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O-RAN: The Next Big Thing in Telecom

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Fast, reliable, and low-latency data services are essential deliverables from telecom operators today. Realizing them is pushing operators to enhance infrastructure, expand network capacity and mitigate service degradation. Unlike other industries, though, telecom networks are vast monoliths comprising fiber optic cables, proprietary components, and legacy hardware. Because of this, there is less enhancing—and more shoring up the creaking infrastructure.

The evolution of RAN

Radio access networks (RAN) are the backbone of the telecommunications industry. However, the industry's propensity to incubate and evolve newer, cost-effective, and energy-efficient technologies has been slow due to monopolization by RAN component manufacturers.

Throughout the history of mobile network evolution, innovation has been driven by the need to ensure a superior customer experience. This calls for an evolution from legacy systems to alleviate shortcomings and address rising demand. The same can be said for the need to evolve the RAN ecosystem to revolutionize the mobile communication industry, as we now move to a new technology like 5G.

Breaking the monolith

To truly appreciate the significance of Open Radio Access Network (O-RAN)—a RAN interface that supports interoperation between vendors' equipment—one must first understand how RAN architecture has evolved through the years.

Traditional RAN architecture

A typical RAN consists of the baseband unit (BBU), the radio unit (RU), and antennas. Traditionally, all RAN hardware was housed on-site within a mobile tower. These sites were controlled by a base station controller (BSC) residing in the backhaul space and connected to the core network. This type of RAN architecture was more suited for a technology like 2G, the first technology designed for digital mobile communication.

Distributed RAN (D-RAN)

To overcome the coverage limitations of traditional RAN, radio units were split from the rest of the hardware (BBU) while maintaining a single wired connection between the two. The split part, known as the remote radio unit (RRU), was housed closer to the antenna to improve wireless coverage. Vendor monopoly persisted, and hardware design changes were always a vendor choice. This type of RAN architecture was used extensively for 2G, 3G, and 4G technology.

Single RAN

As network technology evolved, co-location of multiple technologies led to the need for new radio units for 2G, 3G, and 4G. At the same time, innovation to support multiple technologies in the same software stack led to the consolidation into a single RAN. This model helped operators modernize their older systems at a lower total cost of ownership (TCO).

Cloud RAN (C-RAN)

The next evolution came with the emergence of Cloud RAN, marking a redistribution of functionalities. The BBU and its software components were now hosted in a centralized cloud environment, while the RRUs remained on-site. Because these could be co-located, the evolution to C-RAN delivered resource efficiencies and minimized costs.

Virtualized RAN (vRAN)

Virtualized RAN represents a decisive shift in RAN innovation by disaggregating the BBU software from BBU hardware. This opened the possibilities of using any COTS hardware, making it vendor neutral. Through network function virtualization (NFV), operators can rapidly deploy new applications and services, scale resources, and improve reliability.

A New Era Unfolds: Open RAN

Historically, RAN vendors used proprietary equipment with tightly coupled hardware and software. Because they controlled the distribution, use, access, service, and maintenance of the RAN, operators were heavily dependent on their vendors for advances and upgrades. This hindered their ability to innovate as proprietary RAN cannot sync with other equipment, leading to vendor lock-in and higher TCO.

The good news is that today, radio access networks are on the cusp of change thanks to the Open RAN movement that brings together vendors, software developers, telcos, and more to develop new RAN prototypes based on open-source, open architecture, and open networks.

According to the Telecom Infra Project, "OpenRAN is a vendor-neutral disaggregation of RAN at both the hardware and software levels on general-purpose processor-based platforms." It breaks all proprietary bonds between hardware, virtualized components, and even software, exposing all interfaces and connections. This deconstruction provides an open playground for true innovation.

Potential opportunities

Despite investing in network upgrades and greater data throughput, the revenue from data services has increased only marginally over the past few years. To remain profitable, operators must reduce operational and capital expenses (OPEX and CAPEX), an opportunity afforded by O-RAN in the following ways.

Enhance service agility

O-RAN provides a commonality among heterogeneous resources, allowing operators to take advantage of market trends and user behavior by deploying services quickly.

Elevate network management

O-RAN orchestration supports automation by allowing programmable creation and deployment of containerized resources to meet service-level requirements of ultra-reliable and low latency communications (URLLC) and enhanced mobile broadband (eMBB) slices. As deep intelligence penetrates RAN architecture, it will create AI-based closed-loop automation to support faster decision-making to enhance the overall network-management process.

Eliminate proprietary vendor monopolies

With vendors free to produce flexible future-proof hardware, operators can further exploit the spectrum. They may section spectrum for different industries or dense user hotspots and provision this dynamically for greater quality of service, quality of experience, and customer stickiness.

CAPEX reduction

Open RAN primarily involves disaggregating traditional fit-for-purpose solutions into off-the-shelf hardware and open-standards-driven software, thereby enabling a larger ecosystem of vendors and improving vendor diversity. The combination of commercial off-the-shelf (COTS) hardware and standards-driven solutions is expected to offer operators a significant gain in CAPEX reduction. Studies indicate that the traditional RAN domain is easily the most expensive part of a mobile network, representing 65 to 70 percent of its total cost. According to Deloitte, Open RAN can reduce CAPEX by 40 to 50 percent. The open standard promotes faster innovation cycles,

improves supply chain diversity, and encourages automation of network operations to enable a lower overall network TCO.

However, it is important to note that the diversity and larger ecosystem afforded by O-RAN can create integration challenges if not well-orchestrated or limited by hardware choices. As the network becomes increasingly software-driven, it becomes imperative to look at integration challenges from a software-driven system view.

AI and ML in Open RAN RIC

Artificial intelligence and machine learning (AI/ML) will have a much more comprehensive and transformative impact on the end-to-end network in an O-RAN environment. The O-RAN Alliance specifications provide a framework to use AI and ML to optimize radio resources in LTE and 5G networks. The framework heavily relies on AI/ML technologies to improve performance and operation automation through intelligent algorithms that improve the system continuously. This is done through applications hosted on the RAN Intelligent Controller (RIC) platform, which can be implemented for near real-time control and non-real-time control. AI-enabled policies and ML-based models generate messages in non-RT RIC and are conveyed to the near-RT RIC.

RIC is evolving, and projects are ongoing

RIC is evolving, and a number of new initiatives have come to the fore. For example, at the end of August 2020, the Open Networking Foundation (ONF) introduced a software defined radio access network (SD-RAN) project to develop an open-source Near Real-Time RAN Intelligent Controller (nRT-RIC) that is compatible with the O-RAN architecture. In September 2020, Samsung and KDDI demonstrated a network slicing use case involving an RIC to manage radio resources to guarantee required service levels.

The TIP OpenRAN 5G NR Project Group is also active, with the launch of its RAN Intelligence and Automation (RIA) subgroup to develop and deploy AI/ML-based applications (as xApps) for a variety of RAN use cases, including radio resource management, massive MIMO, quality of experience, optimization, and more.

AI/ML-based closed-loop automation

Because Open RAN provides flexibility in terms of disaggregation and interfaces, it can optimally use AI/ML for optimization and automation in a way that these actions are not guided but are fully closed-loop automation. Open RAN provides multiple touchpoints in terms of open interfaces to perform data collection and enrichment information, which can be used for model training to enable intelligent feedback mechanisms to enable AI/ML-based closed-loop automation. Open RAN supports open APIs like xApps and rApps for real-time and non-real-time model implementation and decision-making, which allows the accommodation of multiple models and the selection of the best-suited solution for the use case.

The overall approach drift and AI/ML-enabled closed-loop automation would help in reducing OPEX through advanced and adaptive self-managing capabilities, which would help in accelerated time-to-value and reduced risk of human errors.

The O-RAN future

The RAN ecosystem has evolved significantly at each stage of mobile network technology transformation, from the days of 2G, to now, the inception of 5G. As 5G moves toward becoming mainstream, Open RAN at the network edge is expected to benefit applications, including autonomous vehicles and Internet of Things (IoT) solutions.

ABI Research has predicted that Open RAN CAPEX spending will overtake traditional RAN spending by 2028. Leading European telecommunications operators, including Deutsche Telekom, Orange, Telefónica and Vodafone, have already committed to deploying Open RAN as part of their 5G rollouts. The open standards promoted by the O-RAN Alliance will allow the development of open interfaces and faster deployment of radio access networks by leveraging technologies such as AI/ML and real-time analytics. Additionally, Open RAN brings considerable innovation potential to the telecommunications industry by creating an open ground for innovation, not just for traditional RAN vendors but also for new players and startups, ensuring revolution in network economics as we know it today.