Workload Brief

3rd Generation Intel Xeon Scalable Processor

5G Virtualized Radio Access Network (vRAN)

Flexible Performance for 5G vRAN Deployments

The 3rd Generation Intel® Xeon® Scalable processor improves dramatically on capabilities to run high-performance, platform-efficient vRANs.

As wireless network operators build out 5G infrastructures, they are accelerating their adoption of network functions virtualization (NFV) to cost-effectively handle the massive increases in data volumes, diversity, and transfer rates. The radio access network (RAN) is a particular focus of this effort, due to traditionally high costs of implementation and the RAN's primary role in delivering a high-quality customer experience. To gain agility and scalability for new use cases around mobile and enterprise services, operators are embracing vRAN.

Deploying vRAN on general-purpose servers based on Intel architecture enables scaling and flexibility with a system of pooled resources that are allocated dynamically where they are needed to increase utilization and efficiency.

Flexible Performance on General-Purpose Hardware

Physical-layer processing of signals between base stations and customer endpoints puts significant processing demands on vRAN systems. Dramatic increases in data transfer rates as well as more stringent latency requirements compared to 4G massively expand the amount of data processing at any given time. Likewise, capacity measures such as massive MIMO increase the complexity of signal processing algorithms to make more efficient use of spectrum.

Single-socket servers for vRAN deployments can be sized flexibly for specific implementations—narrowband versus midband for example. The 3rd Generation Intel Xeon Scalable processor offers 8 to 40 powerful cores and a wide range of frequency, features, and power levels. Performance features built into the processor itself and Intel platform ingredients, including Ethernet and accelerators, combine to meet service levels for throughput and latency, as illustrated in Figure 1.

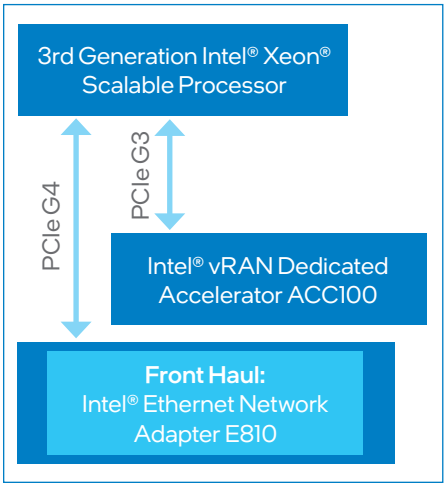

Figure 1. vRAN server components

- **3rd Generation Intel® Xeon® Scalable processors,** combined with Intel® Ethernet 800 Series Network Adapters, deliver an average of up to 62 percent more performance on a range of network workloads over the prior generation, as well as more cores per socket at the high end. That increased processing power is balanced by expanded resources in the memory and I/O subsystems. Performance is expanded further by the new processor instructions discussed below.
- **Intel® vRAN Dedicated Accelerator ACC100** offloads Layer 1 forward error correction (FEC), a well-defined, compute-intensive fixed function 5G workload that improves efficiency over noisy or unreliable transmission channels. Offloading this computation from the main processor frees up computation resources for signal processing, enabling higher overall throughput.
- **Intel® Ethernet Network Adapter E810** provides connectivity for vRAN nodes at up to 100 Gbps per adapter port, with packet-classification optimizations that directly benefit vRAN workloads. Dynamic Device Personalization is a feature that allows multiple personalization profiles to specify optimizations and packet-handling parameters for individual traffic types, increasing throughput and enabling sophisticated traffic prioritization.

Extending vRAN Performance Gains with New Processor Instructions

The 3rd Generation Intel Xeon Scalable processor introduces a number of new instructions that build on existing Intel® Advanced Vector Extensions 512 (Intel® AVX-512) instructions to benefit 5G workloads. In particular, these new instructions accelerate bit-processing kernels in the wireless signal processing software pipeline. For example, new bit-manipulation instructions enable modulation mapping kernels to operate on smaller data units, down to sub-byte sizes. This more granular data handling makes modulation more efficient and accelerates time to completion.

Assisted by this new instruction set, the 3rd Generation Intel Xeon Scalable processor can significantly increase cell density coverage for operators. Intel estimates a 2x increase in massive MIMO throughput in a similar power envelope for a 3x 100 MHz 64T64R configuration, which is considered the best-in-class implementation, as shown in Figure 3.[1]

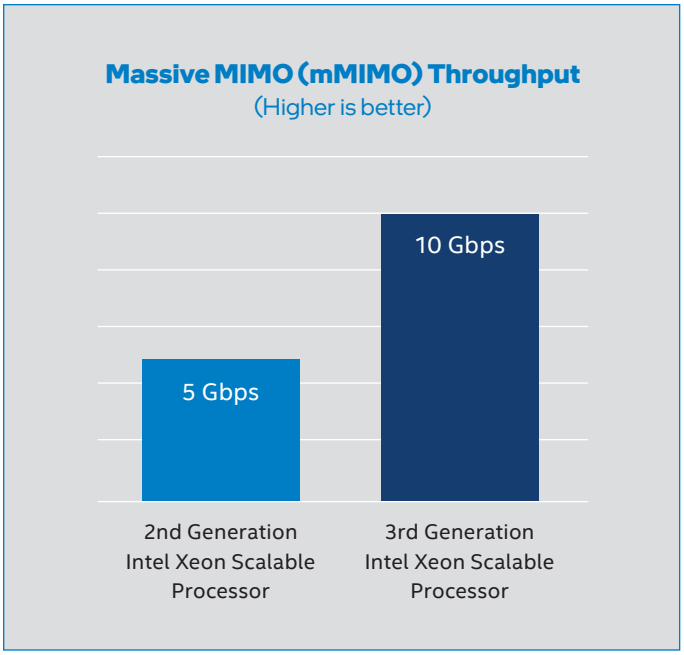

Figure 3. Throughput increased by estimated 2x with 3rd Generation Intel Xeon Scalable processors.[1]

Note: While all kernels will generally benefit from the new microarchitecture, some will not benefit from the new instructions

Accelerating vRAN Adoption with FlexRAN

To help accelerate vRAN development on general-purpose servers, Intel developed the FlexRAN software reference architecture nearly a decade ago. FlexRAN enables baseband unit (BBU) functionality to be implemented in software on Intel Xeon processors in the 4G or 5G wireless network, from edge to core. It supports the broader ecosystem in optimizing vRANs based on NFV infrastructure for hybrid cloud architectures based on 3rd Generation Intel Xeon Scalable processors, including taking advantage of the new instruction sets for the platform. The Intel vRAN Dedicated Accelerator ACC100 Adapter works seamlessly with FlexRAN to accelerate FEC and other 5G workloads.

FlexRAN has been utilized by many leading operators and has been licensed by more than 100 equipment makers, creating a robust and growing ecosystem. The reference architecture is suited to deployment for both indoor and outdoor base stations, including low-power, short-range small cells. For more information, see the video, "An Overview of FlexRAN* Software Wireless Access Solutions."

Intel is an active participant in the O-RAN alliance—an industry initiative to evolve open RAN technologies. Intel introduced the FlexRAN APIs as a contribution to the standardization of interfaces for vRANs globally. FlexRAN defines a Layer 1 pipeline optimized using the data plane development kit (DPDK) as well as optimized libraries that help enhance throughput for various 5G workloads. This enablement for ecosystem collaboration is contributing to innovation around open, efficient platforms for 5G and beyond.

Rakuten, a Japanese technology company, is using FlexRAN as part of its implementation of one of the world's first fully virtualized cloud-native mobile network.

Intel Select Solutions for vRAN

The complexity of networks today requires the right mix of hardware and software components to build an infrastructure that meets each operator's requirements. Intel Select Solutions for vRAN eliminate guesswork with rigorously benchmark tested and verified solutions optimized for real-world performance. The Select Solutions provide tightly specified hardware and software components, purpose-built for virtualized RAN, that can dramatically accelerate deployment and time to new services, while reducing implementation risk for CoSPs. Learn more at: intel.com/selectsolutions.

Conclusion

The dawn of the 5G era is marked in part by network operators intensifying their transitions to flexible platforms that support virtualized functions such as vRANs operating in a software-defined environment. The flexible performance of the 3rd Generation Intel Xeon Scalable processor enables that effort, augmented by additional platform components such as Intel ethernet network adapters and hardware accelerators. The FlexRAN reference architecture helps drive ecosystem innovation forward on those platforms, enabling an agile infrastructure for today's workloads and the demands of tomorrow.

Learn how Intel is accelerating 5G network transformation at www.intel.com/5g

[1] Performance varies by use, configuration and other factors. See [91] at www.intel.com/3gen-xeon-config

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