Open RAN

As 5G is continues to be rolled out in Europe, and its advantages realised, we present an overview of one of the innovations which can help facilitate this transition. This paper explains what Open RAN is and assesses its expected impact on innovation, roll-out, competition, security and efficiency. We provide an overview of the state-of-play of Open RAN and suggest some ways in which EU public policy can contribute.
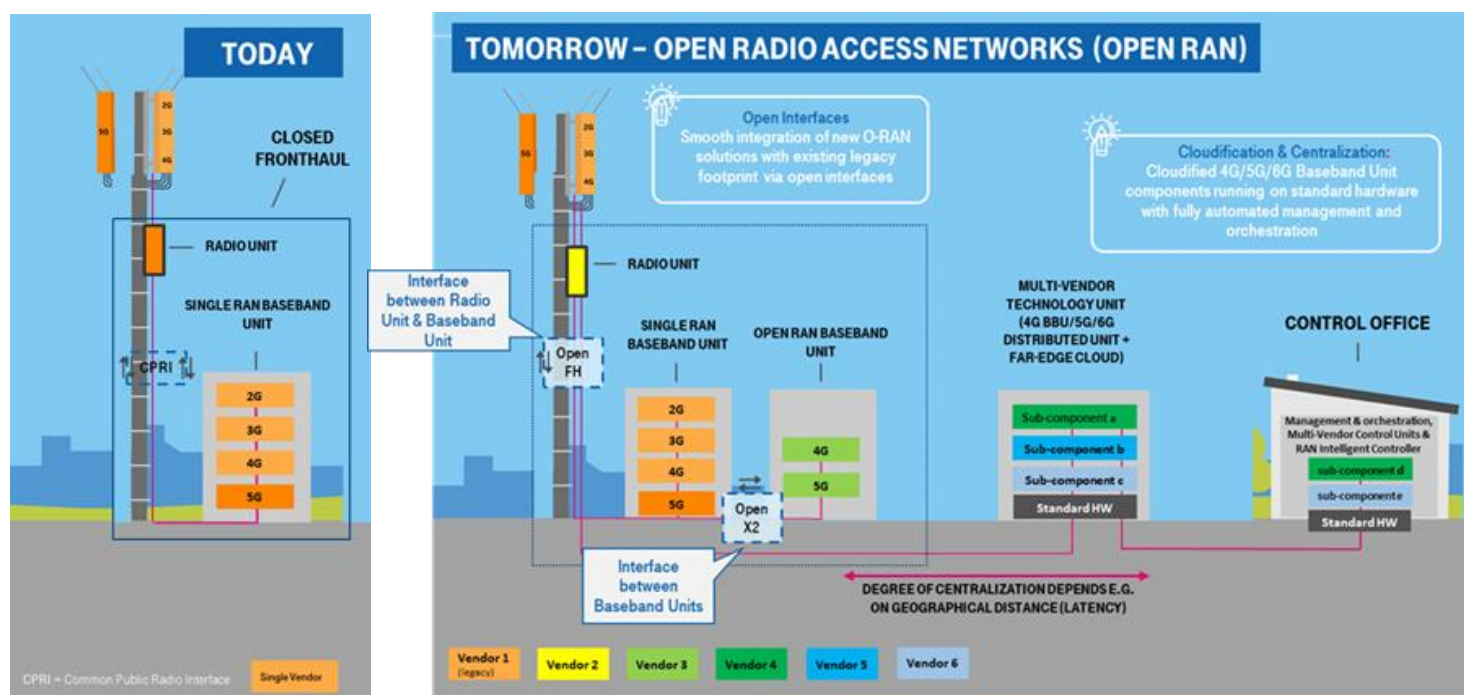
What is Open RAN?

Traditionally, the various components of Radio Access Networks (RAN) have been provided as a unitary and proprietary combination of hardware and software integrated into a single platform. Due to the lack of interoperability, it was not possible to combine sub-components from different vendors, resulting in de-facto 'lock-in' with a single vendor solution. The ambition for Open RAN is to create an **open and interoperable multi-vendor architecture** that enables the separation between hardware and software, and the softwarization of the network (network virtualization) and introduces open interfaces leveraging cloud native implementation of wireless network functions.

In an Open RAN environment, the RAN is disaggregated into:

- Radio Units (RU): perform radio functions, including frequency conversion, amplification, and analogue to digital and digital to analogue conversions.
- *Distributed Unit (DU)* and *Centralized Unit (CU)* – the computation parts of the base station, sending the digitized radio signal into the network. Instead of using custom hardware, the DU and CU can now be virtualized and run on any cloud server, if it is close enough to the base station.
- Antennas: transmit radio signals and receive signals back from the user equipment.

Multi-vendor interoperable products and solutions in Radio Access Networks, along with network virtualization, have the potential to re-define the way we design, build and operate modern mobile networks. Through its role in promoting openness in modern communication networks and favouring the flourishing of the respective supply chains, Open RAN will accelerate innovation in 5G networks and support the objectives of supply diversification, network virtualization and automation.

Opportunity to accelerate innovation and strengthen EU leadership in RAN

A more diversified RAN ecosystem is expected to spur more innovation in support of new capabilities, such as customized 5G networks, or energy efficiency improvements on both the semiconductor and software side, as well as to increase the European strategic capabilities in this area. By widening the overall supply options and increasing specialization in the development of sub-components, Open RAN will allow new innovation to be introduced more quickly. New functions in the RAN architecture will support even further innovation.

When a "trusted management" of the technological platform is enabled, the RAN can be broken down into a set of functions that communicate via open interfaces, allowing a closer control of the software and potentially increasing security. Open RAN also makes the radio network more programable and automated, allowing other applications to use AI and machine learning technologies. These will be integrated by operators to shape coverage and improve service quality according to the specific needs of the various use cases, such as Industry 4.0, V2X, smart cities, among others.

The disaggregation and virtualization of the RAN will also go hand in hand with Edge computing implementation, as Open RAN can be deployed in a cloud environment using virtualized or containerized network functions. The corresponding computing resources need to be located much closer to the radio location for latency concerns, than a centralized cloud design permits today. This means that more processing capacity for Open RAN must be built at the edge of the network, boosting demand for edge nodes installations and enabling a potential extension to, and faster development of, other edge use cases.

Last but not least, for Europe, Open RAN offers an opportunity to strengthen its leadership in modern network technology. EU vendors still hold a strong position in the RAN supply chain. However, other regions, most notably Asia and the US, are increasingly establishing technology leadership in open and disaggregated network technology. For Europe, it is thus of strategic importance not to fall behind in the development of this network architecture model, which is likely to capture a significant share of the total RAN market in the years to come. Open RAN will also bring the opportunity for a new EU ecosystem to develop, if appropriate and timely measures are taken at EU level to support it.

Benefits of strengthening an EU ecosystem in radio access space

The move away from the monolithic systems of today to an architecture based on modular and open components is expected to generate a new European ecosystem in the radio access space, where today three vendors are estimated to control approximately 80% of the market.

Open RAN can significantly lower the barriers to market entry for new vendors and can pave the way for new business models, either through existing technology providers that specialize in one area, playing new and critical roles as systems integrators, or through new market entrants, universities and start-ups. A less concentrated market will help manage risks such as single-vendor dependency and vendor lock-in.

A recent report published by Vodafone, Deutsche Telecom, Telecom Italia, Telefonica and Orange[1] has identified, on the basis of a study made by Analysys Mason, 13 major Open RAN players in Europe. The study also shows that Europe has over 30 SMEs and some larger companies potentially capable of addressing Open RAN challenges. While they are still at an early stage of development, they can develop and expand, also thanks to a set of adequate European measures supporting this ecosystem − see last section. On the contrary, if Europe's operators and industries had to look elsewhere for Open RAN, this could put EUR 15.6bn of industry revenues, and global influence, at risk according to Analysys Mason's June 2021 forecast.

In addition, once a more diversified supply ecosystem is established, operator costs can be reduced through greater choice of vendors and increased flexibility to maximize the benefits of their investment, so that savings can be redirected to faster, more widespread and sustainable network deployment. Even though cost savings still need to be realized, especially regarding brownfield deployments, the use of standard hardware and improved offers should generate reductions in the operators' capital expenditures, while reducing operating costs in the long run through the rigorous use of automation along the life cycle of solutions. In addition, cost-savings can be realised by the pooling of standard hardware in the RAN.

Addressing energy efficiency and sustainability concerns

Telecommunications industry is committed to sustainability and reducing its own environmental footprint, with many operators taking concrete steps to address emissions in their supply chain and setting concrete requirements for vendors. That is why energy efficiency and sustainability concerns are an important consideration for operators in assessing the potential of Open RAN. Moreover, energy costs are a significant driver of total operational costs for network operators, driving a widespread industry demand to improve energy efficiency for Open RAN components.

While it is hard to draw conclusions at this stage on Open RAN environmental impacts given the level of maturity of the technology and the lack of empirical data, energy efficiency is a critical element of the development efforts and assessment of Open RAN done by the operators and vendors. The performance in relation to power consumption is expected to improve as the technology matures, and the ecosystem grows scale. Network automation will further increase efficiencies and lead to performance gains.

By executing as much software as possible in the cloud, Open RAN networks can take advantage of the economies of scale inherent to cloud computing as well as the smart distribution of computing resources in an edge cloud environment. Improvements in the performance of processors will further drive energy efficiency of hardware components used in Open RAN networks. Interoperability and modularity of the architecture will allow to translate efficiency gains in hardware components much faster into the network than before.

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1 https://www.orange.com/en/newsroom/press-releases/2021/europe-urged-act-now-build-open-ran-ecosystem

There remains much work to ensure that modular systems can achieve equivalent or better energy efficiency than integrated systems. The energy efficiency and the sustainability of the network are currently key requirements and point of attention in the Open RAN development.

Security first approach

Open RAN can help solve critical security vulnerabilities that have been at the core of recent geopolitical talks by diversifying the telecom vendor market. Despite this, the complexity of Open RAN systems will require further work on integration and testing, as well as collaboration between industry and policymakers.

The telecoms sector puts security first. The sector's ability to serve customers and retain them depends on trust, which is founded on high security standards. This will continue to be the case as Open RAN evolves. Increased vendor competition will improve security by reducing reliance on a small number of vendors. Wide usage of open interfaces will also enable more transparency and common controls to track vulnerabilities. A risk-based strategy is recommended, which identifies concrete risks and their eventual impact, and the relevant mitigation steps across attack surface while pursuing the goal of a Zero Trust Architecture. In traditional systems, the Radio Access Network was considered trusted. However, zero trust assumes that there is no implicit trust of a user or asset based upon physical location, network location, or ownership[2]. As such, anything and everything trying to connect to Open RAN systems must be verified before access is granted. In order to deliver the level of security expected by network operators and users, Open RAN systems should follow industry best practices and comply with trusted standards working towards the guiding principle of zero-trust.

Security is already in the focus of industry and policymakers' efforts. The O-RAN Alliance[3] has set up a dedicated security focus group which is developing security requirements and solutions to ensure Open RAN is secure, based on a risk-based approach and Zero Trust Architecture principles. The European Union Agency for Cybersecurity will issue a report looking at the impacts of various multi-vendor strategies and how to improve the resilience of network supply chains, both at European and at national levels. In this context, in-depth analysis of the security-related implications of open, disaggregated and interoperable network technology solutions by Member States (in the NIS Cooperation Group) is welcome. To this end, it is essential that policymakers collaborate with the industry, to ensure experience from standardization, trials and early deployments is taken into consideration.

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2 NIST SP 800-207, Zero-Trust Architecture, Rose, S., Borchert, O., Mitchell, S., Connelly, S., U.S. NIST, August 2020, https://csrc.nist.gov/publications/detail/sp/800-207/final

3 O-RAN Alliance – a global industry alliance which is working on new RAN specifications and supports its members in integration and testing by implementing a network of open test and integration centers (OTICs): https://www.o-ran.org/.

Industry work is advancing

The operator community sees the potential benefits of Open RAN, and several industry initiatives are underway to accelerate innovation and commercialization, for example through development of common specifications, requirements, trials and verification of deployment scenarios.

Initiatives underway include, for example, O-RAN Alliance or the Open RAN workstream under the Telecom Infra Project initiative, which seeks to define and build 2G, 3G, 4G, and 5G RAN solutions based on general-purpose vendor-neutral hardware and open interfaces.

In addition to these multi-stakeholder projects, individual mobile operators are committing to testing and deployment of Open RAN solutions. In Europe, Deutsche Telekom, Telecom Italia, Telefónica, Orange and Vodafone have also individually committed to the implementation and deployment of Open RAN.[4]

- Telefónica has already started several Open RAN trials in the UK[5], Germany[6] and Brazil[7], having lighted up an Open RAN network in Argentina[8]. Additionally, Telefónica has announced an agreement with NEC to start pre-commercial Open RAN trials in Spain, Germany, the UK and Brazil, planning to scale to a total of at least 800 sites for commercial use, starting in 2022[9].

- Deutsche Telekom has switched on its 'O-RAN Town' deployment in Neubrandenburg, Germany. O-RAN Town is a multi-vendor Open RAN network that will deliver Open RAN based 4G and 5G services. The first sites are now deployed, including Europe's first integration of massive MIMO (mMIMO) radio units using Open RAN open fronthaul interfaces to connect to the virtualized RAN software.

- Orange has launched in July 2021 a 5G SA experimental network in France to act as a blue-print for the next generation of more efficient and agile networks. This network includes a cloud 5G Open RAN. In addition to the recently launched Open RAN test and integration center, it will contribute to prepare Orange's commitment to deploy only Open RAN based solutions from 2025 onwards.

TIM has rolled out Open RAN technology in Saluzzo and more recently carried out a live Open RAN trial over 4G in the town of Faenza (Emilia-Romagna) in April 2021. It has also established an Open RAN 5G

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4 https://www.orange.com/en/newsroom/press-releases/2021/major-european-operators-commit-open-ran-deployments

5https://news.o2.co.uk/press-release/o2-successfully-tests-open-radio-access-network-technology-ran-from-vilicom/

6https://www.telefonica.de/news/press-releases-telefonica-germany/2020/12/telefonica-o2-first-german-network-operator-with-open-ran-in-live-operation.html

7 https://teletime.com.br/30/06/2020/vivo-ja-realiza-pilotos-da-tecnologia-openran-em-petrolina-e-juazeiro/

8https://app.embluemail.com/Online/VON.aspx?data=tJ3a0xumsYgXPOt6SdI5K6jauIJ%2BSq0Hn81D3N1AWznhsVPsnLb56f b7UDyYDwu4ipMvyd%2B2otmuFHigZlxnsj%2FtYjWyULp88FoyTXPtp%2FeZQGa2DAAAlBTzzJC3VW8V!-!I2ltSpEzqwE+HOpsm4WzP/y5hModXVlamKOn6cI1cKyBjHcWmOdpQ+kRxfD3FHuQ

9 https://www.telefonica.com/en/web/press-office/-/telefonica-and-nec-to-build-open-ran-live-pilots-in-4-global-markets-as-a-key-milestone-toward-mass-deployment

standalone connection at its Innovation Lab in Turin (home to the Open Test and Integration Centre from June) and will soon be activated in Matera, thanks to collaboration with Mavenir for RAN components and MTI for 4G Radio Unit.

The focus of these efforts is to foster cooperation among operators and vendors to speed up development and meet industry requirements in terms of interoperability, testing and security. Through these activities, industry aims to identify potential benefits and address potential barriers as technology develops and matures. While 6G remains far-off, the disaggregation and open interfaces, realised by the Open RAN ecosystem, will contribute to the development, deployment and uptake of the next generation of mobile networks.

Policymakers have a role to play to nurture an EU ecosystem on Open RAN

In addition to the industry action, policymakers can facilitate the rise of a European Open RAN ecosystem through efforts to ensure an enabling environment for network innovation and roll-out, supporting research and development, and driving global cooperation. For Europe to remain a technology leader in modern communication networks, investing in Open RAN today will be a crucial factor. Supporting the growth of this ecosystem in Europe will ensure that strategic capabilities can be maintained and strengthened in the long-term.

Beyond the telecommunications industry, the development and introduction of Open RAN promises to spur innovation in a plethora of technology areas that are of strategic importance to the EU, for example in the areas of chipsets, edge cloud, AI and software development. Policy support for Open RAN should therefore be integrated into a wider strategy aiming at innovation leadership and the build-up of strategic technological capabilities in Europe.

Concrete policy efforts at the EU level should focus on:

- Making the development of an EU Open RAN ecosystem a key priority;

- an overall enabling environment that enables the deployment of new Open RAN infrastructure, such as through support of innovation sandboxes or lowering barriers for start-ups and SMEs;

- funding research and development efforts and trials based on EU funds, as well as enhanced cooperation between EU players by way of IPCEIs, Alliances or multi-country projects;

- building on the industry efforts, promoting and recognizing specifications that enable interoperability for Open RAN and global standardization efforts; and

- driving cooperation and dialogue with other countries, such as the US and Japan, to ensure a global approach to RAN technology development and avoid technology islands.

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