Solution Brief

Wireless Communications (4G/5G)

Technologies from Mavenir and Intel Accelerate Open RAN Benefits

Mavenir's pioneering Open vRAN software works across different generations of Intel® architecture platforms to give mobile network operators (MNOs) a RAN platform that delivers high network and user performance

The radio access network (RAN) is the bulk of a mobile network operator's (MNO's) network investment, and its performance and functionality are critical to successful service delivery and innovation. Since the introduction of Open RAN networks, the needs of mobile network operators (MNOs) and capabilities of the RAN have evolved in sync with the availability of software and commercial-off-the-shelf (COTS) servers.

Before Open RAN, MNOs built their RAN with fixed-function and specialized baseband unit (BBU) systems that used digital signal processing compute appliances to convert inbound analog radio signals to digital packets and forward them onto the network, and vice versa. These traditional RAN systems also had proprietary interfaces that offered no widespread interoperability, limiting the MNO to building their network using radio and BBU systems from the same manufacturer.

Market dynamics changed dramatically with the popularity of mobile data services, smart mobile devices and increased competition from new MNOs and over-the-top (OTT) services. MNOs built out their 4G networks with traditional RAN equipment and felt first-hand the profitability pressure that came with the inflexibility of the traditional RAN.

Open RAN was developed by the industry as a way to address the limitations of traditional RAN. Open RAN provided a brand new way to build the network by virtualizing the network functions, replacing fixed-function hardware with open Intel® Architecture based servers and developing cloud native RAN software. The critical BBU was disaggregated into its real-time function distributed unit (DU) and non-real time centralized unit (CU) with open interfaces between them to assign the appropriate function to the node to which it was most logically suited, thus reducing the compute performance needed at each base station.

Industry standards for interfaces created interoperability that allowed MNOs to mix-and-match network functions for the best of breed solution. These open standards also invited new market entrants to develop innovations for better network performance and management and to usher in the use of artificial intelligence (AI) / machine learning (ML).

The Open RAN revolution offers the following benefits to MNOs:

- Open interfaces: allow MNOs to use best-of-breed technology from multiple vendors.
- Scalability: Use of virtualization and cloud native technology means the network can scale to support changes in user demand for services.

Processor Family	Max Core Count	Open RAN Capabilities
2nd Gen Intel® Xeon® Scalable Processors	28 cores; 56 threads	Intel® FPGA PAC N3000 Supports narrowband
3rd Gen Intel® Xeon® Scalable Processors	32 cores; 64 threads	Intel® Advanced Vector Extensions 512 (Intel® AVX-512), AI acceleration Intel® vRAN Dedicated Accelerator ACC100 (discrete FEC accelerator) Supports mMIMO Supports millimeter wave frequencies
4th Gen Intel® Xeon® Scalable Processors	32 cores; 64 threads, on-chip accelerators	Increased capacity Intel® vRAN Boost integrated FEC accelerator Intel AVX-512 - FP16 instruction set Advanced AI acceleration

Table 1. Evolution of RAN features in last three generations of Intel® Xeon® Scalable processor.

- Possible higher energy efficiency: Traditional network equipment can be energy intensive, whereas Open RAN uses IT hardware with a faster roadmap cadence and that also benefits from decades of technology and techniques for managing power – and that will get dramatically better in coming years.
- Innovation: Open interfaces will allow new companies to bring new functionality or management capabilities to the network. Vendors could bring in faster innovation into the RAN by leveraging the significant investments made by chipset vendors. The capability to innovate is further enhanced in a fully virtualized, Open RAN where the L1 is also implemented in software on general purpose processors.

Mavenir, Intel Focus on the Future of Open RAN

Open RAN today delivers an exceptional value proposition and has become a mainstream consideration for 4G and 5G network build outs. Open RAN is constantly evolving and Mavenir is working with Intel to deliver higher performance, and new functionality and management features.

In the early days of Open RAN, MNOs (see Table 1) were concerned that general purpose CPUs couldn't provide the same performance as custom processors used in traditional systems. Then the 2nd Gen Intel® Xeon® Scalable processor came to market and powered those early Open RAN deployments. It was followed by 3rd Gen Intel® Xeon® Scalable processors and 4th Gen Intel® Xeon® Scalable processors which delivered more performance and enabled new services. Table 1 shows the evolution of the CPUs and Open RAN features.

Intel's Role in the Future of Open RAN

Intel's 4th Gen Xeon Scalable processors are at the heart of Mavenir's open virtualized RAN (Open vRAN) solutions. This processor family features up to 32 high-performance cores plus on-chip accelerators including the vRAN Boost integrated FEC accelerator.

Intel® vRAN Boost offloads computationally heavy layer 1 tasks such as low-density parity check (LDPC) decoding and forward error correction (FEC). The integrated accelerator replaces a discrete accelerator card for a solution that reduces system complexity and consumes less power creating more sustainable RANs.

In fact, 4th Gen Intel® Xeon® Scalable processors with Intel® vRAN Boost deliver up to twice the capacity and an additional ~20% compute power savings versus the previous generation Intel architecture processor[1]. The other accelerators built into the 4th Gen Intel Xeon Scalable processors improve performance in AI, analytics, networking, and storage. The processors also have a range of features for managing power to further optimize performance per watt.

The 4th Gen Intel Xeon scalable processor has an integrated Intel® Advanced Matrix Extensions (Intel® AMX), AI accelerator in each core matching deep learning training requirements for numerous applications that traditionally needed to be offloaded to a separate GPU. 4th Gen Intel Xeon Scalable processors with Intel AMX was implemented because it is an efficient and cost-effective strategy for accelerating AI workloads.

As a part of its DU, Mavenir utilizes Intel® FlexRAN™ Reference Architecture, which is a vRAN reference implementation that executes wireless access workloads efficiently on Intel Xeon Scalable processors. FlexRAN is comprised of several modular, virtualized control functions with well-defined interfaces that allow flexible and programmable control of the layer 1 wireless infrastructure. Mavenir also makes use of the open source Data Plane Development Kit (DPDK) especially the O-RAN standard AAL implementation of the Baseband Device (BBDEV) library to better integrate accelerators or FPGAs in PHY layer processing.

Mavenir Comprehensive Open RAN Solution

Mavenir's Open vRAN software supports all mobile network generations (2G, 3G, 4G, 5G) and provides complete baseband unit (BBU) functionality via its own industry standard CU and DU network functions for public and private networks. The solution is compliant with O-RAN Alliance standards.

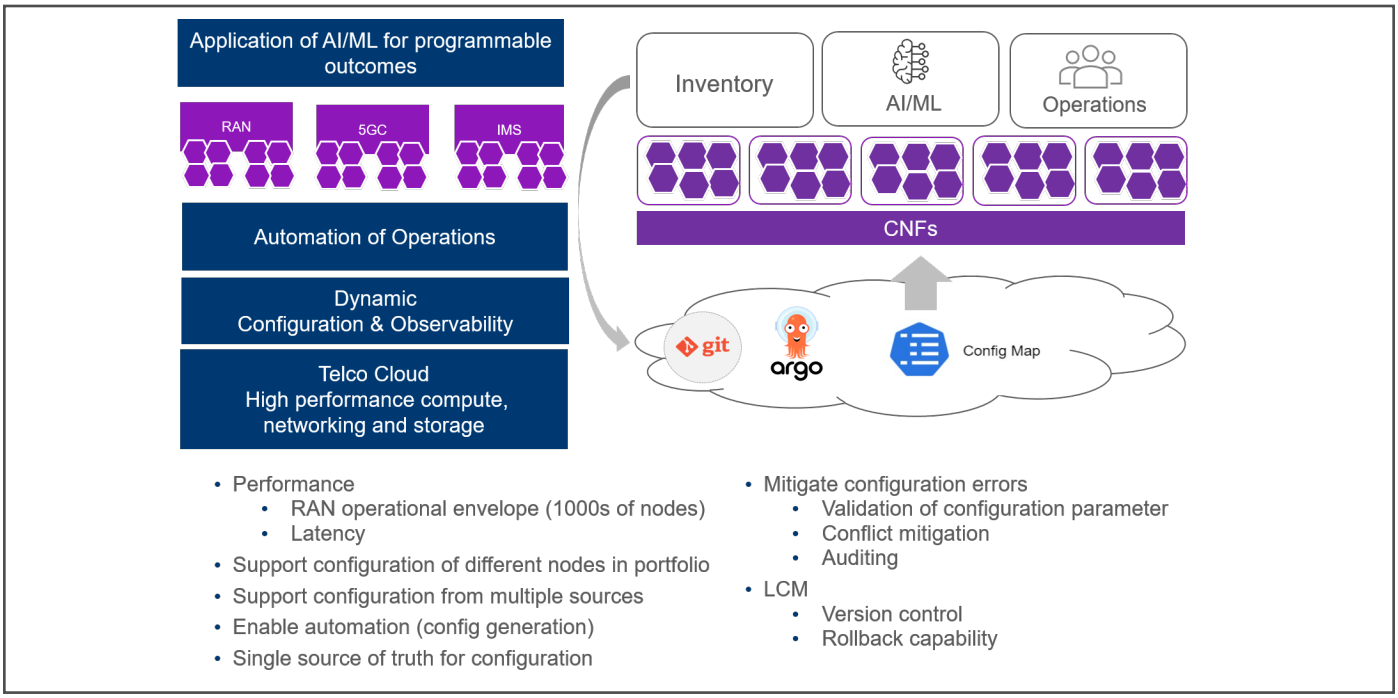

Figure 1. This figure shows the cloud native architecture of the Mavenir Open vRAN software and how it can scale by adding more CNFs.

Mavenir software is cloud-native, with fully containerized microservices allowing it to be deployed easily on Intel architecture in private, hybrid or public clouds (see Figure 1).

As seen in Figure 2, the complete Mavenir network starts with Mavenir's OpenBeam remote radio units (RRU). The RRUs facilitate user equipment (UE) connections to the network. RRUs span micro, macro, mmWave and mMIMO systems and feature low power consumption, low wind load, and integrated management intelligence and automated configuration. The OpenBeam RRUs are Open RAN compliant, feature a modular design, and support both beamforming and multi-band services.

The RRUs connect to a DU that provides real-time processing of radio resource management functions including radio link control (RLC), media access control (MAC) and upper physical layer (PHY) layer information.

The DU passes data to the CU for control and user plane processing. The CU is also containerized and processes packets at layer two (Packet Data Convergence Protocol (PDCP)) and layer three (Radio Resource Control (RRC)).

The CU serves multiple DUs and thanks to disaggregation of these BBU functions, the CU can reside in the cloud or on a server in a regional point of presence (PoP).

Taking this DU/CU disaggregation a bit further, Mavenir's Open vRAN software supports the O-RAN Alliance standard for functionality splits between the DU and the CU. In this way, the MNO can redistribute some centralized and distributed functionality in order to meet specific needs of a network deployment or to utilize lower cost/ lower power servers for the DU.

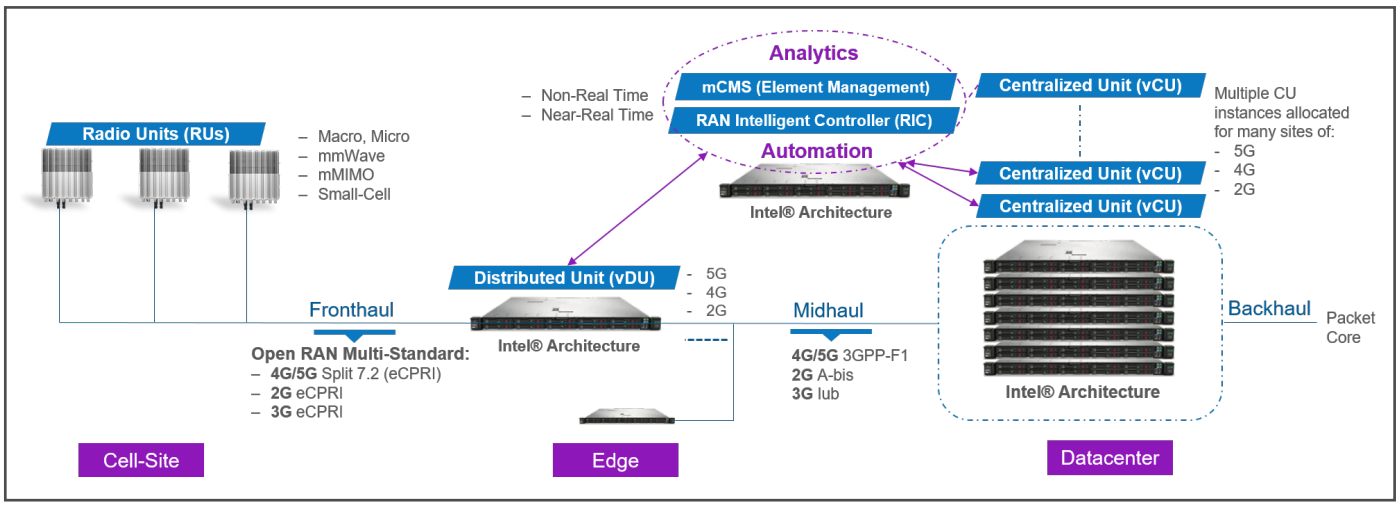

Figure 2. Mavenir network block diagram.

The Mavenir Open vRAN software is architected to improve CPU processing density by supporting Intel® Advanced Vector Extensions 512 (AVX-512). This Mavenir Open vRAN leverages half precision 16 bit floating point data types to double the number of instructions processed per cycle when compared to single precision floating point data types.

Mavenir provides management of the entire system via an element management system and can add extra functionality via a RAN Intelligent Controller (RIC) that allows additional opportunities for optimization to achieve specific target KPIs via third party real-time xApps and non-real time rApps.

Mavenir Webscale Platform Virtualization Platform

Mavenir Webscale Platform (MWP) is a key element of its Open RAN solution. 5G demands networks that are highly adaptable and scalable and that feature zero-trust security functionality, scalability and a high degree of automation. MWP is the component that powers those features.

MWP includes Kubernetes-based Container as a Service (CaaS), Platform as a Service (PaaS) and Telecom PaaS layer Mavenir Telecom Cloud Integration Layer (MTCIL) which is an operations, administration and management (OAM) layer that includes full fault, configuration, accounting, performance and security (FCAPS), analytics, slice management and service orchestration.

Mavenir and Intel Deliver the Future of Open RAN

More CPU processing power means Mavenir software can deliver more features and capabilities. Intel's 4th Gen Xeon Scalable processor, with Intel vRAN Boost, eliminates the need for an external acceleration card and delivers higher capacity for L1 processing based on the cell configuration, and reduces the number of cores/servers needed per cell site compared to previous CPU generations. This paves the way for (MNOs) to support more cloud-native, energy efficient RAN services at a lower cost.

The advantages that are available in a Mavenir Open vRAN solution powered by 4th Gen Intel Xeon Scalable processor family include:

Energy Savings: One of the showcased capabilities of Open RAN on Intel is its potential for reducing operational energy consumption. Tests conducted by Mavenir customers show meaningful energy savings across multiple workload types. By leveraging advanced sleep cycles power management technology available with the Intel® Architecture platforms, Mavenir Open vRAN software opens up even more potential for energy savings in low-load traffic conditions.

RAN Slice Assurance: This is a critical function for service providers as it enables the delivery of 5G services with guaranteed performance and quality levels. Powered by high performance CPUs, this technology allows for dynamic allocation of resources to meet service level agreements, which is essential for offering differentiated services and maximizing network investment returns.

SLA Assurance with AI/ML: Utilizing AI /ML for network slice radio resource management, Mavenir Open RAN platform ensures that operators can maintain service level agreements efficiently. This capability is particularly important for offering revenue-generating business models with optimal radio resource utilization.

Greater vRAN Capacity: Open RAN CUs/DUs enable greater RAN capacity, thanks to disaggregated DU/CU software running on faster CPUs.

Optimization for Various Deployment Scenarios: The technology allows for the functional split between the DU / CU to be customized based on the specific 5G use case, which moves towards greater interoperability and efficient traffic routing.

Support for Advanced Functions: The DU / CU acts as the central hub in the base station, managing both uplink and downlink data traffic, controlling remote radio unit functionality, and handling user data, session management, and mobility functions.

Next-generation Mavenir Open RAN solution offers increased capacity, reduced latency, and optimized resource utilization. It also supports a more flexible and scalable deployment of 5G networks, allowing functions to be moved closer to the radio unit for high bandwidth demands. These developments contribute to the Open RAN movement's broader goals of creating more open, interoperable, and efficient wireless networks.

Conclusion

In just a few short years, Open RAN has gone from a cutting edge technology to being a mainstream consideration for all greenfield and brownfield operators who are expanding their 4G or 5G networks. This is a result of Mavenir's disaggregation of the RAN software creating a new Open RAN solution that has been powered by three generations of Intel Xeon Scalable processors.

This combination is the best choice for any communications service providers (CoSP) making a network plan and elevation journey to harness the power, performance and value of an Open RAN-based deployment. It also sets the stage for more big advances in next-generation O-RANs including dramatic energy savings, RAN slice assurance, AI/ML powered SLAs, expanded RAN capacity and more optimized functionality splits.

Learn More

Open vRAN - Mavenir

Intel Xeon Scalable processors

FlexRAN Reference Architecture for Wireless Access

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

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