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How Open RAN Technologies Will Lead to Secure, Innovative 5G Networks

Introduction

With each passing day, 5G networks inch closer to a mainstream reality as next-gen wireless technology is deployed across the globe. Fully realized, 5G networks have the potential to deliver immense benefits. Indeed, the proliferation of software-enabled 5G networks is projected to drive billions of dollars in growth and create thousands of new jobs in both deploying 5G infrastructure and developing applications that harness 5G's capabilities. With so much at stake, policymakers and industry players face choices that will have ramifications for decades to come as they design, fund, and deploy the critical radio access networks (RAN) that will form the backbone of 5G network infrastructure.

Enter the concept of Open RAN, a different approach for developing the antennas and related RAN hardware used in 5G. Open RAN is designed with open standards, cybersecurity, interoperability, and transparency at the fore. This issue brief explains what "Open RAN" means and describes how software-based Open RAN systems will maximize the benefits of 5G wireless networks.

What Is the RAN? How Does the RAN Fit in the 5G Ecosystem?

The radio access network is just one layer of the larger wireless network ecosystem, but it is perhaps the most tangible aspect of wireless technologies for consumers. Abundant radio equipment is scattered throughout our everyday environment, a constant visual reminder of the connectivity around us. Cell towers, radio antennas, small cell systems attached to buildings and utility infrastructure, and their subcomponents—the radio unit, the base station, and the base station controller—all make up the RAN.

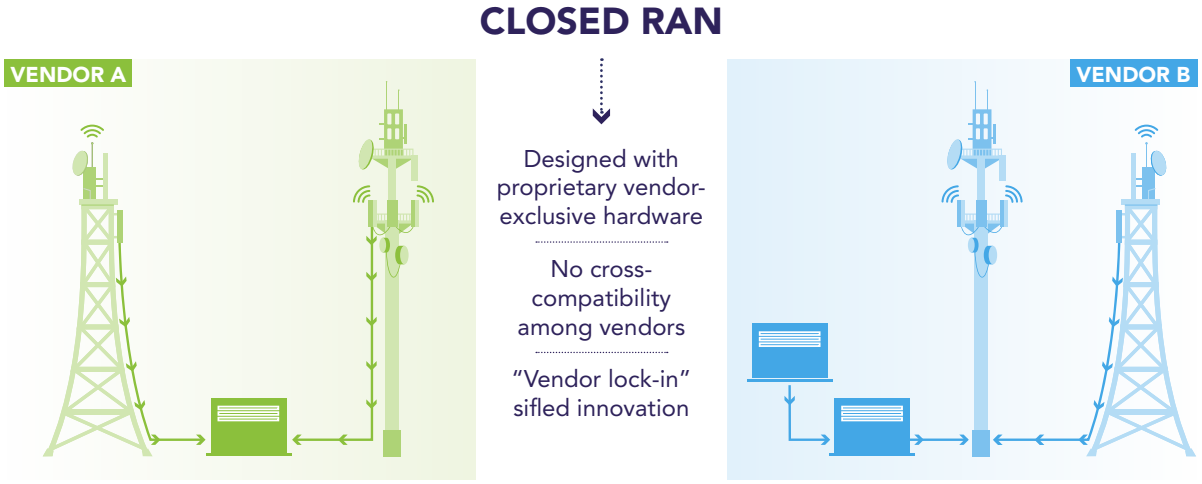
Everyday consumer devices such as mobile phones, smart sensors, connected cars, and other cellular-enabled devices—referred to as user equipment (UE)—cannot connect directly to the 5G core network and the internet on their own. For smartphones and other UE to reach the core, the RAN serves as an intermediary that links cellular-enabled devices to the larger core network where much of the behind-the-scenes 5G intelligence takes place.

What Is Open RAN? How Does Software Enable Open RAN?

The Limitations of Closed Systems

Radio access networks in previous generations of wireless technology were configured as **closed systems**—holistic end-to-end RAN solutions designed entirely with equipment from a sole RAN vendor[1] and marketed to network operators[2] that provide wireless services to customers. RAN hardware from one vendor was typically proprietary and not compatible with rival product offerings. Once a network operator made the significant capital investment to build a network using Vendor A's equipment, the operator was essentially locked into Vendor A for the long haul. Even if Vendor B came along and offered a higher quality product, it would be overly burdensome and cost prohibitive for the operator to switch to Vendor B's product line. Essentially, the operator would have to scrap that section of the existing network and replace all the equipment with the Vendor B's systems.

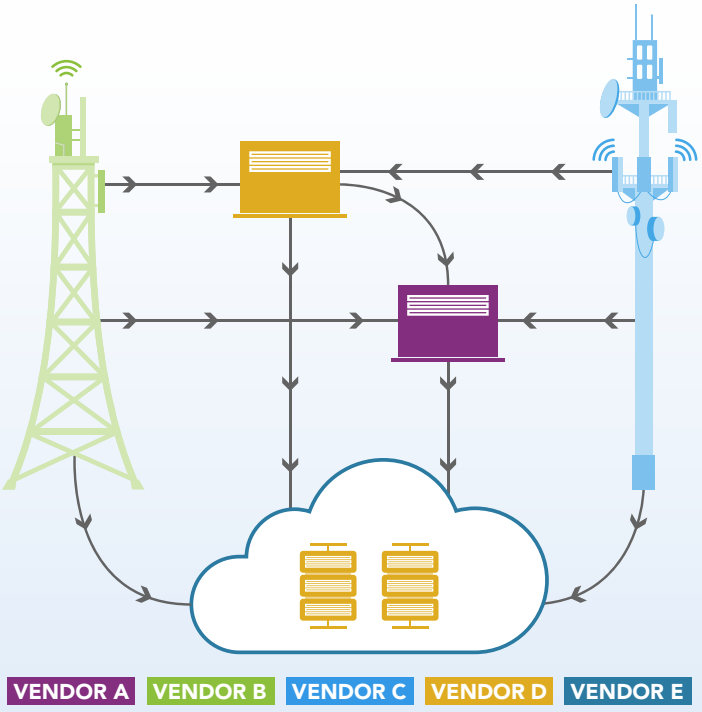
With network operators disincentivized to switch vendors, such closed systems made it difficult for new market entrants to challenge incumbent RAN vendors, stifling innovation in the RAN sector and leading to higher costs and even potential cybersecurity risks for operators depending so heavily on one supplier.



1 Some examples of incumbent vendors in the RAN hardware space include Ericsson (Sweden), Nokia (Finland), Samsung (South Korea), and Huawei (China). As of this writing, there is no major United States-based incumbent RAN equipment vendor to compete on the global stage. Left without a homegrown provider to pick from, U.S. wireless network operators must choose among this limited list of incumbent providers to build the RAN layer of their wireless networks today.

2 Some examples of wireless network operators in the United States include AT&T, T-Mobile, and Verizon. Network operators such as these provide wireless services to various customers, but operators themselves aren't the creators of the network infrastructure powering their services. Operators procure radio access technology from outside RAN equipment vendors.

OPEN RAN

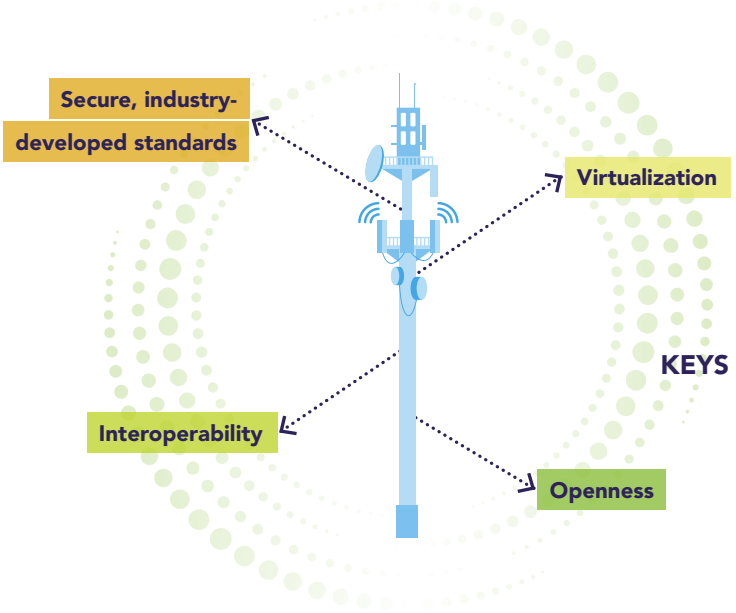


Open interfaces and protocols allow operators to mix and match RAN components from multiple vendors

Developed using secure industry standards for strong cybersecurity across the RAN ecosystem

RAN components can be virtualized, allowing cloud-based software to take the place of previously hardware-dependent network functions

KEYS TO OPEN RAN



ADVANTAGES OF OPEN RAN

- **Better network security**
- **Flexibility, versatility**
- **Increased market competition, more RAN innovation**

The Promise of Open RAN

Conversely, disaggregating 5G network hardware using the **Open RAN** framework offers an alternative that gives operators more choice and flexibility in building their systems. To achieve these benefits, Open RAN depends on four main principles that are closely interconnected:

- **Virtualization.** Although stakeholders were able to successfully virtualize the core network using standardized hardware- and software-based network functions, traditional RAN systems have remained heavily integrated. Open RAN frameworks will allow cross-compatible software to take the place of traditionally physical network hardware.
- **Openness.** What truly sets Open RAN apart from traditional RAN systems of past generations is opening the interfaces and protocols among the RAN components, which govern how network equipment communicates among itself and exchanges data. This makes 5G RAN infrastructure fundamentally more flexible by design instead of vendors keeping the keys locked behind proprietary, "black box" solutions. Open RAN solutions instead embrace a "white box" model, where the interfaces and protocols are widely available to software developers. This importantly allows network operators to decouple network functions from their underlying hardware and pivot to software-based, virtualized network functions in the RAN running on general-purpose equipment and cloud servers.
- **Interoperability.** Opening the proverbial door to the interfaces and protocols unlocks the ability for network operators to mix and match RAN components from multiple vendors instead of being locked into one equipment vendor. Unlike the closed model, Open RAN operators could now theoretically configure a system with a radio unit from one vendor and software-based network functions from a second vendor, all running on cloud servers from a third vendor.
- **Secure, industry-developed standards.** The establishment of clear open standards allows hardware and software makers to design interoperable equipment that is compatible with equipment from other vendors. Standards-setting bodies can and should build strong cybersecurity protections into their standards as a baseline to promote transparency and ensure sufficient protection of the network and its end users. Open RAN standards are set by international organizations such as the 3GPP and the O-RAN Alliance in close coordination with industry and government.

What Are the Advantages of Open RAN versus Traditional Closed RAN Systems?

Better network security

- Compared to closed systems, opening the interfaces and protocols bolsters network security and promotes transparency. Open and transparent software technologies promise inherent cybersecurity advantages in the 5G RAN compared to past wireless generations.[3]

[3] "Securing 5G: A Call to Harness Software Innovation," BSA | The Software Alliance (July 2020), https://www.bsa.org/policy-filings/securing-5g-a-call-to-harness-software-innovation.

- Government and industry stakeholders from the United States[4] to the European Union[5] see Open RAN as an option to address the risk of installing radio access technology from untrusted RAN vendors that pose national security threats. A transparent open framework will allow for an expanded pool of RAN vendors to participate in the market, reducing a nation's dependence on any sole vendor for wireless services.

More flexibility, versatility for network operators

- By assembling an Open RAN with standardized commercial off-the-shelf (COTS) hardware and leaning on the power of cloud data centers, network operators will be able to configure RAN architecture tailored exactly to their unique business purposes—with the flexibility to easily scale resources as needed.
- Open RAN will also complement and accelerate promising software-enabled 5G innovations such as edge computing.

Increased market competition, more RAN innovation

- The inherent interoperability promised by Open RAN unlocks the door for startups and established industry players alike to enter the RAN market without needing to provide a monolithic, inflexible closed product covering the RAN end-to-end.
- Smaller players could disrupt the market by specializing in specific hardware and software aspects of the 5G RAN that can be mass produced, leading to increased choice for network operators and competitive pricing, as well as allowing innovation to flourish.

What Differentiates Open RAN, O-RAN, C-RAN, and V-RAN?

When referring to the general framework of building radio access networks as open systems, the best term to use is "Open RAN." This is often confused with the term "O-RAN," which is a specific set of standards set forth by the O-RAN Alliance standards-setting body. "V-RAN," or virtualized radio access networks, refers to the virtualization of RAN systems—performing network functions through software instead of specialized hardware—whereas "C-RAN" (cloud radio access networks) involves running those virtualized network functions using the power of cloud computing.

- **Open RAN.** The term for the overall framework and method of RAN infrastructure deployed with open interfaces and protocols.
- **O-RAN.** Refers to a specific set of Open RAN standards created by the O-RAN Alliance standards-setting body. *All O-RAN falls under the Open RAN model, but not all Open RAN is part of the O-RAN specifications.*

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4 "Tech Companies Push for New Software to Break China's 5G Lead," *Roll Call* (October 2020), https://www.rollcall.com/2020/10/27/tech-companies-push-for-new-software-to-break-chinas-5g-lead/.

5 "After Huawei, Europe's Telcos Want 'Open' 5G Networks," *Politico* (January 2021), https://www.politico.eu/article/oran-reflow-huawei-europe-telecoms-5g/.

- **V-RAN.** Instead of relying on "bare metal" specialized RAN hardware, virtualizing RAN allows for network functions to be executed virtually using intelligent software tools. In previous wireless generations, dedicated hardware could only handle one network function at a time; decoupling virtual network functions from the underlying hardware and running several functions on general-purpose hardware allows operators to better optimize computing resources, reduce cost, and improve system performance.
- **C-RAN.** Takes the idea of virtualizing network functions and offloads them to servers in cloud data centers, making the power of cloud computing systems available to network operators.

RESOURCES FOR CONTINUED READING

5G Is Software

Securing 5G: A Call to Harness Software Innovation

Building a More Effective Strategy for ICT Supply Chain Security

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