Solution Brief

Network-Optimized 5th Gen Intel® Xeon® Scalable Processors
5G User Plane Function (UPF)

Drive Throughput and Power Efficiency Advantages for 5G Core

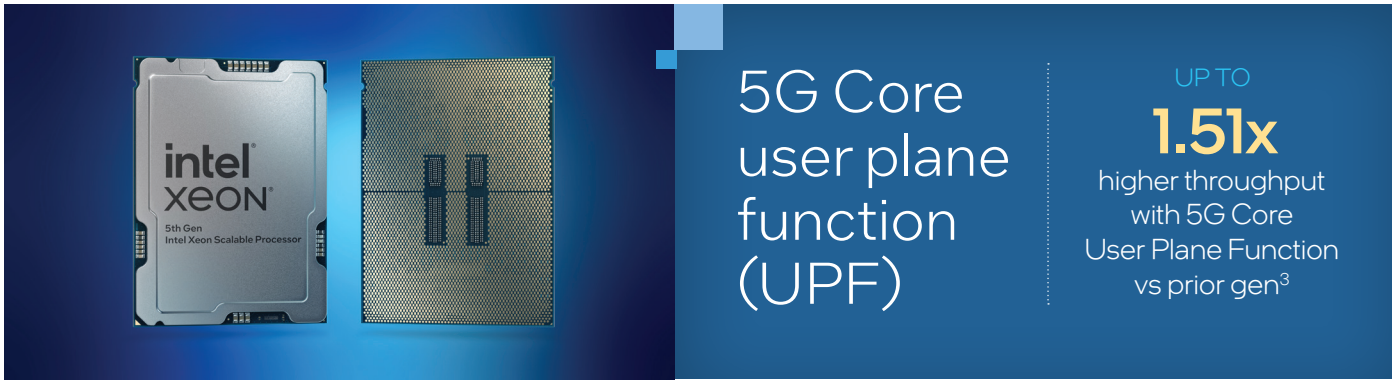
Network-optimized 5th Gen Intel® Xeon® Scalable processors enable high performance for 5G core deployments and reduce total cost of ownership (TCO). Built-in accelerators help increase throughput and decrease latency, while advances in power management enhance both responsiveness and energy efficiency.

Ongoing massive growth in mobile data creates challenges for communication service providers (CoSPs) as they work to cost-effectively scale their networks. Global total mobile network traffic reached approximately 118 EB per month at the end of 2022 and is expected to grow by 4x to 472 EB per month by the end of 2028.[1] In addition, fixed wireless access (FWA) will grow from 21% to 30% of global mobile data traffic over the same period, and by 2028, 80% of FWA will be over 5G.[1] To thrive, CoSPs must build agile infrastructure capable of delivering high throughput with low TCO.

Over the last few years, general-purpose, standards-based servers enabled new efficiencies and cost reduction through workload consolidation. This evolution continues as the 3GPP standards define the cloud-native standalone 5G core implementation as the singular path for CoSPs to deliver advanced, monetizable 5G services and to cost-effectively manage traffic growth.

Network-optimized 5th Gen Intel® Xeon® processors support the next step in that evolution, accelerating 5G core workloads and increasing energy efficiency, with a high-throughput, low-latency platform engineered for the core and scalable to the edge. The processor provides gen-over-gen advances on an architecture that balances compute, memory and I/O resources to drive performance and efficiency for real-world network workloads, such as 5G user plane function (UPF):

- **High-throughput, high-efficiency execution resources**. Improved per-core performance and up to 64 cores per socket, with the industry's most built-in accelerators and energy savings with Intel Infrastructure Power Manager software for 5G UPF applications.
- **Enhanced memory subsystem**. Up to 16% increased DDR5 memory speed and up to 3x total last level cache[2] compared to 4th Gen Intel Xeon Scalable processors, to hold more user plane data close to the processor for enhanced throughput.
- **Expanded I/O speed and capacity**. Up to 80 lanes of PCIe Gen 5.0 per socket, with optimized Intel Ethernet Network Controllers and Adapters, Intel UltraPath Interconnect (Intel UPI) 2.0 speeds up to 20 GT/s and support for Compute Express Link (CXL) Types 1, 2 and 3.



The platform further enhances the scalability and performance of software-defined infrastructure with an enhanced instruction set architecture (ISA). Intel Ethernet 800 Network Adapters complement the Intel Xeon processor for UPF deployments, with protocol-specific (e.g., GTP-U) parsing, classification and steering by means of Intel Dynamic Device Personalization (Intel DDP). Advanced architecture and the industry's largest lineup of hardware accelerators built into network-optimized 5th Gen Intel Xeon Scalable processors provide performance and efficiency across UPF workloads, as introduced in the sections below.

Accelerated encryption with enhanced power efficiency

Extensive encryption and decryption operations protect the privacy and integrity of control plane and data plane transmissions in the 5G core. Because these operations consume significant compute resources, 5th Gen Intel Xeon Scalable processors offer hardware acceleration for encryption using built-in Intel Advanced Vector Extensions 512 (Intel AVX-512), Vectorized Advanced Encryption Standard (V-AES), Intel Multi-Buffer Crypto for IPsec and more for UPF workloads and back-office services, such as OSS, BSS and authentication of applications and devices.

Intel QuickAssist Technology (Intel QAT) accelerates both encryption and compression. With Intel QAT, there is no requirement to send data over the PCIe bus to communicate with external hardware, resulting in improved throughput and overall responsiveness as well as reduction of power consumption and transfer latency.

Power-management improvements for efficiency and responsiveness

Cost-saving and sustainability efforts rely on the reduction and optimization of energy consumption. Network-optimized 5th Gen Intel Xeon Scalable processors give CoSPs an ideal balance between power and performance. Their high per-core throughput and increased core counts support more connections per host or instance. The platform also provides improved performance per watt compared to its predecessor, based on real-world workloads and the rack-level wall power and thermal constraints of telecommunication central offices and data centers.

Intel delivers fine-grained control over frequency and power consumption in run-time environments, without any workload changes. Achieve up to 1.37x performance/watt improvement with Intel Infrastructure Power Manager software for 5G UPF applications vs the prior generation.[4] Carriers can therefore save on energy usage and operating expense (OpEx), while meeting service level agreements (SLAs) and maintaining high quality of experience (QoE).

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Increased throughput with intelligent cores and scale

Intel designed its network-optimized processors to support the distribution of data plane and signaling workloads in the 5G core. The new processors make the best use of system resources by dynamically tuning processing cores to be as efficient as possible. Intel Dynamic Load Balancer (Intel DLB) implements that orchestration with silicon-based load balancing rules and logic built into 5th Gen Intel Xeon Scalable processors. This platform feature operates without occupying the processor cores that otherwise would be needed to execute software-based traffic control.

It is inherently faster and more energy efficient to perform these functions in hardware than software logic, meaning that Intel DLB executes the load balancing function while contributing to better hardware utilization, increased throughput, lower power consumption and lower OpEx. These advantages translate to financial and sustainability benefits for network operators.

Confidential computing protects data

In highly distributed environments, 5G core workloads interoperate with third-party applications, data, services and infrastructure, creating a larger, low-visibility attack surface. Encryption protects data at rest and in transit, but data in use is generally unencrypted. As an example, private keys, which are required for mTLS Sessions in 5G control plane and service-based interface (SBI), may store sensitive data as unencrypted cleartext in current implementations.

Confidential computing protects private data such as encryption keys while in use by isolating the data in hardware-enforced trusted execution environments (TEEs). Decryption only happens inside the TEE, where data can only be accessed by trusted code. No user or process, regardless of privilege level, can reach the data unless explicitly granted that trust. Confidential computing improvements in 5th Gen Intel Xeon Scalable processors include general availability of VM-level and application-level isolation.

For application-level isolation, Intel Software Guard Extensions (Intel SGX) is the most researched, updated and deployed confidential computing technology on the market today, with the smallest trust boundary. Intel Trust Domain Extensions (Intel TDX) provides isolation and confidentiality at the virtual machine (VM) level, isolating the guest OS and applications from access by the cloud host, hypervisor and other VMs.

Service assurance begins with infrastructure telemetry

Service assurance, especially in a cloud native infrastructure framework, is another concern for network operators. There is a visibility gap with cloud-native and virtualized environments between the underlying network infrastructure and the service layers that can prevent the identification, correlation and resolution of the root causes of service degradations and other IT Ops incidents.

The combination of 5th Gen Intel Xeon Scalable processors — with built-in AI — and Intel Platform Telemetry Insights software provides a granular view into operational metrics of the underlying infrastructure, including health, utilization, congestion, power consumption and configuration checks. This data may be integrated into observability programs to trigger notification to NetOps teams and remediation actions as part of closed loop systems. Through the CNCF's OpenTelemetry project, Intel provides a standard implementation for the industry to benefit from infrastructure observability.

Conclusion

Network-optimized 5th Gen Intel Xeon Scalable processors help CoSPs handle 5G core workloads with energy-efficient operation and high density of connections per host or instance. The processor is designed for high throughput and low latency from the core to the edge. Built-in hardware accelerators enhance distribution of work across cores, accelerate encryption and protect data with confidential computing. The energy efficiency of handling these operations in hardware is complemented by enhanced power management software. This platform provides a high-performance, sustainable and secure foundation for next-generation services.

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[1] Ericsson Mobility Report, June 2023. https://www.ericsson.com/en/reports-and-papers/mobility-report/reports/june-2023.

[2] On select SKUs. See [G11 & G12] at intel.com/processorclaims: 5th Gen Intel Xeon Scalable processors. Results may vary.

[3] See [N4] at intel.com/processorclaims: 5th Gen Intel® Xeon® Scalable processors. Results may vary.

[4] See [N17] at intel.com/processorclaims: 5th Gen Intel® Xeon® Scalable processors. Results may vary.

Availability of accelerators varies depending on SKU. Visit the Intel Product Specifications page for additional product details.

Performance varies by use, configuration and other factors. Learn more at https://www.intel.com/PerformanceIndex.

Performance results are based on testing as of dates shown in configurations and may not reflect all publicly available updates. See configuration disclosure for configuration details. No product or component can be absolutely secure.

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