



The Open Future of Radio Access Networks

Telecom Engineering Centre of Excellence (TEE)

Introduction	3
The technology trends leveraged by 5G	4
The Open Future of RAN	5
How far is Open RAN from being mainstream?	6
Real world deployments of Open RAN	9
Why should Telcos consider Open RAN?	10
Telcos' challenges towards Open RAN	11
Enabling Telcos' transition towards Open RAN	13
The emergence of a new network player	14
The financials behind Open RAN adoption	15
Critical Factors To Build Strong Open RAN	16
How can Deloitte help?	17
Who We Are	18
Glossary	19
References	20
Contacts	21

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?



Pedro Tavares

Lead Partner
Telecom Engineering Centre of Excellence (TEE)



Pedro Sanguinho

Senior Manager
Telecom Engineering Centre of Excellence (TEE) -
5G & Beyond Knowledge Lake Head

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



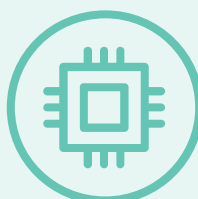
RAN Sharing

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**



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**



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



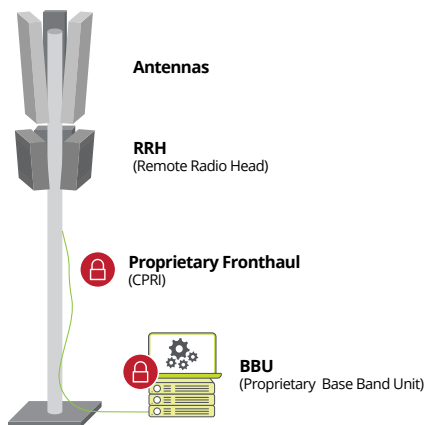
Automation

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

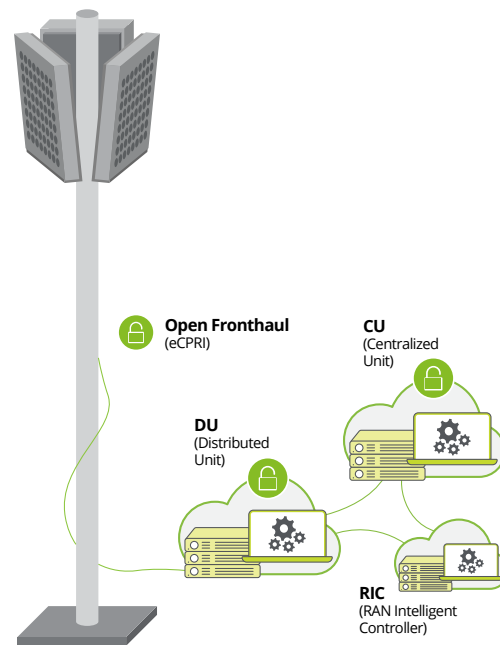
Open vRAN refers to a disaggregated approach of deploying virtualised mobile networks by using **open and interoperable protocols and interfaces**, implemented over a common purpose hardware in a multi-vendor software environment, allowing an increased flexibility over traditional RAN

architectures, aiming to provide **OPEX and CAPEX savings** while **fostering innovation**.



Traditional RAN

- Protocol stack that runs on proprietary hardware
- Radio Unit and BBU are connected via proprietary interfaces
- Single vendor provides both Radio Unit and BBU



Open RAN

- Standardized software centric approach based on commoditized hardware
- Open standard interfaces that ensure deployment of multi-vendor RU and CU/DU ecosystem, powered by an open source AI/ML based platform designed for non and near real time network functions (i.e. a RAN Intelligent Controller)

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.

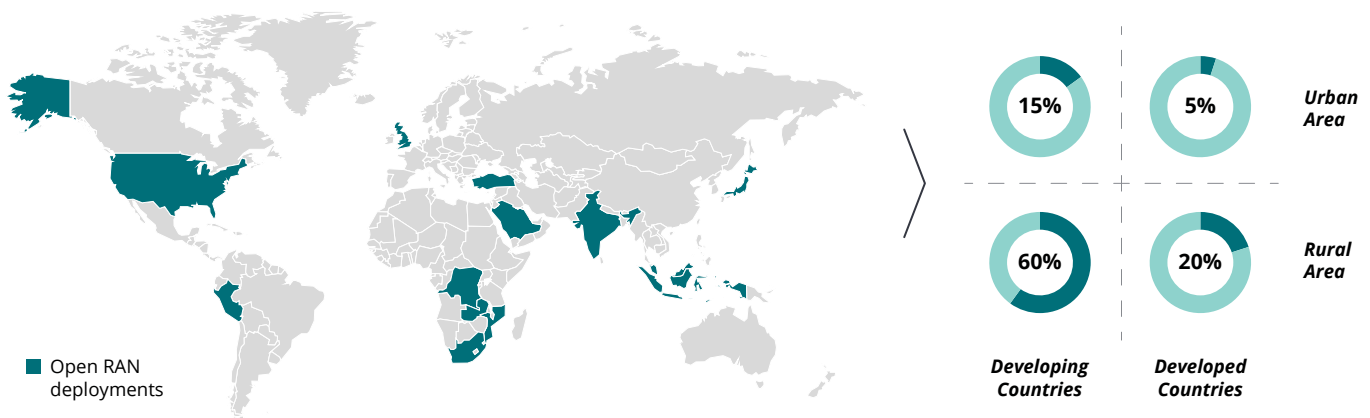
"I believe that in a 5-year horizon, Open RAN would have failed if it's not the dominant architecture on how wireless networks are built"

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.**

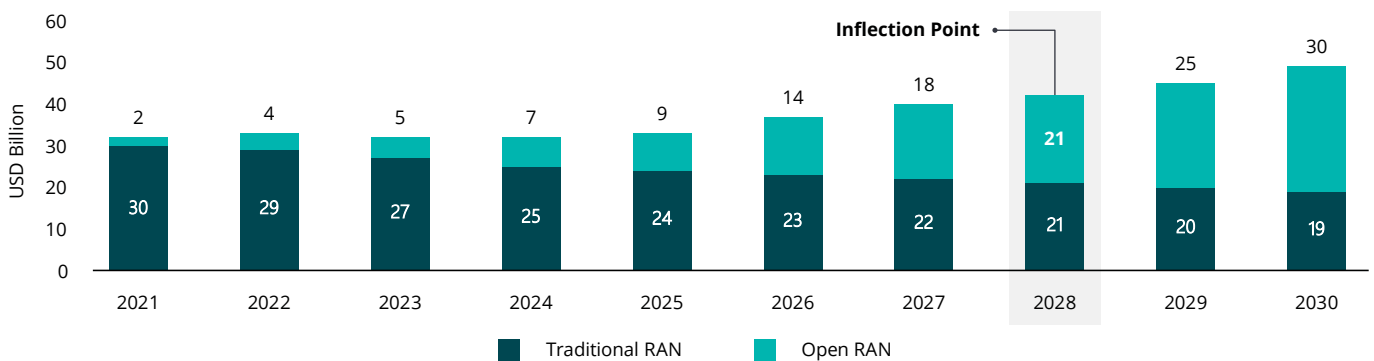
Sources: Deloitte TMT Predictions 2021

⁽¹⁾ Percentage of total Open RAN deployments and field trials

The Open 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

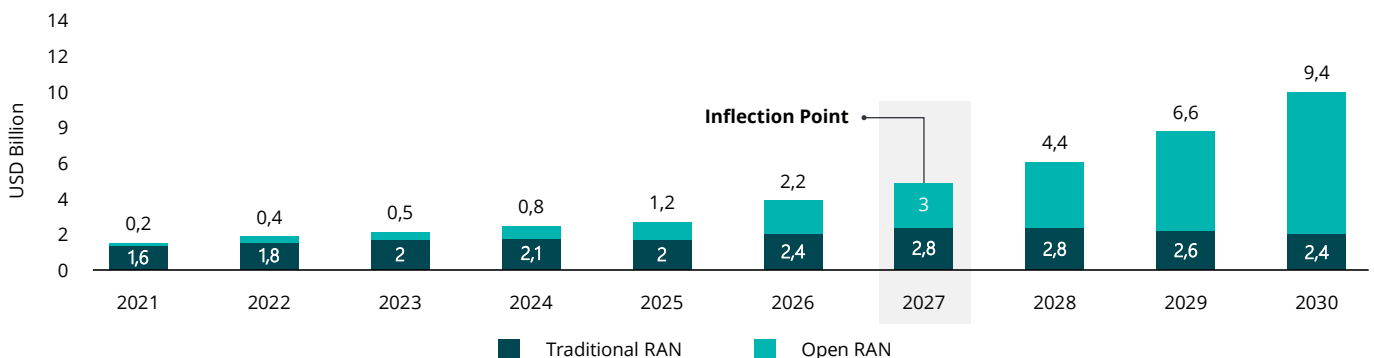
The **inflection point** between traditional mobile networks and Open RAN is expected to occur **during 2028**, with **open interfaces and COTS hardware overtaking proprietary solutions**.



Revenue forecast comparison for enterprise & industry

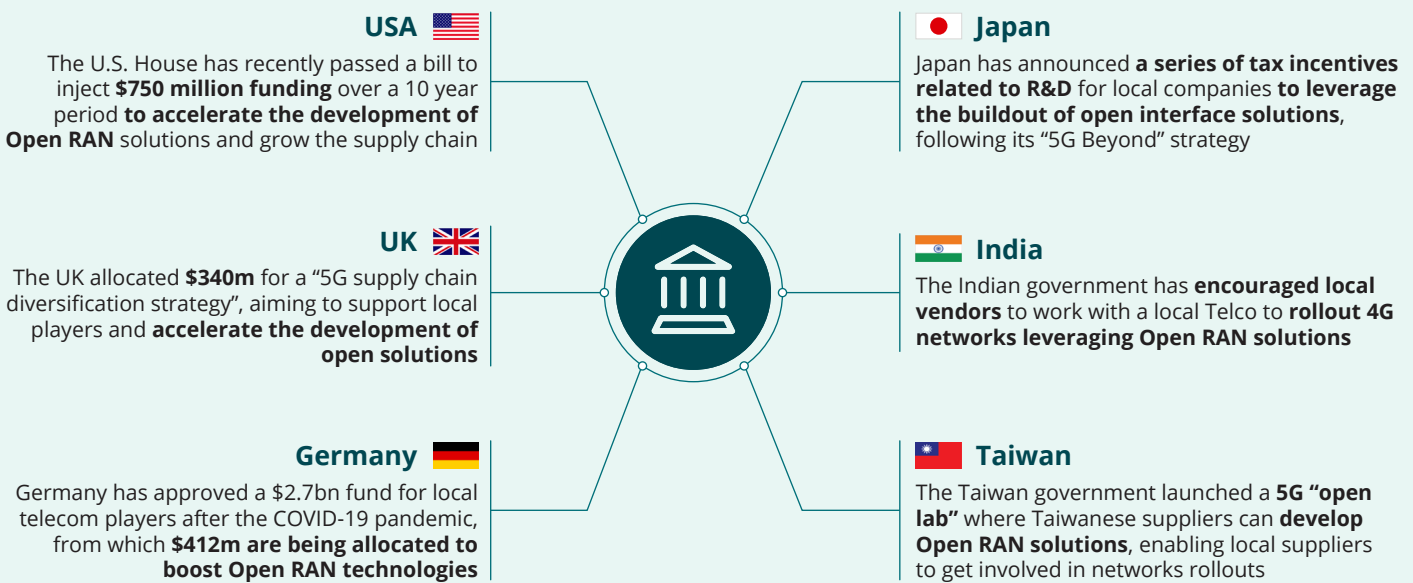
The **inflection point** between traditional and Open RAN for the enterprise & industrial cellular segment is anticipated to happen **during 2027, in line with enterprise digitization enabled by 5G**.

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.



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...



...and new vendors emerging in the market, trying to take advantage of the flexibility provided to Telcos by Open RAN when it comes to vendor selection

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.

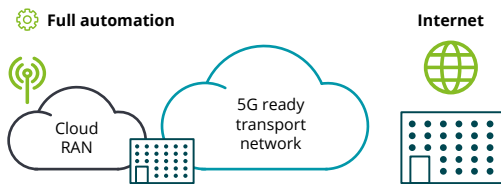
Real world deployments of Open RAN

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**



E2E Virtualized Infrastructure

Commoditized Hardware



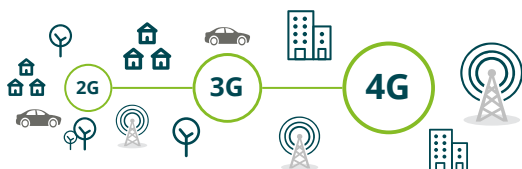
+4000 cell sites



182 VNFS

🇹🇷 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



Rural and Suburban area



24 Macrosites



70k Population



Rakuten was the **first Telco to successfully deploy a fully cloud native** commercial mobile network using Open RAN solutions



As stated by its CTIO, Telefonica's goal is that **50% of the new RAN sites being deployed between 2022 and 2025 to be based on Open RAN**



AT&T's VP of network analytics and automation announced **AT&T has tested Nokia's virtualized RAN solution in New Jersey as part of its Open RAN vision**



Etisalat has partnered with Parallel Wireless to run a **production trial of Open RAN** in Afghanistan for **all mobile generations**



Vodafone has been deploying Open RAN sites in several countries in which it operates, including the UK, Ireland, Turkey and Mozambique



DISH will have Open RAN SW from Altiostar and Mavenir interfacing with RUs from Fujitsu, **making it the first Telco to use two RAN SW vendors**



Bharti Airtel, a board member of the O-RAN, **has been deploying Altiostar's Open RAN solution** in several cities in India

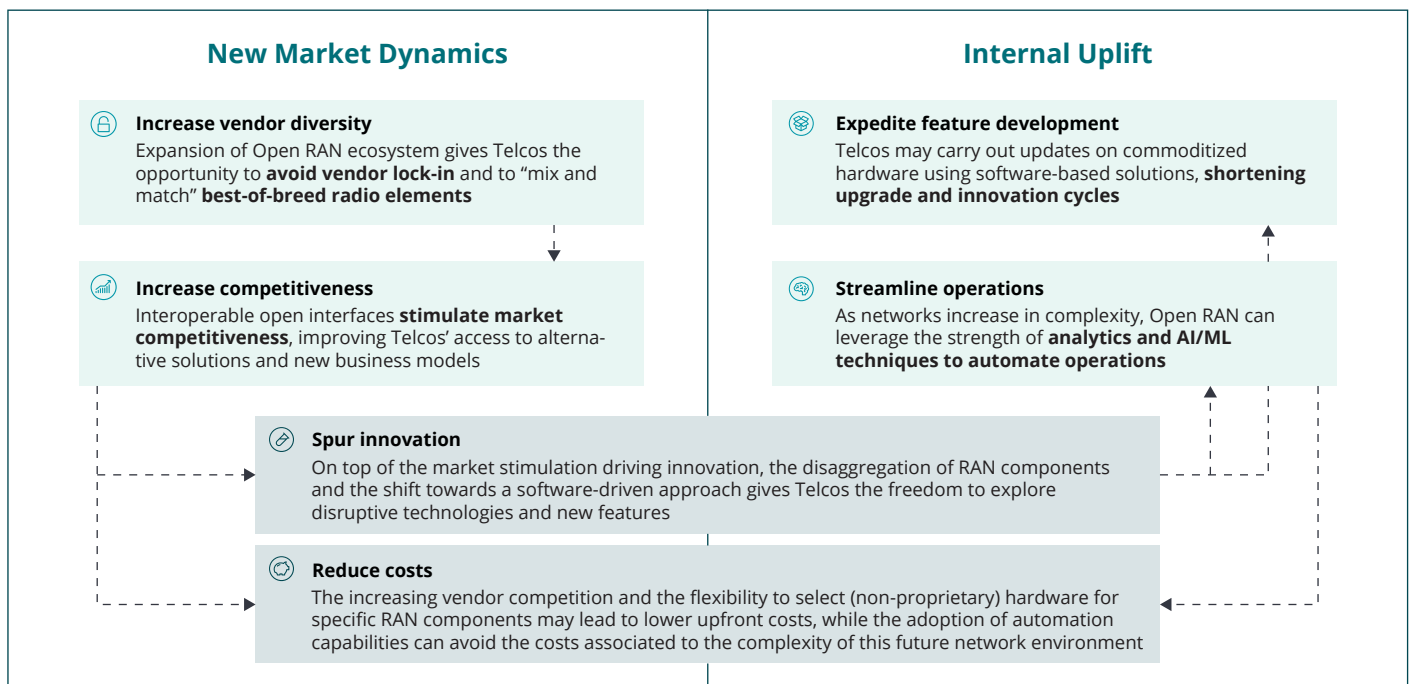


MTN, which is amongst the pioneers of Open RAN, is **planning to deploy more than 5k sites in rural areas** across its 21 operations in Africa

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



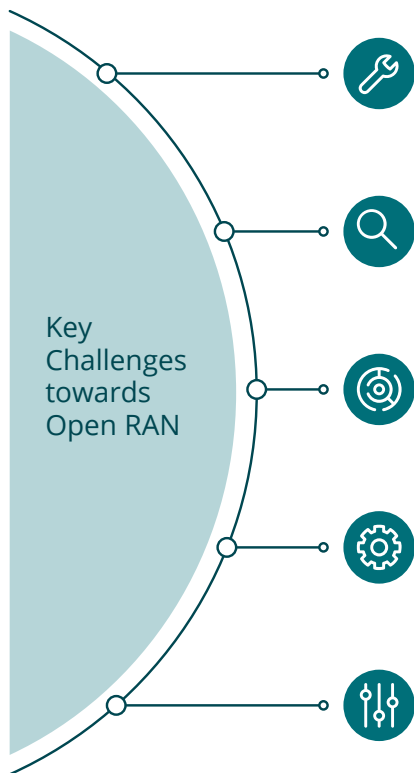
While significant and reaffirming efforts have been undertaken, Open RAN is still maturing and needs to address the complexity associated with an enlarged ecosystem reliant on infrastructure disaggregation.

- 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

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

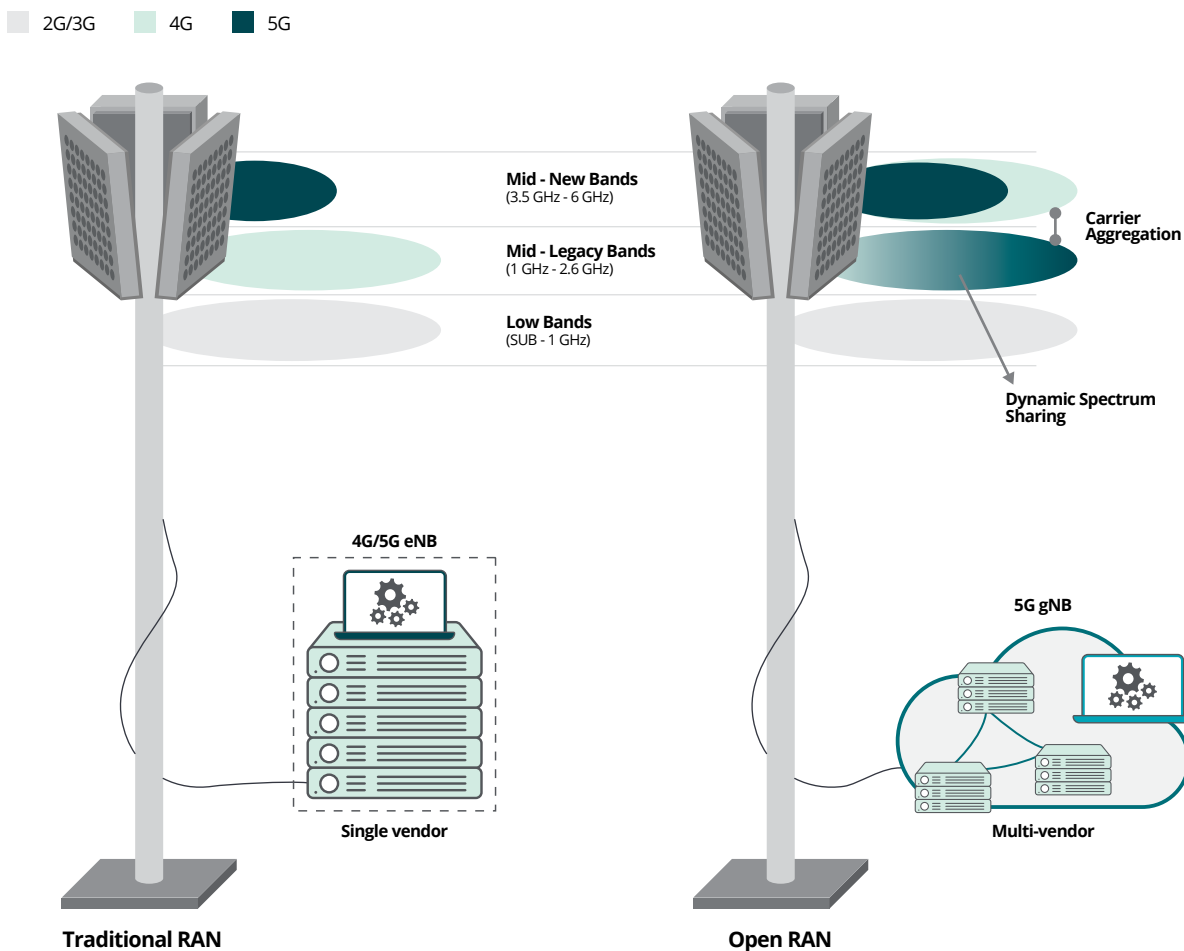
There have been doubts on whether Open RAN networks may not easily fit brownfield Telcos' ambitions but, in fact, **may represent the best solution to respond to, for instance, higher flexibility on network densification or increased**

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**



Telcos will need to rely on the support role of a **Solution Integrator (SI)**



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

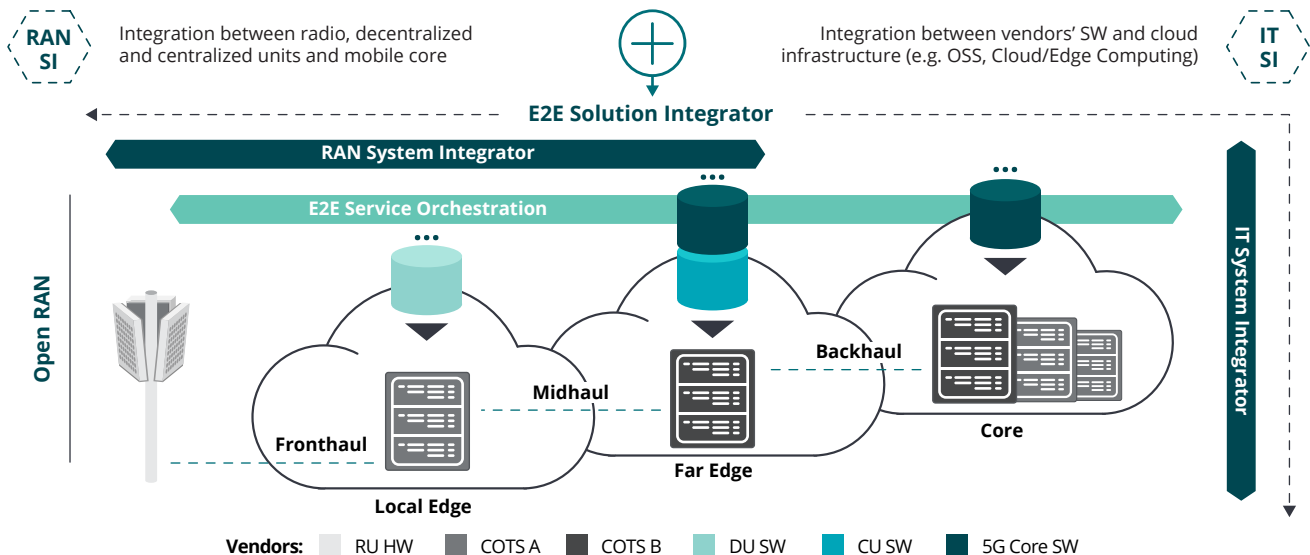
In the USA, Dish expects Fujitsu to provide support for radio and antenna integration while ensuring that the radio units and distributed units are fully interoperable



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 when compared to traditional 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



Lower energy consumption per site because less hardware will be used as functionalities are aggregated in one box



Network automation solutions specifically designed for Open RAN environments, leading to simplified operations



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

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.

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.

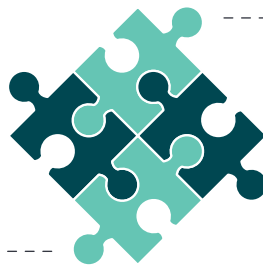
The concept of **Open RAN enables Telcos to set up multi-vendor networks using the solutions that best meet**

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 up them together** while maintaining the reliability and stability of the network

How can Deloitte help?

Deloitte's Telecom Engineering Centre of Excellence in EMEA (TEE) combines the strengths of Engineering background and multidisciplinary teams bridging high technical expertise with strategic consulting skills to provide **thought leadership, talent and global reach.**

This allows the firm to provide clients with unique insights, leading edge methods, actionable analysis, recommendations, and extensive hands-on implementation experience – all firmly grounded in deep industry knowledge and focused on business impact.



Defining the strategic roadmap for Open RAN

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.



Identifying key Open RAN adoption scenarios

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.



Assessing and benchmarking Open RAN solutions

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.



Managing the transformation to Open

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.



E2E Solutions Integrator

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.

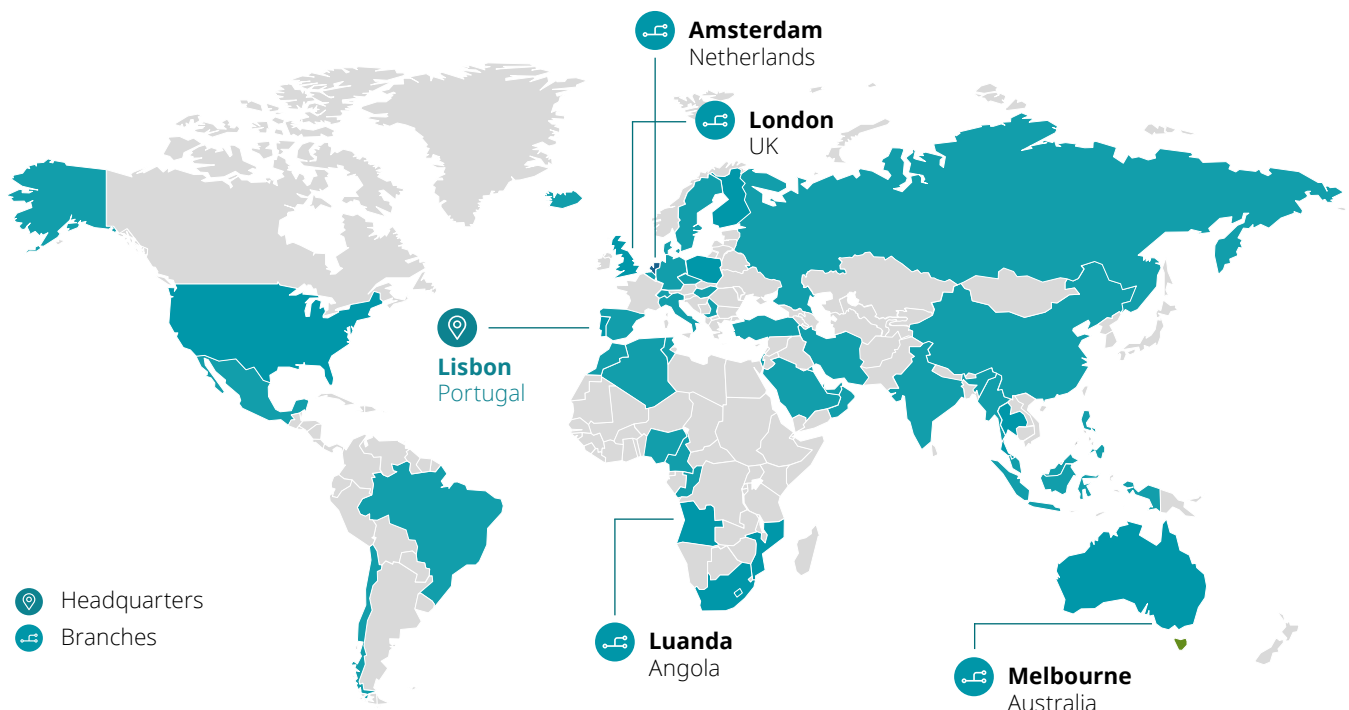
Telecom Engineering Excellence - Who we are

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	RAN – Radio Access Network
AI – Artificial Intelligence	RIC – RAN Intelligent Controller
BBU – Baseband Unit	ROI – Return on Investment
CA – Carrier Aggregation	RRH – Remote Radio Head
CAPEX – Capital Expenditure	RT – Real Time
CEO – Chief Executive Officer	RU – Radio Unit
CI/CD – Continuous Integration and Continuous Delivery	SI – System Integrator
CoE – Centre of Excellence	SW – Software
COTS – Commercial off-the-shelf	TEE – Telecom Engineering Centre of Excellence
CPRI – Common Public Radio Interface	TCO – Total Cost of Ownership
CTIO – Chief Technology Information Officer	TMT – Telecom, Media and Technology
CTO – Chief Technology Officer	VNF – Virtual Network Function
CU – Centralized Unit	vRAN – Virtual Radio Access Network
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	

References

- Deloitte, "Deloitte TMT Predictions 2021", Jan. 2021,
https://www2.deloitte.com/content/dam/insights/articles/US93838_TMT_Predictions_2021/DI_2021-TMT-predictions.pdf?icid=learn_more_content_click
- ABI Research, "Open RAN: Market Reality and Misconceptions", Jun. 2020,
<https://go.abiresearch.com/lp-open-ran-market-reality-and-misconceptions>
- RCR Wireless News, "House unanimously passes \$750 million Open RAN 5G bill", Nov. 2020,
<https://www.rcrwireless.com/20201118/policy/house-unanimously-passes-750-million-open-ran-5g-bill>
- TelecomTV, "Open RAN architectures at heart of UK 5G projects, Jan. 2021,
<https://www.telecomtv.com/content/open-ran/open-ran-architectures-at-heart-of-uk-5g-projects-40645/>
- Politico, "Berlin's €2B plan to wean off Huawei (Nokia and Ericsson too)", Feb. 2021,
<https://www.politico.eu/article/germany-huawei-telecoms-plan>
- NTIA, "(Mavenir) Comments on 5G Challenge Notice of Inquiry", Feb. 2021,
https://www.ntia.doc.gov/files/ntia/publications/mavenir_systems_02102021.pdf
- The Indian Express, "TRAI Chairman: 'Open RAN will present opportunities' ", Jan. 2021,
<https://indianexpress.com/article/business/traai-chairman-open-ran-will-present-opportunities-7153590/>
- Taiwan Business Topics, "Moving Toward Open Networks", Dec. 2020,
<https://topics.amcham.com.tw/2020/12/taiwan-toward-open-networks/>
- Open RAN Policy Coalition, "Open RAN Specifications and Deployment Status", Jun. 2020,
<https://www.openranpolicy.org/wp-content/uploads/2020/06/Open-RAN-Specifications-and-Deployment-Status.pdf>
- RCR Wireless News, "Parallel Wireless trials all-G Open RAN with Etisalat", Apr. 2021
<https://www.rcrwireless.com/20210407/5g/parallel-wireless-trials-all-g-open-ran-with-etisalat>
- SDxCentral, "AT&T's vRAN Test With Nokia Emboldens Open RAN Vision", Mar. 2021,
<https://www.sdxcentral.com/articles/news/atts-vran-test-with-nokia-emboldens-open-ran-vision/2021/03/>
- Telecom Review, "The Promise of OpenRAN", Mar. 2020,
<https://www.telecomreview.com/index.php/articles/reports-and-coverage/3735-the-promise-of-openran>
- TelecomTV, "Cloud native connectivity provider Rakuten Mobile will 'definitely go global' ", Nov. 2019,
https://www.youtube.com/watch?v=x5_JmXiD-el
- TelecomTV, "Tada! Rakuten launches 'free' 5G using Open RAN", Sep. 2020,
<https://www.telecomtv.com/content/5g/tada-rakuten-launches-free-5g-using-open-ran-39793/>
- Telecom Infra Project, "TIP OpenRAN: Toward Disaggregated Mobile Networking", May 2020,
https://cdn.brandfolder.io/D8DI15S7/as/qc19tk-54bsw-305pae/TIP_OpenRAN_-Heavy_Reading_May_2020-_White_Paper.pdf
- TMN Market Report, "Open RAN Market Report 2020", Dec. 2020,
<https://the-mobile-network.com/2020/12/open-ran-market-report-2020/>
- NEC Corporation, "Open & Virtualized -The Future of Radio Access Network", Feb. 2020,
<https://www.nec.co.nz/wp-content/uploads/2020/02/NEC-5G-Open-vRAN-White-Paper.pdf>
- Deloitte Insights, "The next-generation radio access network: Open and virtualized RANs are the future of mobile networks", Dec. 2021,
<https://www2.deloitte.com/us/en/insights/industry/technology/technology-media-and-telecom-predictions/2021/radio-access-networks.html>
- 5G Americas, "Transition toward open & interoperable networks", Nov. 2020,
<https://www.5gamericas.org/wp-content/uploads/2020/11/InDesign-Transition-Toward-Open-Interoperable-Networks-2020.pdf>
- RCR Wireless News, Open RAN 101–Integration and beyond: Why, what, when, how? (Reader Forum), Jul. 2020
<https://www.rcrwireless.com/20200723/opinion/readerforum/open-ran-101-integration-and-beyond-why-what-when-how-reader-forum>

Samsung, "Open RAN 3 - Critical Success Factors to Build a Strong Open RAN Ecosystem", Jun. 2019,
https://images.samsung.com/is/content/samsung/p5/global/business/networks/insights/white-paper/open-ran-the-open-road-to-5g/white-paper_open-ran-the-open-road-to-5g.pdf

Goldman Sachs, Dec. 2018,
<https://www.goldmansachs.com/insights/pages/gs-research/5G-moving-from-the-lab-to-the-launchpad/report.pdf>

iGR, "Open RAN Integration: Run with It", Apr. 2020,
<https://www.parallelwireless.com/wp-content/uploads/iGR-OpenRAN-Integration-White-Paper.pdf>

Senza Fili, "What's the best way to get to Open RAN?", 2021,
https://senzafile.com/publications/best_way_to_openran/

Senza Fili, "Which Open RAN is best for you?", 2020,
<https://senzafile.com/publications/which-open-ran-is-best-for-you/>

Strategy Analytics, "2017 - 2024 Wireless Base Station Sector Forecast: What Should You Know?", Apr. 2019,
<https://www.strategyanalytics.com/access-services/components/advanced-semiconductors/reports/report-detail/2017---2024-wireless-base-station-sector-forecast-what-should-you-know>

Contacts



Pedro Tavares
Telecom Engineering
Centre of Excellence
(TEE) Lead Partner
petavares@deloitte.pt



Pedro Sanguinho
Telecom Engineering
Centre of Excellence (TEE)
- 5G & Beyond Knowledge
Lake Head
psanguinho@deloitte.pt

Acknowledgements

Special thanks to Deloitte professionals who contributed to this publication in terms of researching, providing expertise, and coordinating:

Tiago Pires | Daniel Gonçalves | Elizabete Moreira |
Thiago Silva | Henrique Nascimento | Sérgio Domingues



Deloitte refers to one or more of Deloitte Touche Tohmatsu Limited (“DTTL”), its global network of member firms, and their related entities (collectively, the “Deloitte organization”). DTTL (also referred to as “Deloitte Global”) and each of its member firms and related entities are legally separate and independent entities, which cannot obligate or bind each other in respect of third parties. DTTL and each DTTL member firm and related entity is liable only for its own acts and omissions, and not those of each other. DTTL does not provide services to clients. Please see www.deloitte.com/about to learn more.

Deloitte is a leading global provider of audit and assurance, consulting, financial advisory, risk advisory, tax and related services. Our global network of member firms and related entities in more than 150 countries and territories (collectively, the “Deloitte organization”) serves four out of five Fortune Global 500® companies. Learn how Deloitte’s approximately 330,000 people make an impact that matters at www.deloitte.com.

This communication contains general information only, and none of Deloitte Touche Tohmatsu Limited (“DTTL”), its global network of member firms or their related entities (collectively, the “Deloitte organization”) is, by means of this communication, rendering professional advice or services. Before making any decision or taking any action that may affect your finances or your business, you should consult a qualified professional adviser. No representations, warranties or undertakings (express or implied) are given as to the accuracy or completeness of the information in this communication, and none of DTTL, its member firms, related entities, employees or agents shall be liable or responsible for any loss or damage whatsoever arising directly or indirectly in connection with any person relying on this communication. DTTL and each of its member firms, and their related entities, are legally separate and independent entities.