Innovations Brought by Open RAN

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Abstract

With the advent of the 5G era, a wide variety of use cases are expected to make use of features such as enhanced Mobile Broadband (eMBB), Ultra-Reliable Low-Latency Communication (URLLC), and massive Machine Type Communications (mMTC). Differences in communication requirements for each use case make it important for communication service providers to build a wide variety of networks. In the initial period of the 5G era, many global communication service providers relied on a single vendor and integrated systems dominated the market, making it difficult for customers to construct flexible and agile networks in accordance with their needs. This concern has led to the emergence of a new movement called the Open Radio Access Network (Open RAN) to increase openness of the interface between devices with the aim of encouraging innovation by promoting competition among multiple vendors. In addition to NEC's experience and know-how in communications, we will utilize our cloud computing technology that enables flexible and agile construction as well as our industrial know-how to build a strong ecosystem with partners who aim to promote openness together. This paper introduces NEC's approach to increase adoption of Open RAN required in the 5G era.

Keywords

5G, Open RAN, open networks, virtualization

1. Introduction

The advent of the 5G era has brought about expectations of a wide variety of use cases making use of features such as enhanced Mobile Broadband (eMBB), Ultra-Reliable Low-Latency Communication (URLLC), and massive Machine Type Communications (mMTC). The development of 5G communication networks is proceeding at a rapid pace in countries around the world. Among communication service providers (CSP) who want to build economical, safe, and secure 5G communications networks, Open RAN is attracting attention by enabling the implementation of open and secure 5G networks that benefit from the participation of multiple vendors.

2. Innovations Brought About by Open RAN

2.1 What is Open RAN

Open RAN disaggregates the radio access network (RAN), including base station equipment, into elements based on open specifications so that products from multiple vendors can be combined. Open RAN is expected to ultimately reduce the costs of operating 5G communication networks and stimulate innovation by enabling the introduction of new vendors and a variety of equipment suited to actual needs and use cases. This will stimulate competition in the RAN market, which has been dominated by a small number of vendors until now. The fact that Japanese communication service providers (CSPs) were among the first in the world to introduce full-scale Open RAN means that expectations are high for Japanese CSPs to take the lead in this field.

In realizing Open RAN, it is not realistic for a single vendor to provide all of the components to meet the needs of a great variety of use cases. The challenge has become how to build an ecosystem with guaranteed reliability and safety. This requires a best-of-breed approach to selecting and building the optimum hardware and software from a wide range of products and solutions from multiple vendors.

Open RAN is expected to greatly change the existing market model, particularly by helping CSPs avoid vendor lock-in, a situation that results from limitations in options presented by monopolies and oligopolies of incumbent vendors. It is also expected to reduce the total

Table Expectations and challenges of communication service providers for Open RAN.

Expectations	Challenges
-Acceleration of innovation -Liberation from vendor lock-in, introduction of competitive environment -Operational efficiency	-Standardization of open interface and interconnectivity between different devices -Integration of multiple systems -Smooth transition from existing systems

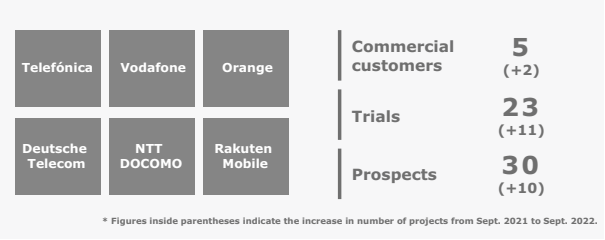

Fig. 1 NEC's global 5G initiatives.

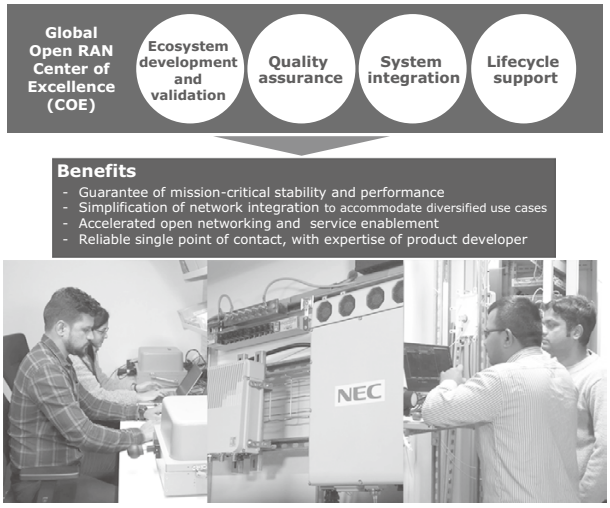

Fig. 2 NEC's Open RAN business development base in the UK.

cost of ownership (TCO) and to accelerate innovation by reaping the benefits of virtualization (**Table**).

As a result, the expectations for Open RAN and the challenges to its adoption are becoming clear, and NEC is engaged in demonstration experiments and a variety of other activities to solidify the expectations of CSPs around the world (**Fig. 1**). Also, the current geopolitical environment has pushed governments in many countries to seek to establish diverse, resilient supply chains. Governments around the world have high hopes for Open RAN, and some countries are promoting various initiatives to support the introduction of Open RAN.

2.2 Open and virtualized networks

In response to the expansion and evolution of demand for mobile communications, telecom carriers are rapidly verifying open and virtualized technologies that enable flexibility and scalability of their networks. At the same time, they're also expected to reduce operating costs. The momentum for the introduction of Open RAN is increasing, particularly in Europe and North America, as seen with the Open Testing and Integration Centres (OTICs) and other activities promoted by the O-RAN ALLIANCE and the Telecom Infra Project (TIP). NEC has also built a verification environment capable of interoperability testing (IOT) of Open RAN systems in the UK (**Fig. 2**) to assist with the introduction of openness and virtualization technologies by CSPs in many countries[1)].

NEC's Centre of Excellence lab houses hardware and software solutions and facilities that enable telecom carriers and network equipment vendors to collaborate in conducting tests and doing work. The main facilities include a virtual infrastructure for running O-RAN central units and O-RAN distributed units (O-CUs and O-DUs), a signal generator/analyzer for unit testing of O-RAN radio units (O-RU), a UE-simulator for the end-to-end testing, a shield box for over-the-air (OTA) testing of the O-RU, and a radio darkroom.

Following the trend of virtualization that has occurred in the IT world, network functions virtualization (NFV) is also advancing in telecommunications. Until now, virtualization in the wireless domain has been considered technically difficult because it requires higher performance for complex signal processing when compared to general purpose processing on a COTS server. But advances in related technologies, such as accelerators, have made virtualization of RANs a trend. Specifically, network control technologies using NFV and software are expected to enable the dynamic provision of required functions by virtualizing the CU/DU functions. Such a virtualized radio access network (vRAN) is expected to reduce operating expenses (OPEX) by using artificial intelligence (AI) and machine learning (ML) technologies to reduce power consumption, expand the network according to needs, and improve maintenance and operational efficiency. vRAN is expected to optimize the various resources required for wireless networks by introducing new technologies and pooling capacity using software thereby leading to a reduction in total cost of ownership (TCO) for deployment and operation.

Open vRAN also allows RAN software to use open interfaces via NFV for various network functions and is expected to free global telecom carriers from vendor

lock-in and pave the way for a diverse and innovative selection of products by providing network capabilities with open interfaces. In addition, this trend is also expected to accelerate implementation of scalable, agile, and intelligent networks that will enable telecom carriers to speed up network deployment and significantly improve operational flexibility.

In Feb. 2022, NEC created NEC Open Networks, a comprehensive product, solution and service suite that provides CSPs worldwide with open, secure 5G networks based on segmented RAN components, xHaul Transport, core network, operation automation software, and a system integration service platform.

2.3 Open RAN market

The emergence of Open RANs is expected to significantly change the framework of the existing telecommunications equipment market, improve innovation via new competition, and create new opportunities for telecom carriers by diversifying their options. The trend toward openness is expected to spread further in the future.

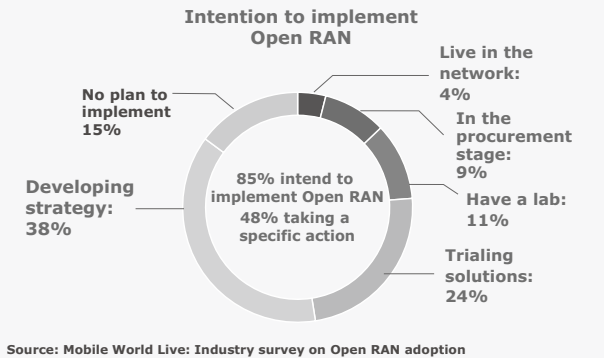

Fig. 3 Industry survey on Open RAN adoption.

According to a survey conducted by NEC, 85% of major telecom carriers intend to introduce Open RAN (**Fig. 3**). In the 5G base station market, Open RAN is expected to expand to 30% – 50% by 2030.

Another survey by NEC showed that 13% of CSPs are already conducting commercial Open RAN operations or are in the procurement stage, and that 35% of the providers have their own labs or are conducting trials. Particularly active among them are global carriers such as Vodafone (UK) and Telefónica (Spain), with the former having announced that 30% of its European networks will be based on Open RAN by 2030. The United States, British and German governments have also indicated their intention to promote Open RAN and are establishing guidelines for implementation and introducing subsidy programs to promote its adoption. In addition, other notable examples include new entrants known as greenfield operators such as 1&1 (Germany) and Dish Network (USA) who are actively pursuing commercial deployment to enjoy the benefits of Open RAN (**Fig. 4**).

2.4 Expectations and benefits of Open RAN introduction

While Open RAN is expected to accelerate innovation eliminating vendor lock-in, expansion of options through the participation of new vendors, and reductions in deployment and operational expenses, the advantages of Open RAN go even further. The introduction of Open RAN will also accelerate the digital transformation (DX) of networks and lay the foundation for Beyond5G and 6G.

5G brings new technologies and use cases, and many telecom carriers see the introduction of Open RAN as a trigger for operational and organizational optimization. It is expected that the flexible, scalable building concept of Open RAN will be incorporated into the foundations of 6G solutions to come in the future (**Fig. 5**).

Surveys conducted by NEC indicate that CSPs expect

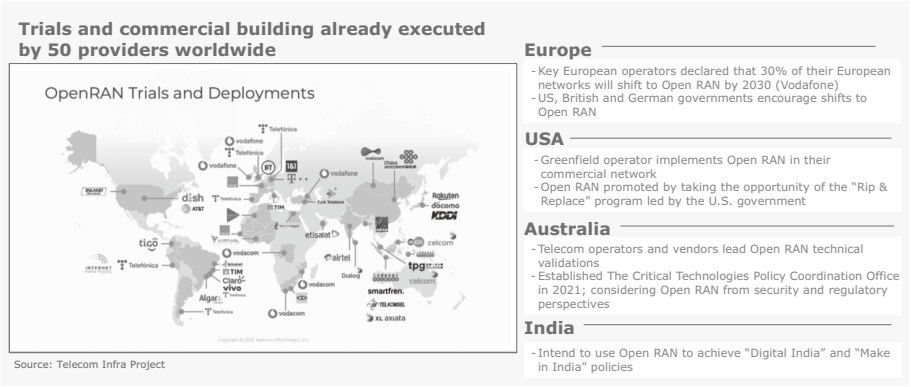

Fig. 4 Results in global industry momentum: Open RAN trials and deployment.

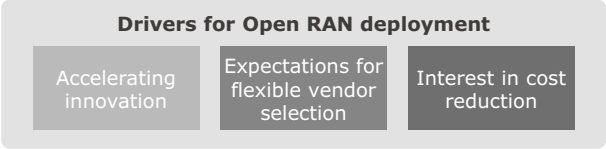

Fig. 5 Expectations for Open RAN deployment.

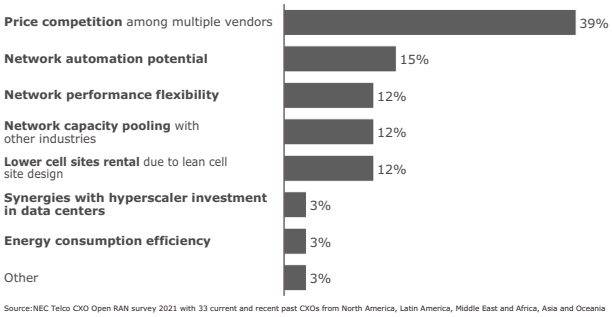

Fig. 6 Expectations for TCO reduction with Open RAN deployment.

to reduce their TCO by promoting a competitive environment that has multiple potential suppliers and by sharing virtualization resources. In addition, the maturing of network automation technology in the future would allow for more efficient network construction. At the same time, Open RAN is expected to reduce the total cost of network ownership by an average of approximately 15% (20% in the long run without initial deployment costs) compared to conventional RAN construction (**Fig. 6**).

While Open RAN is expected to enable the faster adoption of new services and use cases, its deployment does have associated risks. For example, the additional work-load required to integrate devices from multiple vendors is a trade-off for the benefits that Open RAN brings, and the selection of interoperable components and proven configurations will be a major stepping stone to increased adoption of Open RAN.

2.5 Challenges in Open RAN introduction and NEC's solutions

While telecom carriers may face these challenges with fragmented architectures (**Fig. 7**), vendors with system integration capabilities (system integrators) — like NEC — can play a central role in the verification and implementation of end-to-end solutions. As a leading company in Open RAN, NEC can help overcome these challenges by leveraging its knowledge and experience in communications, IT, and cloud systems to create an ecosystem with carrier-grade quality assurance to meet

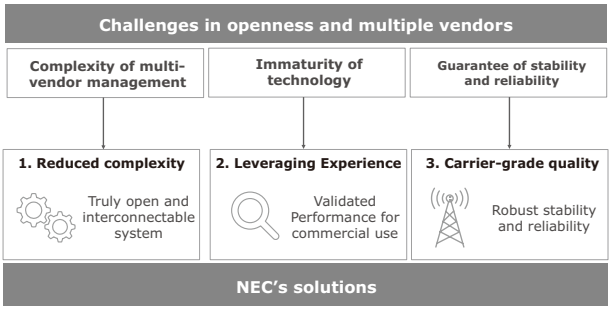

Fig. 7 Challenges of multi-vendor adoption in the promotion of openness.

customers' objectives.

2.6 Standardization activities (O-RAN ALLIANCE, TIP)

Standardization activities by industry groups and associations play an important role in promoting the openness of RANs, because standardizing is the only way to ensure interoperability among vendors. NEC contributes to the promotion of Open RAN through its participation in industry groups such as the O-RAN ALLIANCE and Telecom Infra Project. In particular, NEC and others at PlugFests, which demonstrate Open RAN interoperability, are working to accelerate interoperability based on the O-RAN specifications and to promote and implement it in real-world environments.

NEC actively supports, participates in, and contributes to the activities of the O-RAN ALLIANCE by leading several work items and by serving in different O-RAN ALLIANCE working groups (WG1, WG2, WG3, WG4, WG5, and WG10).

3. Conclusion

NEC demonstrates its leadership and support for Open RAN through its experience in supporting the deployment of large-scale Open RAN commercial networks in Japan and through its long-standing global track record of building wireless networks and other communication networks. NEC is considered a major supporter of the introduction of Open RAN among communication service providers around the world. As a result, in 2021, we were selected by Vodafone as a vendor of 5G base station equipment[2] and also participated in the Open RAN project run by German Telecom[3]. Also, NEC is conducting commercial demonstrations with Telefónica[4] and began building an Open RAN verification network in 2022 in cooperation with Orange (France)[5].

NEC will continue to promote the global deployment

of Open RAN by making full use of its track record with many global vendors.

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Vol.17 No.1
September 2023

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