Product Brief

4th Gen Intel® Xeon® Scalable Processors with Intel® vRAN Boost

Integrated Acceleration for High-Performance, Energy-Efficient vRANs

4th Gen Intel® Xeon® Scalable processors with Intel® vRAN Boost provide significant processing capacity gains while substantially enhancing performance-per-watt.[1] The platform integrates vRAN acceleration directly into the processor, eliminating the need for external accelerators to reduce system complexity and cost.

Communication service providers (CoSPs) worldwide are transforming their networks, driven by the unprecedented growth in mobile data, an expanding diversity of connected endpoints and a desire to create new service revenue streams. To meet these needs sustainably and provide high-quality user experiences, CoSPs must make their wireless networks programmable to achieve greater scalability and flexibility. By reimagining radio network architectures, CoSPs are preparing for the next wave of exponential data growth while increasing innovation speed and providing customers with new, value-added services.

Driven by the rollout of 5G services, the global virtualized radio access network (vRAN) market is expected to grow at a CAGR of about 19% through 2030, reaching $6.4 billion by that year.[2] To help optimize those investments, CoSPs are shifting from hardware-based, single-purpose infrastructure to software-defined, fully virtualized architectures running on general-purpose, standards-based servers. Potential cost savings include both capital expense (CapEx) through reduced equipment footprint and operating expense (OpEx) provided by greater energy efficiency.

4th Gen Intel® Xeon® Scalable processors with Intel® vRAN Boost are optimized to drive down the cost of deploying and operating vRAN infrastructure while unleashing innovation.

Built for Massive, Energy-Efficient vRAN Capacity

4th Gen Intel Xeon Scalable processors provide outstanding energy-efficient performance across networking use cases, including vRAN deployments. The platform delivers up to twice the capacity for vRAN workloads versus the prior generation.[1] It is optimized for high throughput and low latency, with built-in acceleration for packet and signal processing, load balancing and AI. It also provides higher memory bandwidth compared to the previous generation, with I/O capacity to meet the highest capacity requirements for next-generation vRAN deployments.

Building on that foundation, 4th Gen Intel Xeon Scalable processors with Intel vRAN Boost integrate vRAN acceleration directly into the CPU. By eliminating the need for external accelerator cards, this integration helps reduce the complexity and bill-of-materials cost of vRAN deployments for CoSPs. It is also power-efficient, providing approximately 20% additional compute power savings, beyond the 4th Gen Intel Xeon Scalable processors' generational gains alone.[1]

UP TO **2X** vRAN Capacity[1]

~20% Additional Compute Power Savings[1]

Up to Double the vRAN Capacity with Outstanding Energy Efficiency

Signal processing is at the heart of vRAN workloads, and fast operation of the bit-processing kernels in the wireless pipeline is central to improving the efficiency of vRAN deployments. 4th Gen Intel Xeon Scalable processors include a new 512-bit Intel® Advanced Vector Extensions (AVX) for vRAN instruction set architecture (ISA) with additional support for vRAN workloads through the use of 16-bit half-precision IEEE-754 floating-point operations. Complementing the existing 32-bit and 64-bit floating-point instructions already available in Intel Xeon CPU server products, and providing new complex-valued native hardware support, the new instructions execute twice as many 16-bit half-precision floating-point operations compared to 32-bit single-precision floating-point operations in a single AVX register, further increasing performance of signal processing, media processing and AI applications. These features and other improvements help deliver up to double the vRAN capacity of the prior generation.[1] This doubling of the platform's capacity is compounded by an additional 20% compute power savings from the integrated vRAN accelerator in 4th Gen Intel Xeon Scalable processors with Intel vRAN Boost.[1]

In addition, new shallow sleep states, C0.1 and C0.2, significantly reduce power consumption while recovering to full operating power more rapidly than from existing, deeper sleep states.[3] With the very low exit latency, the platform makes processor core resources available more immediately, to help avoid dropped packets, helping to both improve service quality and reduce energy consumption. As a result, carriers can implement more effective power-management policy to reduce operating expenses while meeting service level agreements (SLAs) and delivering outstanding quality of experience (QoE) to subscribers.

Flexibility, Scalability and Choice

4th Gen Intel Xeon Scalable processors with Intel vRAN Boost are drop-in compatible with any platform that supports 4th Gen Intel Xeon Scalable processors, announced in January 2023. This compatibility allows for board design reuse for a variety of deployment use cases, reducing the cost of developing and supporting a portfolio that supports the entire network. It also enables virtual network functions to be flexibly deployed in any node in the network, leveraging general-purpose servers based on Intel architecture to deliver a converged-services advantage. Operators can run all core, edge and access workloads flexibly on a common platform, driving dramatic resource efficiencies and reducing total cost of ownership (TCO).

The processor's hardware flexibility is complemented by software compatibility with current and previous generations of Intel platforms. In addition, select SKUs will support operation in ambient temperatures down to −40° C, simplifying solution delivery for networks across varied and uncontrolled environments. Likewise, the platform is scalable across vRAN deployments, from small cells to macro cells, and in both distributed and centralized cloud environments.

This scalability and flexibility enables a single design to be reused across networks, significantly reducing hardware design as well as software development and integration costs. The disaggregation of hardware and software components in the solution architecture enables CoSPs to choose their preferred combination of best-in-class components. In fact, vendor choice is granular to the level of individual layers of the RAN stack, maximizing operator flexibility and choice.

Open Ecosystem Alignment

Intel remains dedicated in its support of the open industry ecosystem as the primary engine of choice for transformation. Accordingly, the drivers for Intel vRAN Boost accelerators are open sourced and compatible with the O-RAN ALLIANCE Accelerator Abstraction Layer (AAL) API.

Intel also continually optimizes FlexRAN™ reference software for vRAN to take advantage of emerging hardware capabilities of Intel platforms. This software supports a wide range of 5G deployments, including sub-6GHz, massive MIMO, mmWave, small cell and private wireless. FlexRAN software for vRAN is pre-integrated with the AAL API, allowing transparent upgrade to 4th Gen Intel Scalable processors with Intel vRAN Boost from the prior-generation platform.

Intel's long legacy of networking, software, and hardware expertise drives an unparalleled ecosystem of vendors, tools, standards and strategic alliances that empower CoSPs to innovate new products and services quickly, shorten time to market and conserve time and money. For vRAN deployments, 4th Gen Intel Xeon Scalable processors and 4th Gen Intel Xeon Scalable processors with Intel vRAN Boost enable CoSPs to advance flexibility and scalability while increasing performance and energy efficiency.

Transforming the Next Generation of vRAN

4th Gen Intel Xeon Scalable processors with Intel vRAN Boost will initiate new levels of simplicity, flexibility and scalability, with an open platform built to rapidly integrate innovative solutions. An unparalleled ecosystem of solutions and providers will maximize choice and confidence among CoSPs. The rest of this section outlines some of those innovations.

A Cloud-Native Step Forward

Cloud-native, fully virtualized RAN based on Intel Xeon processors delivers web-scale benefits through secure, containerized microservices, allowing CoSPs to deploy composable applications anywhere. 4th Gen Intel Xeon Scalable processor with Intel vRAN Boost enables CoSPs to achieve cost savings through cloud economies of scale while optimizing their network's performance-per-watt using cloud-native capabilities such as:

- **Simplified network upgrading and testing.** Microservices-based approach enables upgrading components independently of each other at a granular level.
- **Converged services.** End-to-end virtualization makes it possible to run RAN, edge and core workloads on a common platform.

- **Automation and workload rebalancing.** Monitor telemetry data and resource utilization, then rebalance workloads dynamically.
- **Energy savings.** Leverage power management technologies to adjust frequency (P-states) and put cores into various sleep states (C-states) to minimize power use, even under high-load conditions.
- **Baseband pooling in the Distributed Unit (DU).** In periods of low activity, consolidate baseband traffic on fewer processing cores.
- **Processor core reuse.** Apply unused cores to non-traffic workloads, such as administration and management (OAM) functions.
- **End-to-end network slicing.** Ensure that SLAs can be deployed on demand for mission-critical services such as Ultra Reliable Low Latency Communications (URLCC).
- **AI and machine learning.** Dynamically reconfigure networks to save costs, get more value from infrastructure and support new revenue streams.

Open Foundation for Innovation, Today and Tomorrow

As CoSPs continually optimize their networks to realize cost and quality advantages, 4th Gen Intel Xeon Scalable processors with Intel vRAN Boost provide an open platform for integrating innovative solutions. The open ecosystem around RAN technologies enables flexible combination and rapid replacement of RAN software components from multiple sources, including a mature ecosystem of open source networking software. Intel is deeply invested in contributing code to optimize open source projects for the latest hardware platform capabilities.

To help maximize throughput, Intel has optimized key open source projects relevant to vRANs for 4th Gen Intel Xeon Scalable processors, to take advantage of the platform's expanded ISA and new hardware accelerators. These include the data plane development kit (DPDK), which cuts overhead by bypassing the kernel to handle packet processing in user space, and vector packet processing (VPP), which uses DPDK to accelerate encrypted packet forwarding.

High performant FlexRAN reference software for vRAN takes advantage of optimizations and delivers comprehensive RAN features and capabilities. It provides an architecture for solution vendors to readily modify in support of specialized deployment scenarios, helping realize development and deployment efficiencies. The ability to make changes as needed helps enable rapid adoption, migration and the addition of innovative features and applications. In addition, Intel's advanced software development tools, libraries and software kits simplify the development of optimized software for vRAN functions across the data and control planes, including emerging AI-based functions for capabilities such as traffic steering.

Expertise, Experience and the Ecosystem to Deliver Proven Solutions You Can Trust

4th Gen Intel Xeon Scalable processors with Intel vRAN Boost are the culmination of many years of Intel leadership as a market driver and ecosystem enabler for vRAN, including both hardware and software technologies. Intel has consulted with global CoSPs on the deployment of advanced networks, and Intel Xeon processors are market-proven in production telecom networks, including cutting-edge vRANs. In fact, nearly every commercial vRAN deployment in the world today operates on Intel architecture, and in use by more than 150 licensees of FlexRAN reference software.

These implementations also draw on Intel's more than a decade of experience on the cutting edge of network virtualization, from the core to the edge to the RAN. They encompass learnings from extensive vRAN and Open RAN commercial deployments, as well as inputs from tier-1 CoSPs from all over the world. Based on this combination of hardware and software enablement with accumulated expertise, CoSPs can be confident in their path forward deploying high-throughput, energy-efficient vRANs.

4th Gen Intel Xeon Scalable processors with Intel vRAN Boost will cover a range of configurations from 12 to 32 cores per socket, with certain SKUs supporting operation down to −40° C. Beyond the integration of Intel vRAN Boost, these SKUs have been further optimized for next-generation vRAN deployments in terms of I/O, scalability and thermal design power (TDP) specifications. Single socket configurations remain the predominant offering for vRAN optimized platforms, and I/O requirements are met by Intel® Ethernet E800 Series Adapters, which utilize PCIe 4.0 and support key timing synchronization features.

Ecosystem Support Through Intel® Network Builders

The Intel Network Builders Program helps partners innovate and adapt to evolving business, technology and end-user needs, effectively and cost-efficiently. The program provides members with a variety of technical enablement options such as hands-on support from subject matter experts, access to virtual testing and optimization labs, training, tools and other resources.

4th Gen Intel® Xeon® Scalable processors with Intel® vRAN Boost vRAN Optimized (-3N/-3NE)															
SKU	Cores	Base (GHz)	All Core Turbo (GHz)	Cache (MB)	TDP (Watts)	DDR5 Memory Speed	Scalability	Customer Config PCIe Lanes	AMX Support	Default DSA Devices	Default vRAN Boost Devices	Intel SGX Enclave Capacity	Extended Temp Support	Intel On Demand Capable	Die Chop
AMX Enabled SKUs															
5433N	20	2.3	3.0	37.5	160	4000	1S	48L	Yes	1	1	128GB	No	✓	EE LCC
Commercial Temp SKUs															
6443N	32	2.0	2.7	60	195	4400	1S	64L	No	1	1	128GB	No	✓	EE MCC
6433N	32	2.0	2.7	60	205	4400	1S	64L	No	1	1	128GB	No	✓	EE MCC
6423N	28	2.0	2.7	52.5	195	4400	1S	64L	No	1	1	128GB	No	✓	EE MCC
6403N	24	1.9	2.7	45	185	4000	1S	64L	No	1	1	128GB	No	✓	EE MCC
5423N	20	2.1	2.8	37.5	145	4000	1S	48L	No	1	1	128GB	No	✓	EE LCC
Extended Temp SKUs															
6433NE	32	2.0	2.7	60	205	4400	1S	64L	No	1	1	128GB	Yes	✓	EE MCC

EE = Edge Enhanced, LCC = Low Core Count, MCC = Medium Core Count

Please visit intel.com/xeon or contact your Intel representative to obtain the latest product specifications. Intel processor numbers are not a measure of performance. Processor numbers differentiate features within each processor family, not across different processor families. All processors support Intel Virtualization Technology (Intel VT-x). Intel may make changes to specifications at any time, without notice.

Conclusion

4th Gen Intel Xeon Scalable processors with Intel vRAN Boost provide high capacity and low latency for vRAN deployments, with fully integrated vRAN acceleration that drives up performance per watt and power efficiency, with reduced system components. Further, it unleashes the innovations and efficiencies made possible by full end-to-end virtualization and cloud-native architecture. The platform is a critical ingredient for CoSP networks going forward, delivering flexibility, scalability and choice from the open industry ecosystem. It helps operators scale with agility and control in a future of massive bandwidth demands and rapid, constant change, to better meet the challenges that yield opportunity.

Learn more:

intel.com/4thgenxeonvran

[1] For workloads and configurations visit www.Intel.com/PerformanceIndex. Results may vary.

[2] Transparency Market Research. "Virtualized RAN (vRAN) Market." https://www.transparencymarketresearch.com/virtualized-radio-access-network-market.html.

[3] Vodafone, July 7 2022. "Vodafone, Wind River, Intel, Keysight Technologies and Radisys test 'green' Open RAN network." https://www.vodafone.com/news/technology/vodafone-wind-river-intel-keysight-technologies-radisys-test-green-open-ran.

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.

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