The Open Future of Radio Access Networks

Telecom Engineering Centre of Excellence (TEE)
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Introduction

In the 2021’s edition of Deloitte’s Telecom, Media and Technology (TMT) predictions, Open and virtualized Radio Access Networks (RAN) are highlighted as the future of mobile networks. Although the Open RAN market is still in its early days there are active deployments across the globe, where MNOs are testing the technology in greenfield, rural, and emerging markets.

Even though deployments are starting slowly, they could easily double in 2021. Government’s funding R&D initiatives to foster the development of Open RAN readiness in US, Japan or Europe, together with Tier 1 operators joint initiatives to accelerate adoption, it is now clear that the transformation of radio access networks towards a more open and disaggregated architecture is a given.

While the ecosystem develops fast and the expectations remain high around innovation growth, cost savings and vendor lock-in avoidance, there are still many concerns to be addressed on technology maturity, adoption scenarios and networks lifecycle management.

This paper intends to provide a view on adoption expectations, challenges and reasons why Telcos are considering adopting Open RAN. What is missing and what is required to turn this ambition into reality in the coming years?

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The technology trends leveraged by 5G

There are several technology trends being leveraged by the new generation of mobile communications. These can not only create new business opportunities but also enable Telcos to reduce costs while increasing their network capacity and operational efficiency. The concept of Open RAN is one of these key trends and it is the focus of this paper.

- **Open RAN**: The disaggregation of hardware and software solutions with open interfaces and APIs leverages the adoption of COTS hardware, which can lower costs and foster innovation.
- **RAN Sharing**: RAN sharing involves the partial or complete sharing of the RAN network elements, such as the network core and spectrum, in order to accelerate deployments while reducing costs.
- **Small Cells & mmWaves**: The usage of massive MIMO antennas, smaller cells and mmWaves will help to define the best way to densify 5G networks, securing higher bandwidth connectivity and enhanced QoE to end users and enterprises.
- **Edge Computing**: Edge Computing brings computing power as close as possible to the data sources (e.g. IoT devices such as sensors monitoring environmental conditions), thus supporting reduced latency and backhaul bandwidth consumption.
- **Slicing and Private 5G**: Network slicing enables Telcos to create multiple logically isolated networks on top of the physical infra while private 5G represents the creation of a dedicated network in which the customer has full control.
- **Automation**: The usage of cost effective and data driven automation powered by AI/ML, Open API, data analytics and DevOps, enables Telcos to overcome the operational complexity added by 5G.
The Open Future of RAN

Open vRAN refers to a disaggregated approach of deploying virtualised mobile networks by using open and interoperable protocols and interfaces, implemented over a common propose hardware in a multi-vendor software environment, allowing an increased flexibility over traditional RAN architectures, aiming to provide OPEX and CAPEX savings while fostering innovation.

Openness in RAN

There is wide recognition of Open RAN’s potential to disrupt the existing marketplace. At the same time, the low maturity of the technology presents challenges that need to be addressed.

**Benefits**
- TCO Efficiencies
- Player diversity
- Fosters innovation
- Reduce Time-to-Market

**Challenges**
- Performance & feature parity
- Skills and capabilities
- Interoperability challenges
- Legacy technologies
How far is Open RAN from being mainstream?

Open RAN based solutions are step-by-step going towards the maturity phase, in which they can be seen as a mainstream solution. Not only there are major technology vendors incorporating or planning to incorporate open RAN solutions in their portfolio, but relevant Telcos have been moving from trials towards initial deployments in live networks. For this technology to succeed, the industry to adopt the specifications being defined by standards organizations like O-RAN Alliance and live performance and reliability of Open RAN based networks reach similar performance levels and feature parity of traditional architecture.

"I believe that in a 5-year horizon, Open RAN would have failed if it’s not the dominant architecture on how wireless networks are built"

CEO of Parallel Wireless, Steve Papa

Open RAN maturity and commercial deployments

Deloitte estimates that there were, as of December 2020, around 35 active Open RAN deployments across the globe. 85% of these involve Telcos deploying Open RAN in developing markets, the majority being in rural areas.

Where are Telcos deploying Open RAN? (1)

Open RAN adoption will likely accelerate in 2021 because it can address Telcos’ necessities regarding optimized TCO, higher vendor flexibility and easier upgradability. Moreover, in case governments force Telcos to replace installed 5G RAN solutions from restricted vendors, the growth rate of Open RAN adoption might increase further. However, as the technology becomes mainstream, with a higher number of deployments and field trials, not only in rural areas but also in dense urban markets, new challenges are expected to be found. This may create an initial feeling of “disillusionment” that will presumably disappear as Open RAN solutions become fully mature, which can take 3 to 5 years.

Sources: Deloitte TMT Predictions 2021

(1) Percentage of total Open RAN deployments and field trials
The Open Future of Radio Access Networks

The Open RAN market is expected to grow and overtake traditional RAN solutions in both public cellular and enterprise & industrial cellular segments over the next decade. In the long term, the enterprise & industrial cellular market has the potential to become bigger than the public cellular market if enterprise vertical requirements are addressed.

Revenue forecast comparison for public networks

The inflection point between traditional mobile networks and Open RAN is expected to occur during 2028, with open interfaces and COTS hardware overtaking proprietary solutions.

Revenue forecast comparison for enterprise & industry

Enterprises will be interested in adopting more flexible and lean solutions, leveraging their previous hardware investments. As such, Open RAN might be a preferred solution to address this market demand.

Sources: ABI Research
Amidst the current political landscape and the restrictions on Chinese network vendors, telcos are reassessing network architecture and considering shifting towards Open RAN to break vendor lock-in. Vendors, motivated by the governments funding initiatives to foster R&D efforts in Open RAN, have been including Open RAN solutions into their portfolio’s roadmap, providing higher flexibility of choice to Telcos.

The political landscape has been impacting the telecommunications industry, with several governments encouraging Telcos to adopt Open RAN solutions...

Policy makers and governments around the world show interest on RAN supply chain disruption and support market development of alternative vendors to expand the ecosystem and avoid having their country’s communications infrastructure being based on a single vendor only. This has accelerated the emergence of Open RAN startups such as Altiostar, Mavenir, Accelleran, Airspan or Parallel Wireless, which offer solutions compliant with the O-RAN architecture.

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Sources: Indian Express, RCR Wireless, Politico, NTIA, TelecomTV, Taiwan Business Topics
Real world deployments of Open RAN

There are several mobile network operators, both greenfield and brownfield, around the globe considering the adoption of Open RAN solutions or already deploying technologies based on this architecture. Key examples are Rakuten, which operates the world’s largest Open RAN in Japan, and Vodafone, that has been conducting multiple trials over the past few years in its European and African OpCos.

**Japan**  
In the land of the rising sun...

...Rakuten launched the world’s largest Open RAN and plans to extend its network nationwide, achieving ~40% lower costs (CAPEX) when compared to traditional telecom infrastructure.

**Turkey**  
In the land of the crescent moon...

...by using ALL G RAN solution from Parallel Wireless, Vodafone Turkey was able to modernize its legacy network while supporting subscribers on “all G” technologies.

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Why should Telcos consider Open RAN?

Anchored in virtualization and standardization, Open RAN is touted as one of the technological trends with more potential to reshape the telecom industry and has received worldwide interest from Telcos.

Key drivers behind Open RAN adoption

<table>
<thead>
<tr>
<th>New Market Dynamics</th>
<th>Internal Uplift</th>
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<tbody>
<tr>
<td><strong>Increase vendor diversity</strong></td>
<td><strong>Expedite feature development</strong></td>
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<tr>
<td>Expansion of Open RAN ecosystem gives Telcos the opportunity to avoid vendor lock-in and to “mix and match” best-of-breed radio elements</td>
<td>Telcos may carry out updates on commoditized hardware using software-based solutions, shortening upgrade and innovation cycles</td>
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<td><strong>Increase competitiveness</strong></td>
<td><strong>Streamline operations</strong></td>
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<tr>
<td>Interoperable open interfaces stimulate market competitiveness, improving Telcos' access to alternative solutions and new business models</td>
<td>As networks increase in complexity, Open RAN can leverage the strength of analytics and AI/ML techniques to automate operations</td>
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<tr>
<td><strong>Spur innovation</strong></td>
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<tr>
<td>On top of the market stimulation driving innovation, the disaggregation of RAN components and the shift towards a software-driven approach gives Telcos the freedom to explore disruptive technologies and new features</td>
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<tr>
<td><strong>Reduce costs</strong></td>
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<tr>
<td>The increasing vendor competition and the flexibility to select (non-proprietary) hardware for specific RAN components may lead to lower upfront costs, while the adoption of automation capabilities can avoid the costs associated to the complexity of this future network environment</td>
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While significant and reaffirming efforts have been undertaken, Open RAN is still maturing and needs to address the complexity associated with an enlarged ecosystem reliant on infrastructure disaggregation.

**Interoperability**
The combination of a broad range of solutions from multiple vendors increases the likelihood of incompatibilities and the need for ascertain accountability.

**Performance**
Conversely to traditional vendors’ solutions, the new players’ solutions in the market have yet to be proved their performance claims to a greater extent.

**Scalability**
Open RAN architectures have been mainly tested in regional and less densified areas, which raises concerns on whether these solutions can meet the requirements of large scale deployments.

**Integration**
Open RAN may face integration challenges on stacked up (and proprietary) technological environments, and the magnitude of savings might not be as expressive as in greenfield deployments.

Sources: Deloitte Insights, NEC
Telcos’ challenges towards Open RAN

Each Telco evaluating Open RAN has its own business case and specific technology challenges to be addressed, and deployment models will differ significantly between greenfield, brownfield and mixed networks. Even though all face a common set of key challenges, that represents a greater burden for brownfield and mixed models due to the critical necessity to integrate new Open RAN technology with the legacy and proprietary solutions already in place while securing demanding 5G rollouts.

- **Handle complex integration**
  Open RAN potentiates multi-vendor environments, which require integration between different software modules or between software and hardware solutions, therefore maximizing the complexity of system integration. For a brownfield Telco, this context may be more challenging as it will need to consider legacy technologies present in the network.

- **Enable end-to-end service orchestration**
  Telcos have been trying to enable E2E service orchestration for the past years and the adoption of Open RAN may facilitate that goal due to the adoption of open APIs and interfaces. The challenge exists for all Telcos but brownfielders will likely need to provide E2E service orchestration capabilities to both their Open RAN and legacy architectures, thus increasing complexity.

- **Secure consistent network performance**
  A common concern often pointed, relates to the technology maturity of Open RAN solutions while compared with traditional architectures deployed massively across highly densified and demanding networks. Securing feature parity, consistent network performance and QoE is key. Brownfielders, due to the integration of new and legacy technologies, are expected to experience additional challenges to deploy Open RAN.

- **Operations & Maintenance capabilities**
  Maintenance and network operations in general can initially become more complex by the increased number of vendors required to deploy a single site. Additionally, a new technical team profile is required moving from HW towards SW centric and virtualized environment. DevOps, CI/CD, and AI/ML skills will be paramount to secure proper network operational performance daily.

- **Network Lifecycle management**
  Since Open RAN networks are expected to be multi-vendor environments, upgrades should be carefully planned and coordinated between the different providers in the network to reduce risks of interoperability issues. Brownfield Telcos are expected to have an additional obstacle since they need to consider potential impacts on the legacy network.

Sources: 5G Americas

There have been doubts on whether Open RAN networks may not easily fit brownfield Telcos’ ambitions but, in fact, may represent the best solution to respond to, for instance, higher flexibility on network densification or increased footprint in geographical areas that do not financially justify the investment in traditional RAN solutions. However, Open RAN deployments require a consolidated maturity in terms of network virtualization, which can force brownfield Telcos to increase their CAPEX in cloud infrastructure in case they have not yet engaged in a network virtualization journey.
Aggressive 5G rollout plans and milestones, radio access network renovation, new spectrum integration, legacy networks decommission, endless capacity upgrades, backhaul evolution, embracing a Telco Cloud reality, among others, are more detailed examples of the challenges faced by Telcos that can have a massive disruption in current network plans.

Illustrative example on how Network evolution from traditional based architecture towards Open RAN can be challenging

Example of specific challenges faced by brownfield operators:

- Secure interoperability among new and legacy vendors
- Detail a legacy network strategy (i.e. 2G/3G evolution)
- Define proper spectrum strategy including new Open RAN compliant RU’s
- Potentiate consistent network performance and QoE amongst all the network
- Align feature parity requirements mainly on Dynamic Spectrum sharing (DSS) and Carrier Aggregation (CA)
- Evaluate fronthaul capacity and midhaul/backhaul homogeneous requirements
- Adopt consistent network security frameworks
- Implement E2E service orchestration and network automation supporting both architectures
Enabling Telcos’ transition towards Open RAN

Even though many Telcos are eager to move forward with Open RAN, the disruption of traditional models, typically reliant on the simplicity of single vendor environments, raises concerns related to the management of complex multi-vendor RAN deployments. Nonetheless, if Telcos want to harness the full potential of the broad variety of solutions that are emerging, they should consider engaging on an...

Operating Model transformation
complemented by an organizational restructuring, to support Telcos implementing, scaling, driving and value their Open RAN operations.

Processes
- Existing frameworks, processes and governance approaches will need to be adapted for a more interoperable, open environment
- Processes and frameworks should be redefined to ensure MNOs can support the integration of multi-vendor solutions

Capabilities
- A new set of capabilities that Telcos have not previously needed will become critical as Telcos move to the cloud
- Investment is required to build future-fit capabilities that can tackle the complexity of a software based networks (e.g. CI/CD, DevOps)

Talent
- Multi-disciplinary talent will be required with a mix of upskilling / retraining existing talent and hiring new external talent
- As operational complexity increases, skills such as Analytics and Big Data become more relevant

Sources: Deloitte Insights 2021
The emergence of a new network player

A disaggregated RAN means that Telcos can expect more vendors and products in the ecosystem. The traditional system integrator needs to evolve in order to tackle not only the Open RAN challenges but also to secure the delivery of end-to-end network solutions, especially in a 5G context.

Open RAN brings the need of a new glue-type role in the industry…

Vendor selection
Support Telcos selecting best-of-breed technologies from multiple vendors while optimizing costs

Integration gaps
Address end-to-end performance gaps and eliminate the need of multiple parties getting together

RAN expertise
Provide expertise to address gaps in a multi-vendor environment

… and Telcos are starting to partner with solution integrators to take this role

In the USA, Dish expects Fujitsu to provide support for radio and antenna integration while ensuring that the radio units and distributed units are fully interoperable

Solution integrator role in Open RAN

With the ITization of mobile networks and the emergence of multi-vendor networks, the role of a solution integrator will be needed in next-generation networks, securing not only the integration of network components but also the implementation of adequate E2E services orchestration and 5G use cases.
The financials behind Open RAN adoption

Open RAN provides Telcos the opportunity to reduce network costs as it maximizes the levels of flexibility of RAN deployments and RAN operations. In fact, there are already several studies forecasting that OPEX and CAPEX will decrease in Open RAN. However, there is limited consensus on the magnitude of these savings.

### Up to 50% CAPEX reduction

Studies from Goldman Sachs, Senza Fili and Strategy Analytics estimate **CAPEX savings to be between 40% and 50% due to Open RAN**, when comparing to traditional RAN deployments. This reduction is driven by:

- Upgrades and replacements are expected to be cheaper as Telcos move beyond relying on proprietary solutions

### Upfront Investment Required

Even though Open RAN potentiates CAPEX reduction, it also requires significant upfront investments that can diminish Telcos’ interest in adopting such solutions:

- Investment to establish fit-for-purpose Telco cloud infra.
- Investment to upgrade front-haul of the network

### Up to 35% OPEX decrease

Studies from Goldman Sachs, Senza Fili and Strategy Analytics estimate **OPEX savings to be between 31% and 35% due to Open RAN**, when comparing to traditional RAN deployments. This reduction is driven by:

- Software based RAN solutions that allow a faster deployment of new or upgraded features, reducing implementation cycles
- Network automation solutions specifically designed for Open RAN environments, leading to simplified operations
- Lower energy consumption per site because less hardware will be used as functionalities are aggregated in one box
- Open and standardized APIs enables Telcos to remotely monitor, troubleshoot and fix the network reducing the need for on-site interventions

These forecasts need to consider the following remarks:

- Values can only be confirmed when massive rollouts are materialized
- Brownfield and greenfield operators experience different challenges, therefore numbers will differ
- Each network is different, meaning TCO exercises will always need to be evaluated on a case-by-case basis

Sources: Deloitte Insights 2021, iGR, Senza Fili, Strategy Analytics
Critical factors to build strong Open RAN

In general, deployment of proprietary RAN solutions impact the ability of Telcos to select solutions from vendors other than the original one, resulting in low flexibility in network rollouts.

The concept of Open RAN enables Telcos to set up multi-vendor networks using the solutions that best meet their requirements while promoting collaboration among the industry, thus potentiating innovation. However, there are key factors to consider in order to build a strong Open RAN environment.

Collaboration among the industry

- An open collaboration between RAN vendors, both traditional and new vendors, can build confidence and trust in the products created by the ecosystem
- Telcos, vendors and standards organizations must work together, and openly share, discuss and solve challenges, thus enabling a clear understanding of Open RAN rollouts

Minimize network complexity

- Network complexity increases with the number of vendors involved, thus it is critical for vendors to work alongside to address challenges related to rollout and operations
- Open RAN solutions are required to work effortlessly with legacy systems in order to avoid any negative impact on network performance and reliability

Multi-vendor interoperability

- There are specific interoperability requirements in Open RAN that are critical for Telcos to enable the benefits of a multi-vendor mobile network
- Open RAN standards typically focus on potentiating secure multi-vendor interoperability and integration, thus the SI role is crucial for Telcos to “open their RAN”

Solution integration capabilities

- SI capabilities intend to address network complexity in multi-vendor environments and potentiate a sustained growth of Open RAN deployments
- The Open RAN architecture requires an understanding of different products in order to set them up together while maintaining the reliability and stability of the network

Sources: Samsung
As a result of a wide experience in network transformations, Deloitte is well positioned to define a customized strategic roadmap for Telcos to adopt Open RAN based solutions. The adoption of Open RAN can occur in a multitude of scenarios, such as rural areas, network densification or even private networks, and Deloitte can help to identify the most suitable approach.

Deloitte’s extensive knowledge of both traditional and state-of-the-art network solutions places it as the ideal partner to evaluate vendors and their solutions. Deloitte can efficiently manage the network transformation program, identifying the most suitable technical strategy and qualifying the required business case to secure the expected return of investments (ROI) on network evolution.

System integration capabilities alone are not enough when dealing with Open RAN. Deloitte acts as an end-to-end Solution Integrator, ensuring that best-of-breed network components, automation and orchestration are fully integrated, tested and certified.
The Telecom Engineering Centre of Excellence (TEE) has a footprint spanning 4 continents and has delivered projects in over 50 countries being currently supported by 1 headquarters and 5 branches with circa 80 telecom engineers.

We deliver professional telecommunications engineering consulting services globally supporting our customers via a global network of offices from Europe to Australia, having delivered over 200 projects globally in over 50 telecom operators.

Working together with other Deloitte practices when needed, our integrated business ecosystem provides a differentiated set of core foundations beyond telecoms engineering which, when combined, enable a portfolio that assures end-to-end business impact beyond the deployment of technical solutions.

Our focus is on making an impact that matters.
Glossary

API – Application Programming Interface
AI – Artificial Intelligence
BBU – Baseband Unit
CA – Carrier Aggregation
CAPEX – Capital Expenditure
CEO – Chief Executive Officer
CI/CD – Continuous Integration and Continuous Delivery
CoE – Centre of Excellence
COTS – Commercial off-the-shelf
CPRI – Common Public Radio Interface
CTO – Chief Technology Officer
CU – Centralized Unit
DC – Data Center
DSS - Dynamic Spectrum Sharing
DU – Distributed Unit
eCPRI – Enhanced Common Public Radio Interface
E2E – End-to-End
EMEA – Europe, the Middle East and Africa
HW – Hardware
IT – Information Technology
IoT – Internet of Things
ML – Machine Learning
mmWave - Millimeter wave
MNO – Mobile Network Operator
NOC – Network Operations Centre
NFV – Network Functions Virtualization
ORAN – Open Radio Access Network
OPEX – Operational Expenditure
OSS – Operations Support System
QoE – Quality of Experience
R&D – Research and development
RAN – Radio Access Network
RIC – RAN Intelligent Controller
ROI – Return on Investment
RRH – Remote Radio Head
RT – Real Time
RU – Radio Unit
SI – System Integrator
SW – Software
TEE – Telecom Engineering Centre of Excellence
TCO – Total Cost of Ownership
TMT – Telecom, Media and Technology
VNF – Virtual Network Function
vRAN – Virtual Radio Access Network
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