xeon processors (Intel Gold 6342) featuring 24 (48 total) cores has a total TDP of 2 x 230W = 460W. In comparison, a new Intel Xeon 6741P processor with 48 cores has a TDP of just 300W. When considering a rack scale deployment, substantial savings can be attained.

- Performance/Watt Increase – The new single-socket CPUs can produce more performance per watt than earlier CPUs.

- Save on physical space when deploying in power constrained racks, compared to dual socket systems with the same performance portfolio.

- Up to 136 PCIe 5.0 lanes for peripheral expansion and flash storage devices, with Intel Xeon 6 with P-cores 1-socket solutions

- Software Licensing – A single-socket system may lower these costs for applications where end-users are charged on a per-socket basis, regardless of usage. Users can halve their licensing fees for socket-based software licensing models.

Workloads for Single-Socket Optimized Servers:

Many workloads will benefit from single-socket servers. These include:

- Storage systems, including software-defined storage, necessitate higher data transfer rates between devices and storage drives (NVMe SSDs) to facilitate more extensive storage solutions (NVMe for caching). This requirement for high fan-out storage devices is combined with modest compute requirements. As storage workloads focus on data, the streamlined architecture of a single processor server minimizes the optimization effort needed.

- Virtualization – Whether it's on-premises or in the cloud, a single-socket system can handle a huge number of virtual machines simultaneously. This is largely due to the support for a large memory pool with up to 16 DDR5 DIMM slots, generous drive bays for storage, and plenty of add-on card slots. The Intel Xeon 6 with P-cores single-socket solutions is truly the star of the show for this generation.

- Web Servers – Each connection to a web server does not require a significant amount of computing power. Thus, a new single-socket server can handle the traffic that used to be handled by a dual-socket server. The high frequency of CPUs designed for single-socket servers allows for many connections to a single-socket server.

- Scale-Out Databases - Many databases require substantial I/O, which new Xeon-based systems can offer due to a higher number of PCIe lanes. Smaller databases, designed for SMBs, are an ideal application match to single-socket systems.

- Content Delivery Networks (CDN) – CDN environments are ideal for single-socket servers. The high-frequency CPUs, along with many PCIe lanes, mean that a significant amount of data access from storage and transmission to high-speed networking is possible simultaneously.

- File/Email Servers—Single-socket systems are ideal for enterprise environments as file and email servers, as they are less expensive than similar dual-socket systems.

- Small-Scale ERP – Many organizations need a low-cost solution for their Enterprise Resource Planning applications, where the traffic to the server is not significant. A single-socket system is an excellent match for these environments.

- Electronic Design Automation (EDA) – The simulations of complex circuits can be accomplished using single socket servers. Many companies that design CPUs and GPUs use single socket servers.

Supermicro Single-Socket System Portfolio

Supermicro's single-socket rackmount server families are designed for various workloads and, utilizing a building block design, are available in 1U and 2U form factors. For cloud-based and enterprise applications, a single-socket server, in comparison to earlier generations of dual-socket servers, reduces costs for workloads in these environments. While many Supermicro product families offer single-socket options, the best configurations are found in the following X14 product lines:

- Hyper: 1U or 2U servers with Intel Xeon 6 6900/6700/6500 series processors. The specific servers are:
    - SYS-212HA-TN – 2U with a single Intel Xeon 6900P processor and GPU expandability
    - SYS-112HA-TN – 1U with a single Intel Xeon 6900P processor
    - SYS-212H-TN – 2U with a single Intel Xeon 6700/6500 series processor with P-cores or a 6700 series processor with E-cores and GPU expandability
    - SYS-112H-TN – 1U with a single Intel Xeon 6700/6500 series processor with P-cores or a 6700 series processor with E-cores
- CloudDC: 1U Servers with DC-MHS
    - SYS-112C-TN – 1U with a single Intel Xeon 6700/6500 series processor with P-cores or a 6700 series processor with E-cores
- WIO: These systems are ideal for workloads where a single-socket system is sufficient and with limited memory requirements
    - SYS-112B-WR – 1U system with a single Intel Xeon 6700/6500 series processor with P-cores or a 6700 series processor with E-cores
    - SYS-512B-WR – 1U system with a single Intel Xeon 6700/6500 series processor with P-cores or a 6700 series processor with E-cores and with GPU expandability
    - SYS-522B-WR – 2U system with a single Intel Xeon 6700/6500 series processor with P-cores or a 6700 series processor with E-cores and GPU expandability
- GrandTwin®: Supermicro Multi-Node servers are designed so that independent servers share power and cooling components, which can increase efficiency.
    - SYS-212GT-DNAF – 2U / 2 Node system with a single Intel Xeon 6900 series processor with P-cores

    - SYS-212GT-HN(F)(R) – 2U / 4 Node system with a single Intel Xeon 6700/6500 series processor with P-cores or a 6700 series processor with E-cores
- SuperBlade®: Density-optimized, and energy-efficient multi-node platform optimized for AI, Data Analytics, HPC, Cloud, and Enterprise workloads. Available as a 6U enclosure with 10 or 5 nodes, or an 8U enclosure with 20 or 10 nodes.
    - SBI-612B-1C2N (Single-width blade, Xeon 6700/6500, 2x U.2 NVMe SSDs)
    - SBI-612B-1NE34 (Single-width blade, Xeon 6700/6500, 4x E3.S SSDs)
    - SBI-612B-5NE34 (Dual-width blade, Xeon 6700/6500, 4x E3.S SSDs)
    - SBI-612BA-1NE34 (Single-width blade, Xeon 6900, 2x M.2 NVMe SSD, 4x E3.S SSDs)
    - SBI-612BA-5NE34 (Dual-width blade, Xeon 6900, 4x E3.S SSDs)

- Edge: Thermal optimized edge systems for environmentally challenging environments.
    - SYS-212B-FN4TP (2U short-depth, Xeon 6700/6500, Front I/O)

- Storage Servers: Systems for massive storage capacity
    - SSG-542B-E1CR60 (4U top-loading with 60 bays)
    - SSG-542B-E1CR90 (4U top-loading with 90 bays)
    - SSG-542B-DE1CR90 (4U dual-node top-loading with 90 bays)

Supermicro Family	Intel 6900P	Intel 6700P	Intel 6500P	Intel 6700E
SuperBlade®	Yes	Yes	Yes	Yes
Hyper	Yes	Yes	Yes	Yes
CloudDC		Yes	Yes	Yes
WIO		Yes	Yes	Yes
GrandTwin	Yes	Yes	Yes	Yes
IoT Server		Yes	Yes	Yes
Storage		Yes	Yes	Yes

Technology Advancements

A single-socket server offers a number of advantages over dual-socket servers. The single-socket CPUs available today exceed the performance and capabilities of dual-socket servers from about two generations ago. In terms of core counts, PCIe lanes and performance, memory access, and the peripherals available, a new single-socket server will easily outperform previous generations of dual-socket servers.

- Core counts – The latest CPUs have core counts that double the core counts of a few generations ago.
- PCIe Lanes and Performance – The performance of the I/O of a new single-socket server exceeds older dual-socket servers through a combination of more PCIe lanes and significantly higher speed than previous generations of systems.
- Memory Capacity and Access – the performance and capacity of memory that can be used significantly rises with each generation of CPUs.

Comparing some of the basic technologies across a number of generations of Intel Xeon CPUs, it can be seen the tremendous performance and capability increase, on a per socket level.

CPU	2nd Gen Intel® Xeon® – Single-Socket Optimized	3rd Gen Intel® Xeon® – Single-Socket Optimized	Intel® Xeon® 6 with P-core Single-Socket Solution	Benefit
Core Counts	Up to 24 cores	Up to 36 cores	Up to 128 cores	5.33x increase over 2nd 3.56x increase over 3rd
Memory	DDR4-2933	DDR4-2933	DDR5-6400	2.18x memory bandwidth
PCIe	PCIe 3.0	PCIe 4.0	PCIe 5.0	4x throughput increase vs 2nd 2x throughput increase vs 3rd
PCIe Lanes	Up to 48	Up to 64	Up to 136	2.83x more lanes than 2nd 2.13x more lanes than 3rd
CXL	---	---	CXL 2.0 (up to 64 lanes)	Increase shared memory pool

Intel New One-Socket Optimized CPUs

With the recent introduction of Intel's Xeon 6 series processors, the company has made several CPUs available that are optimized for one-socket servers by replacing UPI links with additional PCIe lanes. These highly optimized CPUs excel at workloads like CDN, for instance, that utilize 136 PCIe lanes—significantly more than the 88 lanes found in other Intel Xeon 6 processors. Typically, these extra lanes are used to support additional storage or networking devices, such as NVMe drives and add-on cards.

The CPUs in this optimized one-socket series include:

CPU	Cores	TDP (Watts)	Base Clock Rate	Boost Clock Rate	DDR5 Memory / MRDIMM Memory
6781P	80	350	2.0	3.2	6400 / 8000
6761P	64	350	2.5	3.6	6400 / 8000
6741P	48	300	2.5	3.7	6400 / NA
6731P	32	245	2.5	3.9	6400 / NA
6521P	24	225	2.6	4.1	6400 / NA
6511P	16	150	2.5	4.2	6400 / NA

Benchmarks

For comparison, look at an example, comparing an older 2-socket system with a current 1-socket optimized system. The data shows, from running the SPEC.org SPEC 2017 Floating Point Rate benchmark that a new system with just one CPU is 2.6X faster than an older system with 2 Intel Xeon Gold CPUs.

- Floating Point and Integer Performance of a System: The SPEC performance suite is a widely referenced benchmark for floating point benchmarks. Looking at the "rate," which is a measure of overall system performance (reference www.spec.org) :

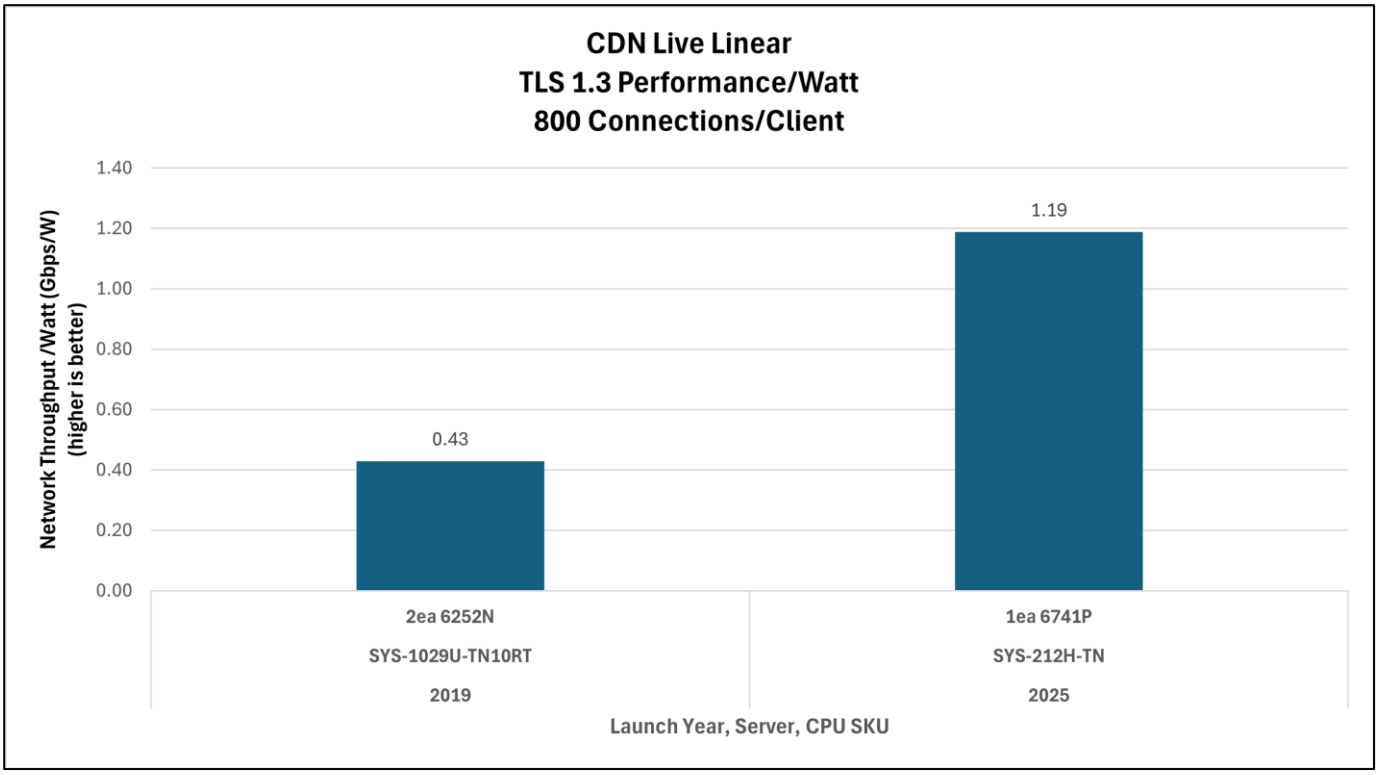
Benchmark	CPU Used	# CPUs	Result (Higher is Better)	Ratio
SPEC 2017 Floating Point Rate	Intel Xeon 6980P	1	1360	2.6
	Intel Xeon Gold 6348	2	524	1.0
SPEC 2017 Integer Rate	Intel Xeon 6980P	1	1270	2.6
	Intel Xeon Gold 6348	2	487	1.0

These results show that a single-socket server with the Intel Xeon 6980P processor is 2.6X faster than a 3rd Gen Intel Xeon Gold processor when comparing floating-point rate, and 2.6X faster than a 3rd Gen Intel Xeon Gold processor when comparing integer rates.

- CDN Performance – Content Delivery Networks (CDN) servers require a large amount of I/O to cache data and deliver it to client devices. Therefore, a system with a high number of PCIe lanes that can access a large number of storage and networking devices is critical for high bandwidth. Below are the tested specifications to compare a new single-socket server (SYS-212H-TN) and an older dual-socket server (SYS-1029U-TN10RT). A detailed discussion of the following benchmark can be found at: https://www.supermicro.com/solutions/Solution-Brief_X14_Hyper_Intel_Xeon6_Varnish_Enterprise_CDN_Performance.pdf

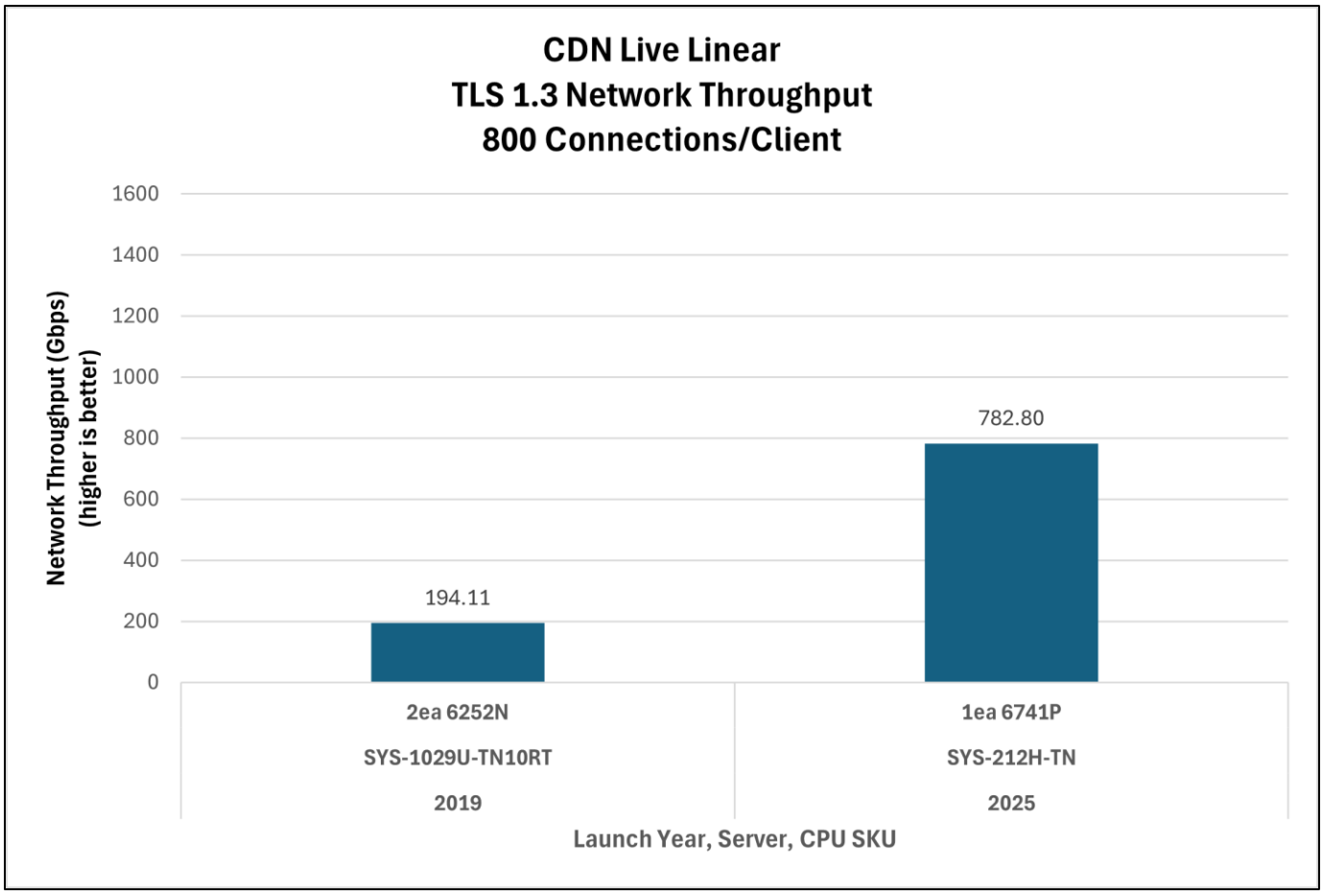
Generation		
System Type (# Processor)	Dual CPUs	Single CPU
System	SYS-1029U-TN10RT	SYS-212H-TN
CPU	2x 2nd Gen Intel Xeon 6265N (48 cores total)	1x Intel Xeon 6741P (48 Cores)
Memory	384GB DDR4-2933	512GB DDR5-6400
Storage	10x Gen3x4 NVMe	16x Gen5x4 NVMe
Network	200Gbps (2x Gen3x16 100GbE)	800Gbps Line Rate (2x Gen5x16 2x200GbE)

The following chart shows the performance increase of using a single socket Hyper series system compared with a dual-socket system from approximately 2019. The performance per watt is approximately 2.8 times higher. This benchmark is for the Live Linear benchmark.

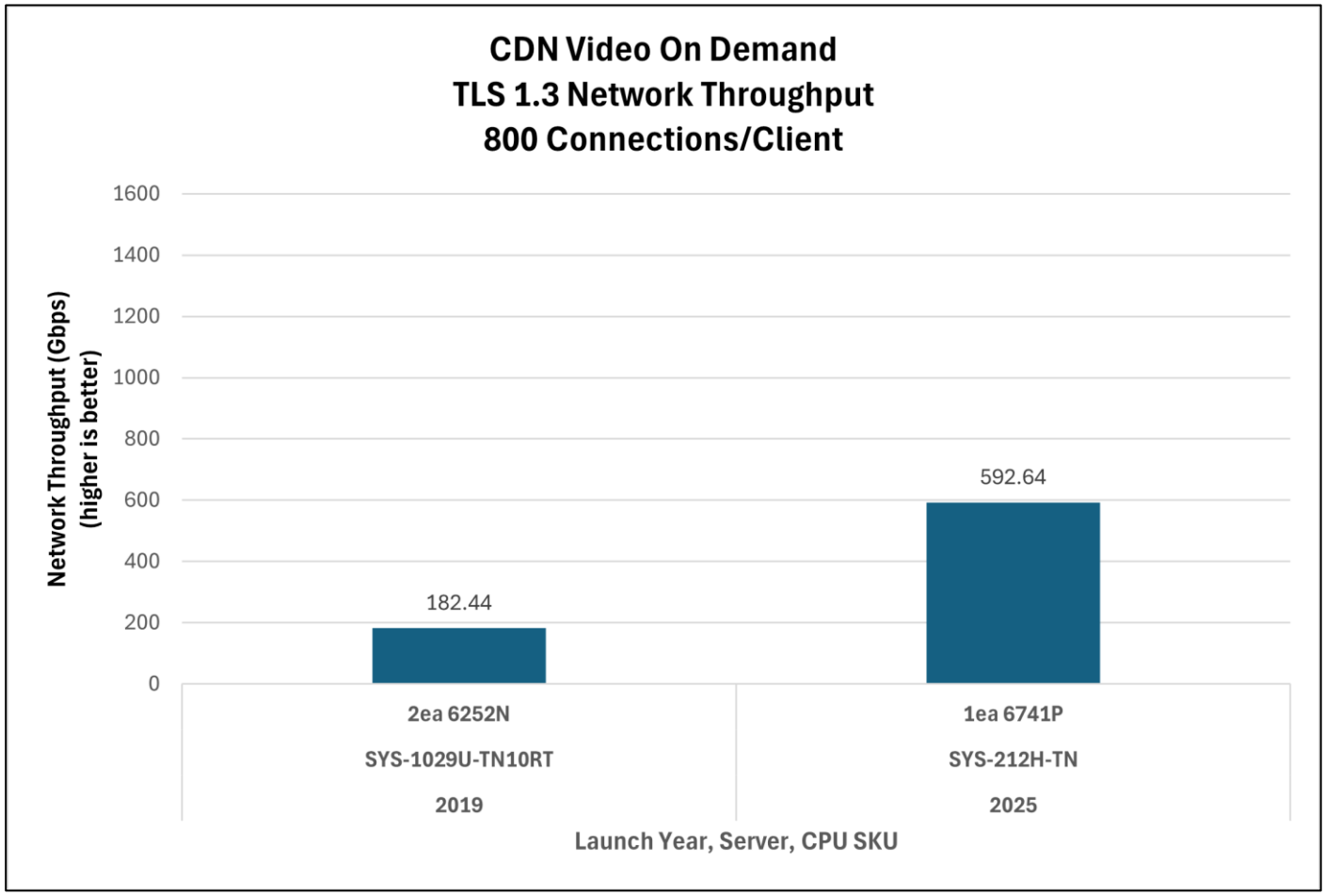


When looking at the network throughput, comparing a Supermicro Hyper system with a single-socket optimized processor, the performance is over 4 times faster than a system with dual 2nd Gen Intel Xeon scalable processors. This benchmark is for the

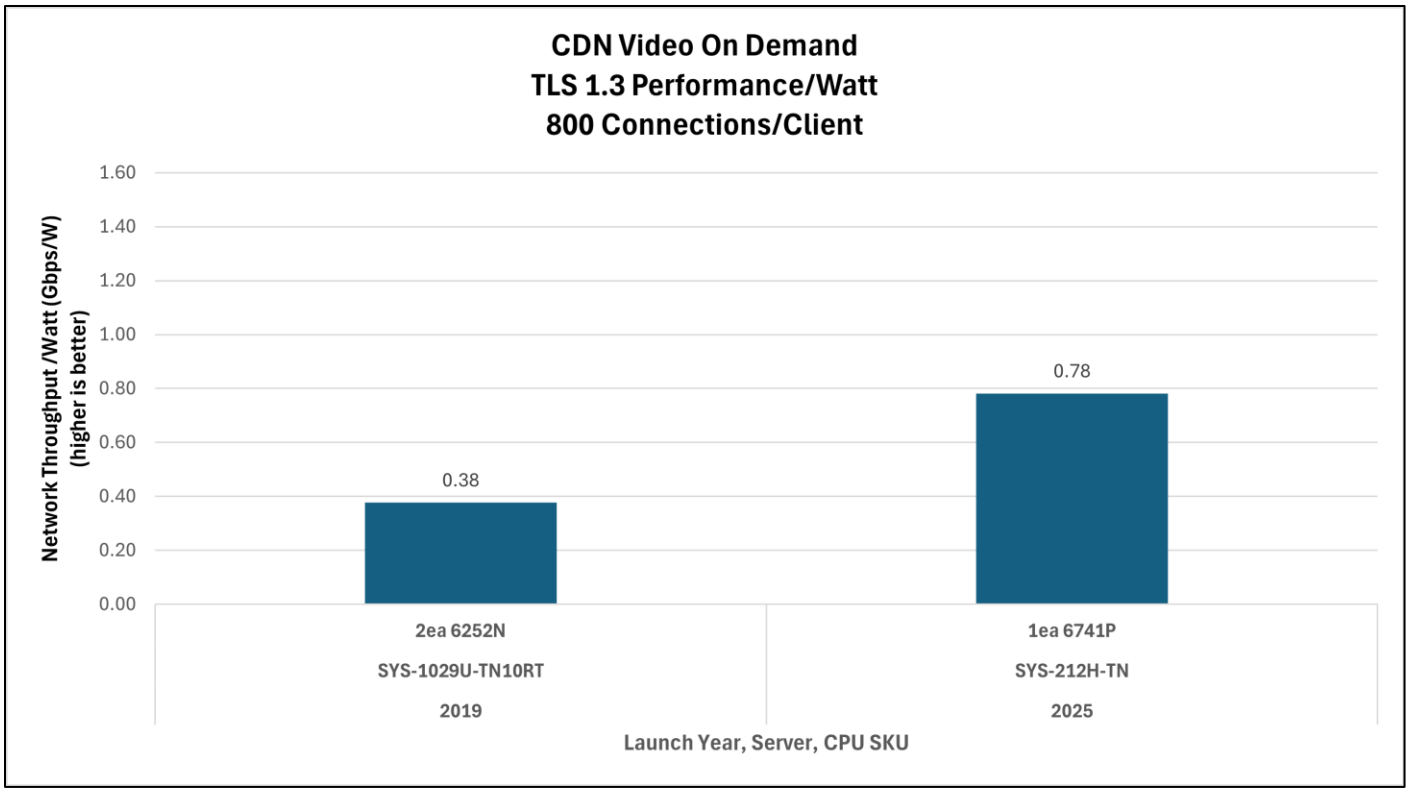
Live Linear benchmark.



For a test case that measures a Video-On-Demand application, an X14 Hyper system with a single-socket optimized processor shows a 2.5X increase in performance over a dual-socket system with 2nd Gen Intel Xeon scalable processors.



The following benchmark shows that a Video-On-Demand workload shows a 2X increase in performance/watt when compared to a system that uses dual 2nd Gen Intel Xeon scalable processors.



Looking at some system components, below is a comparison of a Supermicro BigTwin® with dual 2nd Gen Intel Xeon processors compared to a Supermicro Hyper server with a single Intel Xeon 6980P processor.

	System (example)	CPU(s)	Cores/System	PCIe Lanes / PCIe Version	Memory
Intel Xeon	SYS-2029BZ-HNR (BigTwin)	2	2x 28 = 56 (2nd Gen Intel Xeon)	2 x 40 PCIe 3.0	2x 6ch 2933 MT/s
	SYS-112H-TN (Hyper)	1	1x 80 (Intel Xeon 6 6781)	136 x PCIe 5.0	1x 8ch 6400 MT/s

Comparing some of the basic technologies across a number of generations of Intel Xeon CPUs, it can be seen the tremendous performance and capability increase, on a per socket level.

Summary

The Supermicro single-socket servers meet the requirements of various workloads where density and energy efficiency are critical. The latest generation of single-socket servers can outperform earlier dual-socket systems, leading to lower initial costs and ongoing operating expenses due to decreased power consumption.

For More Information

https://www.supermicro.com/en/products/single-processor

CDN Benchmark Solution Brief: https://www.supermicro.com/solutions/Solution-Brief_X14_Hyper_Intel_Xeon6_Varnish_Enterprise_CDN_Performance.pdf

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