BUILDING AN OPEN RAN ECOSYSTEM FOR EUROPE

for Europe to lead in this essential innovation

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Executive Summary

This paper highlights the urgent need for Europe to make Open Radio Access Networks (RAN) a strategic priority. Europe's best opportunity to defend and grow its place in the global 5G and 6G industry lies with building a broad and deep Open RAN ecosystem.

At a time when connectivity enables all parts of society and the economy to benefit from digital services it is vital to have powerful and secure networks underpinned by strong supply chains. The European Commission's 5G Supply Market Trends report (August 2021) sets two overarching goals:

1. Develop an open and secure 5G ecosystem,
2. Promote European digital autonomy and technological sovereignty by supporting collaboration between new and traditional vendors and a strong approach towards open specifications in the 5G ecosystem.

Open RAN creates opportunities for new and traditional providers to support these goals by helping to foster innovation across industries. This rapidly increases the choice of components, and therefore the potential to innovate and meet the demands for a fast-growing variety of different use cases and applications.

Network operators will need to deploy flexible networks with advanced features and services more quickly, more widely and more cost-efficiently, which is crucial to maintain EU competitiveness and technology leadership. This can only be achieved with interoperable, modular and open network architectures that allow many suppliers to compete and innovate. Open RAN significantly accelerates this development, driving innovation across the mobile network value chain and provides the basis for establishing a dynamic and vibrant ecosystem of European players that can deliver innovative and tailored solutions that are secure, resilient and environmentally sustainable; increasing the resilience and stability of the supply chain.

Critics claim that Open RAN will allow non-EU players into European markets and therefore put Europe's digital sovereignty at risk. This is misleading as it ignores the fact that Open RAN is coming regardless of what Europe decides - a matter of when, not if. The real question is whether Europe wants to lead this new approach or become a follower. If Europe does not act now, it risks another technology gap that would harm Europe's future competitiveness in innovative and efficient next generation networks, and ultimately its leadership and sovereignty in its own region.

Open RAN deployment will happen gradually as the technology matures and reaches mass-industrial scale, meaning Traditional RAN will remain the dominant solution in 5G roll-out for the short term. However, Open RAN is quickly becoming the next industry standard and innovation in this space is rapidly accelerating towards a point of maturity. This means Open RAN will become the technology of choice in the deployment and modernisation of networks. If the EU acts now, investment can help mature Open RAN for large scale deployment, especially in dense urban areas. There is still time for Europe to ensure its current global leadership position in the RAN value chain is translated into a future global leadership in Open RAN, but this will only happen if the EU acts now.

This paper describes the role that Europe and Open RAN will play in future networks and highlights the urgent need for Europe to make Open RAN a strategic priority, using an analysis of the Open RAN value-chain and current players. The paper reveals important strengths and gaps that EU policymakers will need to consider and presents a set of policy recommendations for Europe to maintain a lead in the development and deployment of next generation mobile networks. This requires policymakers and Administrations to:

Ensure high-level political support for Open RAN

- European policymakers should actively promote the development of an innovative, open and interoperable telecommunications ecosystem.
- A dialogue between the EU Commission, Member States and industry stakeholders leading to a joint public statement supportive of Open RAN. Europe needs to talk with "a common voice" related to Open RAN.

Create a European roadmap for network innovation

- The European Commission should create a European Alliance on Next Generation Communication Infrastructures as it has done for Cloud and Semiconductors, which are all vital enablers for a whole range of industries.
- It should lead to a strategic roadmap and action plan to embrace emerging technologies starting with Open RAN. The roadmap and action plan should drive and be reflected in European associations and initiatives such as the IPCEI on Microelectronics & Communication Technologies, the 5G Industry Association, the Joint Undertaking on Smart Networks & Services and multi-country projects.

Incentivise and support EU Open RAN development

- Policymakers should reduce investment risk for EU vendors and start-ups, and support EU partnerships, testbeds and trials with local and EU funding and tax incentives, in technology areas which are strategically significant for the future of the EU.
- This includes funding from the European Commission and National Governments for consortium projects that allow European companies to create strong partnerships and become viable players in the Open RAN value chain.

Promote European leadership in O-RAN standardisation

- Formal cooperation between 3GPP, ETSI[1] and the O-RAN Alliance by supporting adoption of O-RAN specifications as voluntary standards by ETSI, possibly through a fast track procedure, in complement to existing 3GPP specifications.
- A globally harmonised set of standards for Open RAN which ensures the openness and interoperability of network equipment, including pan-European certification for Open RAN interoperability and quality to build deployer and ecosystem confidence.

Engage in international partnerships

- Work with international partners to promote a secure, diverse, and sustainable digital and ICT supply chain. The EU should make use of formats such as the G7, the EU-US Trade and Technology Council and the Japan-EU ICT Dialogue to advance the development and deployment of open and interoperable network architectures.

[1] ETSI and O-RAN cooperation agreement should expand to include a fast-track procedure to accept O-RAN Alliance specifications as ETSI standards

Chapter 1: Open RAN and the Role of Europe in Future Networks

Advanced communications infrastructure is fundamental for digitalisation and thus the functioning and growth of modern economies and societies. New technologies such as network slicing, edge computing and open architectures, supported by artificial intelligence / machine learning (AI/ML), will transform networks from pure communications systems into platforms for innovation. With 5G, networks will become part of the application space, involve new players and pave the ground for new services. This will lead to a plethora of new and innovative applications such as telemedicine, smart factories, smart homes and autonomous driving.

To cater for a fast-growing variety of different use cases and applications, network operators will need to deploy flexible networks with advanced features and services more quickly, more widely and more cost-efficiently. This essential need to enable faster innovation can only be achieved with an interoperable, modular and open network architecture that allows many suppliers to compete and innovate. By introducing such openness and interoperability in the Radio Access Network, Open RAN significantly accelerates this development, driving innovation across the mobile network value chain.

Roughly speaking, the mobile access network consists of a radio base station with an antenna, a Radio Unit and a Baseband Unit. Current RAN implementations offered by traditional vendors are vertically integrated solutions composed of proprietary hardware and software. This means that all the components need to come from the same vendor as there is no interoperability between vendors' components. Thus, availability of any specific software functionality and hardware is tied to a single vendor. As a result, Mobile Network Operators (MNOs) rely on vendors' individual technology roadmaps for hard- and software updates, limiting the overall availability and pace of technology adoption with each innovation cycle.

In an Open RAN scenario, the RAN is deconstructed and reassembled into a set of fully open and interoperable sub-systems. Interfaces between elements are fully standardised as per O-RAN Alliance architecture and specifications and therefore the hardware and software components no longer need to be sourced from a single supplier and can instead be provided by multiple suppliers.

This so-called disaggregation of the RAN from traditional proprietary systems opens new opportunities for new and traditional providers **(Open RAN will foster innovation across industries)**. This rapidly increases the choice of components, and therefore the potential to innovate and meet the demands for a growing variety of use cases & applications **(Open RAN is crucial to maintain EU competitiveness & technology leadership).** At the same time, it provides the basis for establishing a dynamic and vibrant ecosystem of players that can deliver innovative and tailored solutions that are secure, resilient and environmentally sustainable **(Open RAN will increase resilience & stabilise the supply chain).**

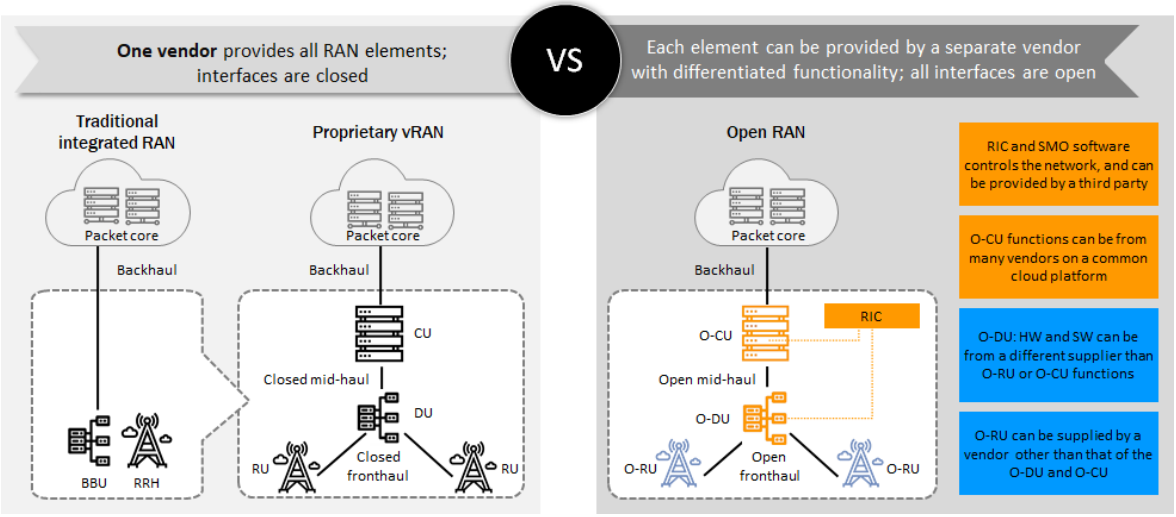

Figure 1. Disaggregation and open interfaces in Open RAN vs Traditional RAN

In addition, virtualisation and cloudification of the different components of the Baseband Unit will allow operators to run various software functions on generic hardware. This will be the next logical step in the technological development of communications networks, enabling sharing of infrastructure for RAN and edge computing. Open RAN will benefit from strong synergies with edge data centres that will provide processing, networking and storage resources. Thanks to these synergies, most of the advanced regions for Open RAN will also become the most advanced places for edge cloud technologies, creating additional competitive benefits for low latency services, Industry 4.0 and e-Health for instance.

Open RAN will foster innovation across industries

- Mobile networks have become part of critical infrastructure as they increasingly become the primary enabler of communication, work, entertainment and industrial transformation. As more and more services build on 5G and, in time, 6G networks, network operators and industry will have an increasing number of different connectivity and functionality needs. Moving from a closed and proprietary system to an open and interoperable system allows multiple players to differentiate by providing different components and functionality. This rapidly increases the choice of components, stimulates innovation to meet demands for new use cases and creates synergies and benefits across industries, and ultimately benefits consumers. For example, network components used in Open RAN networks could also support specific connectivity needs for Industry 4.0, optimising automation and machine learning processes. Where further differentiation is needed additional software modules can be used.

- Faster innovation pace and increased competition will also lead to better products with higher efficiency and lower power consumption (green networks). With improvements such as the Open RAN Intelligent Controller (RIC), operators will be able to enable intelligent traffic prediction and radio resource management using Machine Learning models that adapt to measured network behaviour and performance and unlock significant energy savings.

- Last, but not least, the use of standard hardware and network automation as well as an increased level of competition will drive down overall Total Cost of Ownership with

lower OPEX and CAPEX in the medium to long run. Overall, efficiency gains will help to keep roll-out costs for 5G at a sustainable level, thus helping achieve coverage targets.

Open RAN will increase resilience & stabilise the supply chain

- The wider instability of the telco supply chain is a significant challenge for operators and for governments. Today, the number of global equipment suppliers (even with two in Europe) is not sufficient from a resilience perspective. The key question confronting governments and industry is whether in the future they can successfully source technology that is secure, optimised for their needs and at a competitive price. To meet future demands for innovative and tailored solutions in the digital economy, a resilient, stable, innovative and competitive selection of vendors is vital for essential parts of critical national infrastructure (CNI). Open RAN can play a key part by increasing the number of potential suppliers, reducing dependencies and stabilising supply chains. Open interfaces and interchangeable and separate components also allow for more transparency and better assessment of security vulnerabilities, greater flexibility and agility where changes need to be swift and efficient.

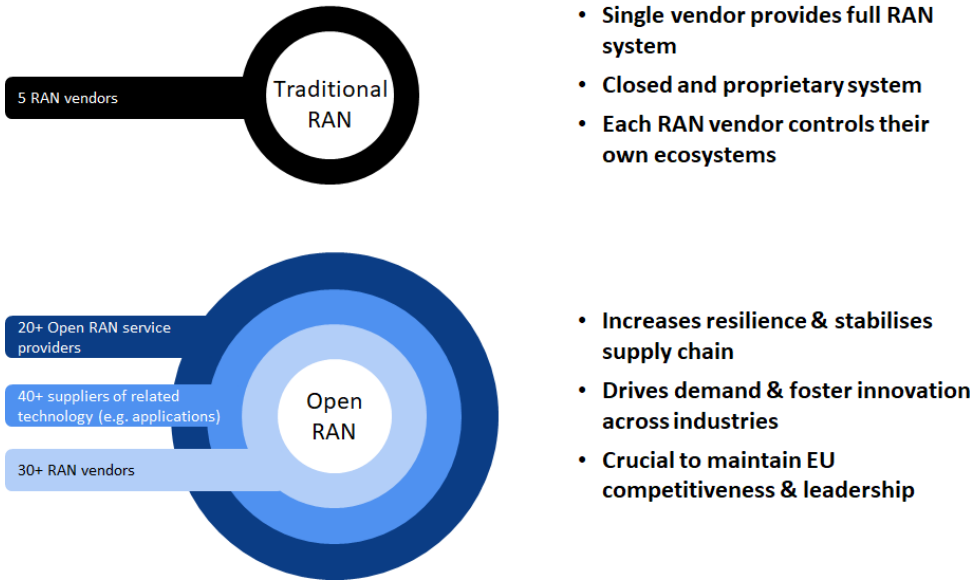

Figure 2. Proprietary versus Open RAN ecosystems: number of active vendors in the RAN supply chain at the start of 2021

Open RAN is crucial to maintain EU competitiveness & technology leadership

- Today, Europe's MNOs and industries are reliant on a limited and closed supply chain. Europe is still home to two important global RAN vendors, and holds leading know-how, technical skills and intellectual property rights (IPRs) in the telecom infrastructure space. European vendors and operators are both active in the standardisation and specification bodies that shape the standards defining networks from 2G to 5G and going towards 6G. Nevertheless, Europe's leadership is increasingly being challenged by Asia and the US, where governments have already identified Open RAN as a strategic lever to pull network competence and technological leadership back into their respective regions and to position themselves favourably for next generation network architecture. It can be expected that the growing demand for Open RAN components from these regions as well as from operators within the EU will make Open RAN the technology of choice and

disrupt the business model for European technology leaders in RAN[2]. It is therefore vital that, also in Europe, Open RAN is identified as a strategic priority early on. Failure to support Open RAN today exposes Europe to the risk of new dependencies as gaps in emerging technology developments will be very hard to close. In fact, we know from experience that a technology leadership gap of 1-2 years may be difficult or impossible to close. Hence a lost opportunity today would have a detrimental effect on Europe's future technological and industrial competitiveness in this space, but equally on the related European ecosystem. Europe is well-placed to build on its existing capabilities and know-how. It can play a unique role in driving Open RAN based on its strong industrial and academic base of expertise, its global leadership in the current vendor landscape and its telecommunications industry, including both vendors and operators, many of which operate globally. They have the know-how and opportunity to encourage the development of new standards and innovative technology enabling Europe to lead the development of next generation network technology.

[2] More cost-effective RANs, built on the basis of operators' requirements rather than vendors' roadmaps, could lead to over USD285 billion in additional GDP globally over the next ten years, and over USD90 billion annually from 2030. (https://telecominfraproject.com/openran-bring-285-billion-global-gdp-gains-stimulated-by-tip-initiatives-develop-open-disaggregated/)

Chapter 2: The Open RAN Value Chain and Vendor Landscape

The change from closed propriety solutions to Open RAN marks a shift in paradigm in network architecture. It will drive innovation for a large and varied number of future use cases and help create an ecosystem that can cater for this demand. This chapter looks at the state of play of the current European ecosystem and also includes European SMEs[3]. The findings are underpinned by results of a supporting European ecosystem research study, conducted by Analysys Mason during the first half of 2021, where 98 companies were analysed. The first step defines the Open RAN value chain and key product and service categories. This helps to identify companies who are either active or have the potential to become active in Open RAN, map them to the categories and provide an overview of Europe's vendor landscape in each of the categories. This overview is meant to serve as a useful tool for developing policy recommendations to build a European ecosystem that is globally competitive and future-proof[4].

The Open RAN value chain is divided into six major technology and service categories:

1. Semiconductors (chips and related components): This category includes design and manufacturing of chipsets and related radio components required to build Open RAN elements such us radio units, active antennas and distributed & centralised server units.

2. RAN hardware: This category includes design and manufacturing of hardware elements for radio units, antennas, distributed server units and small cell products.

3. RAN software: This consists of RAN functions that used to be embedded in hardware but can now run independently on cloud hardware (these pieces of software are called virtualised (vNFs) or containerized (cNFs) network functions This category includes new platforms for automation, management, and orchestration of the RAN elements.

4. Cloud: This category is focused on infrastructure both at edge and core data centres running Open RAN software managed by cloud orchestrators.

5. Services: This category includes System Integration and testing to ensure that software and hardware from many suppliers can work optimally together.

6. Development: This includes activities to contribute and build Open RAN ecosystems, from corporate R&D labs, to incubators, standards organisations, open-source collaborations and labs that share and validate technology.

[3] This study does not explore the state of play for non-European SMEs.

[4] This aims to be representative rather than exhaustive. There may be additional companies active in Open RAN, or the listed companies may be operating in additional segments from those identified here.

Based on current market trends, the next figure shows the expected size of each value chain category in 2026.

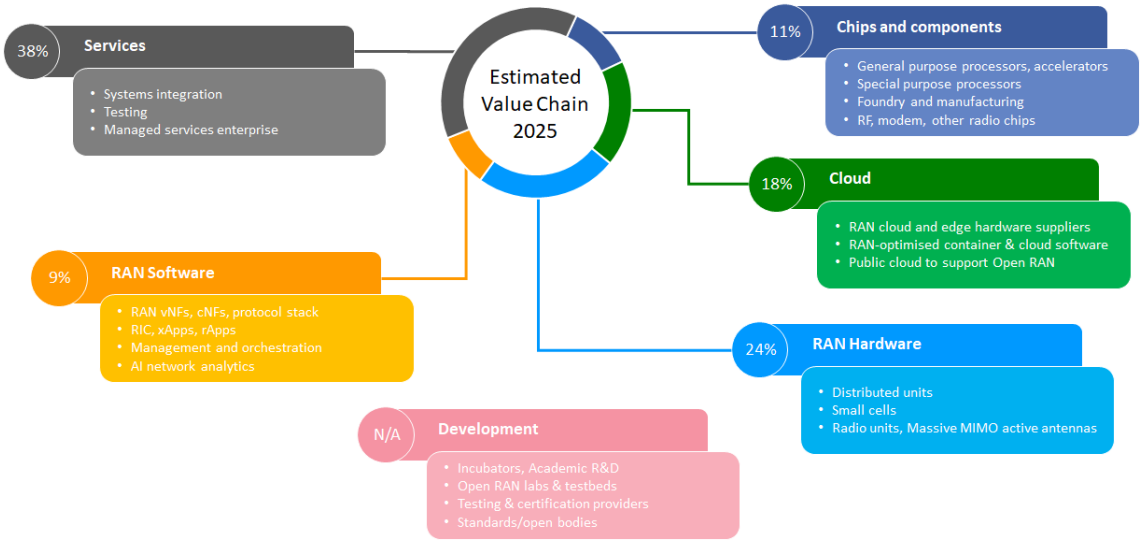

Figure 3: Open RAN value chain estimation 2025. Companies per category & Assessment per category

The value chain breakdown in terms of global vendor revenues (Figure-4), shows that services activities would be the biggest block in expected revenue in the Open RAN value chain, with 38% of total revenue, followed by RAN hardware (24%), Cloud (18%), Semiconductors (11%) and RAN software (9%). A global market worth EUR36.1 billion[5] in supplier revenues from Open RAN is opening up by 2026 and is likely to expand at greater pace beyond 2026. The market value can be split between Open RAN hardware and software (EUR13.2 billion) and the broader RAN platform (Chips and components, Services, Development and Cloud). The biggest growth is expected in Services due to new business models and additional efforts to test and integrate RAN elements from different vendors compared to traditional integrated RAN.

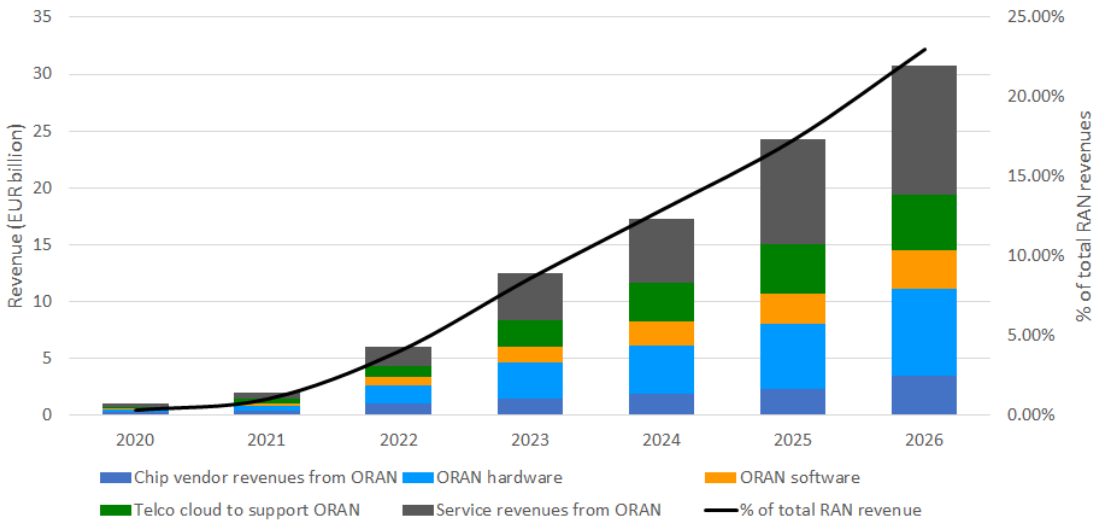

Figure 4. Vendor revenues for Open RAN from 2020 to 2026 by category.

[5] Source: Analysys Mason forecast of Open RAN operator spending and vendor revenue, April 2021

The following analysis shows for each Open RAN technology and service category companies who are either active or have the potential to become active in Open RAN.

Semiconductor (Chips and Components)

This category contains chipsets of different types to cater for a range of RAN hardware elements. They include General Purpose Processors (GPP) to support higher layer RAN functions, Specialised Silicon chipsets for high demand processing workloads, Radio Frequency (RF) Front End (digital signal processing element inside the Radio Units) and Foundry (integrated circuit production of chips and semiconductor elements).

In traditional RAN, most of the semiconductors were designed specifically for one vendor only. In Open RAN, there is a far greater opportunity for chip providers to support equipment from many vendors, providing opportunities for a wider supplier base. Distributed and centralised units can be based on General Purpose Processors (GPP) supporting an ARM or Intel x86 architecture but, to meet the high-performance demands of 5G, these will need to be complemented by accelerators that offload specific tasks. Chipsets may feature components from several suppliers. Radio Units and active antennas need very high-performance specialised processors and RF components. With an Open RAN approach, it will be easier for specialist chip providers to address a broader market of RAN equipment manufacturers demanding those high-performance chips.

Table 1. Europe's rating in Chips and Components (Companies profiled in AM Study 2021)
Strong, Moderate, Weak

		General purpose processors	Specialised Silicon chipsets	Radio Frequency Front end	Foundry
	**European Status**				
	Major vendor active in Open RAN	NXP, ARM	NXP	NXP	NXP
	SME active in Open RAN			Accelercomm, Lime Micro, Picocom, Sivers IMA, SRS	
	Capable of addressing key Open RAN challenges	Infineon, Kalray, ST Micro	ST Micro	Infineon, ST Micro	Infineon, ST Micro, Bosch
	**Major Non-European player**	AMD, Intel	Broadcom, Intel, Marvell, Nvidia Qualcomm, Xilinx	Qualcomm, Xilinx	Intel, Samsung, TSMC

Findings:

- Europe has some providers and promising start-ups, but their impact will be small and fragmented without broad ecosystem support.
- Additionally, Europe has a group of specialist semiconductor vendors that are working on Open RAN in areas such as RF chips and processors optimization to support advanced functionality and very low latency.
- Europe does have a few major semiconductor vendors that could drive scale into Open RAN and help define future platforms, as well as improving digital sovereignty by reducing dependency upon non-European providers and security of supply with their foundries. However, while NXP is developing Open RAN components, ST Micro and Infineon are currently not.
- Moreover, among the global semiconductor players, those from the USA, such as Intel, Marvell and Qualcomm have a strong global market position, and have been more active in Open RAN than those from Europe, such as Infineon and ST Micro.

RAN Hardware

This category contains all the hardware elements that are specific to the RAN but are being developed or modified to support open interfaces to allow them to interoperate with multiple vendors' RAN hardware elements, which include radio units, distributed units and centralised units that are based on specialist semiconductors or general-purpose processors with RAN-optimised accelerators.

In the past, all antennas were passive elements that send and receive signals to and from devices. For higher frequency bands, adoption of active antennas increases, resulting from the introduction of massive MIMO and beamforming techniques. Those need to be integrated with the radio electronics for performance reasons.

In Open RAN, the radio units will increasingly be built to common specifications that include common and open interfaces to other RAN elements. Different initiatives will enable many new companies to compete in the radio unit, which has traditionally been the realm of a small number of players. In this new competition landscape, some will focus on low cost, commoditised units and others on maximum performance Massive MIMO products – the result should be a range of products to suit the needs of any operator or environment.

Small cells have been available for more than a decade but have not become a significant part of the RAN landscape in Europe. However, many Open RAN hardware providers are targeting small cells as a first step, as these units are less challenging to bring to market than top-end macro base station units. Small cells for enterprise deployments are expected to be an important proving ground for Open RAN and an entry point for new suppliers.

Findings:

- The Radio Unit (including active antennas) is the Open RAN value chain category in which Europe has the largest and most diverse base of vendors. There is a significant base of expertise and many of the smaller vendors have been part of the supply chains surrounding Nokia and Ericsson, but are now targeting a broader market, and greater autonomy.
- This provides the potential to make Europe a centre of excellence for this technology, which could support global platforms and markets, gaining scale as a result of open interfaces to any vendor's base stations. US-based RAN software companies cite Europe,

in particular, as an important source of radio expertise, among vendors and also universities and operators' labs.

Table 2. Europe's rating in RAN Hardware (Companies profiled in AM Study 2021)
Strong, Moderate, Weak

		Radio unit incl. active antenna	Distributed unit	Small cells	Full RAN (all elements)
	European Status				
	Major vendor active in Open RAN				Nokia
	SME active in Open RAN	ATL Pharrowtech, AW2S, Bellantenna, Benetel, Celestia, Comlab, Filtronic, RFS, SRS , Siae Microelettronica		Benetel	
	Major Non-European player	AceAxis, Airrays (Xilinx), Airspan, Baicells, Comba, Commscope, MTI, STL, Fujitsu, Gigatera, NTS	Dell, HP, Kontron, Supermicro, CommAgility	Airspan, ip.ccess (Mavenir)	

RAN Software

In Open RAN, software is disaggregated from hardware, allowing software to run on hardware from any supplier. Different RAN software modules can be supported by different developers working together in an integrated way.

An Open RAN network will have a large number of hardware and software elements that will need to be controlled and managed to deliver the best performance. Baseband components (distributed and centralized units) manage RAN signalling and control. The RAN Intelligent Controller (RIC) optimises the radio to suit local conditions and changes in the environment. Service Management and Orchestration (SMO) automates many RAN processes, simplifying and automating network provisioning and service assurance.

Findings:

- Early trials and deployments have mainly been undertaken by US companies such as Altiostar (just recently acquired by the Japanese Rakuten Group), Mavenir and Parallel Wireless. An exception is Belgium's Accelleran. Nokia has developed Open RAN software functions, but these currently only run on Nokia proprietary hardware.
- The development of the RAN Intelligent Controller has been driven by US and Japanese companies so far – e.g. NEC and Amdocs – but there is limited activity in Europe with Nokia, Ericsson and Capgemini developing some of the first implementations.

Table 3. Europe's rating in RAN Software (Companies profiled in AM Study 2021)
Strong, Moderate, Weak

		RAN Software (O-DU/O-CU)	Radio Intelligent Controller (RIC)	Management & Orchestration
	European Status			
	Major vendor active in Open RAN	CapGemini, Nokia	CapGemini, Ericsson, Nokia,	Ericsson
	SME active in Open RAN	Amarisoft, Celfinet, IS-Wireless, Node-H, SRS	Acceleran, IS-Wireless	Highstreet, Inmanta, IS-Wireless, Zeetta
	Major Non-European player	Altiostar, JMA, Mavenir, Parallel Wireless, Radisys, Samsung	Cellwize, HCL, Juniper, Keysight Mavenir, NEC, VMWare	Amdocs, Atrinet, Ciena, DZS, Juniper, HCL, Samsung NEC/Netcracker,

Cloud

This category includes the servers and open software frameworks that have been optimised for the RAN, such us Open RAN edge platforms, RAN-optimised containers, cloud software and public cloud to support Open RAN.

In Open RAN, network software for the Distributed Unit (DU) and Centralised Unit (CU) can run on Commercial-Of-The-Shelf servers from any supplier. However, Cloud platforms are generic by their nature and some vendors are optimising their hardware or software to target the Open RAN opportunity.

In some cases, the Open RAN CU and/or DU may run in a public or third-party cloud rather than the telco's own cloud. This may be unusual among large operators, but some enterprise Open RANs will run in the public cloud. Increasing interest by international Cloud providers to host RAN functionality in the public Cloud may introduce data sovereignty concerns.

Findings:

- US companies have a strong market position in relation to generic cloud platforms - including servers, RAN-optimised container software and public clouds – (though China has its own ecosystem). Some of the US vendors are adapting their platforms to address Open RAN functions of the RAN which will require enhanced functionality.
- There may be opportunities for European vendors to add further RAN-specific enhancements to improve their position relative to the global cloud platforms. For example, Canonical, whose RAN containers framework and Linux implementation are included in some cutting-edge Open RAN developments including a partnership with Lime Micro and UK operator BT/EE. Additionally, due to the synergies between Open RAN and edge data centres, as highlighted already in previous chapter, Europe may have an opportunity to reduce the gap in cloud space with US providers by advancing both Open RAN and Edge cloud deployments.

Table 4. Europe's rating in Cloud (Companies profiled in AM Study 2021)
Strong, Moderate, Weak

		Cloud Hardware	Cloud Software	Public or third-party cloud
	European Status			
	Major vendor active in Open RAN		Canonical, SuSE	OVHcloud
	SME active in Open RAN		BISDN, Ori, Rapid.space,	
	Major Non-European player	Dell, HPE, Kontron, Samsung, Lenovo, Vapor.io	VMware, Red Hat, Google, Microsoft	AWS, Microsoft Azure, Google, IBM, Oracle

Services

Services will play a significant role in the Open RAN value chain to test and integrate multiple vendors' solutions. Many operators will be deploying Open RAN with elements from many suppliers, but they may lack the resources to integrate all these elements themselves. In traditional RAN, integration is usually done by the RAN vendor but in Open RAN, the role of the neutral systems integrator will be greatly enhanced.

An important factor in ensuring that software and hardware from many suppliers can work optimally together is testing for performance and interoperability before deployment. Certification of interoperability helps boost operator confidence.

Findings:

- NEC is currently one of the most successful System Integrators (SI) in Open RAN.
- CapGemini is an active SI and software developer in Open RAN but most of the leading Open RAN vendor-neutral integrators come from India (e.g. Tech Mahindra, Tata, Infosys). Large US players are expected to become more active as larger contracts become available.
- In the European ecosystem, there are many smaller SIs and testing companies, often working on a fairly local basis, that see Open RAN as a strong opportunity to expand their market and make their services more capable of duplication to drive scale. Some large industrial companies such as Siemens, JLR and Bosch are also encouraging integration and testing that is tailored to the enterprise area, and a common framework would help make Open RAN deployable and useful to many industries.
- By 2026, it is expected that Open RAN will account for a substantial portion of the total 5G SI market globally – EUR 13.3 billion in a total segment worth EUR 27.7 billion. It is worth noting that more than half of this spending will be made to support deployment of 5G for non-telecom industries.

Table 5. Europe's rating in Services (Companies profiled in AM Study 2021)
Strong, Moderate, Weak

		Systems integration	Testing	Enterprise Services
	European Status			
	Major vendor active in Open RAN	CapGemini, Atos, Reply	Rohde&Schwarz, Spirent	Nokia, Cellnex
	SME active in Open RAN	Siticom	EANTC, SRS	EDZcom, DenseAIR, Ontix, Freshwave, Aspire
	Major Non-European player	Accenture, NEC, IBM, HPE, Tech Mahindra, TCS	Keysight, Viavi	Google, Microsoft, Cisco

Development

This category of the value chain consists of activities that contribute to fostering an Open RAN ecosystem in Europe, from incubators such as the Telecom Infra Project ecosystem (TIP), universities with projects focused on 5G and Open RAN, labs set up by operators or sponsored by governments, to standards organizations such as ETSI or the O-RAN Alliance.

These range from pure research projects in universities or corporate R&D labs, to incubators that help commercialise some of those findings through start-ups, to the standards organisations, open-source collaborations and labs that share and validate the technology. Maximising the impact of all these activities through funding and by creating collaborative frameworks across the region, and between industry and academia, are important ways through which policymakers can stimulate the Open RAN ecosystem.

Summary

This study has identified 13 major Open RAN players in Europe compared to 57 major Non-European players. However, many European players are at an early stage of development and have not yet secured commercial Open RAN contracts, whilst vendors from other regions are moving ahead in actual sales, building an advantage that may risk Europe's future competitiveness in network technology (see Figure 5).

European vendors are not even present in all Open RAN sub-categories (e.g. Cloud Hardware), and are outnumbered in almost all categories by Non-European players (e.g. 2 major European vs 9 major Non-European players in the semiconductor category). This demonstrates important gaps and weaknesses in the end-to-end European Open RAN ecosystem. This study also shows that Europe has over 30 SMEs and some larger companies potentially capable of addressing Open RAN challenges, but their presence is fragmented, and their impact will be further diminished without broad ecosystem support.

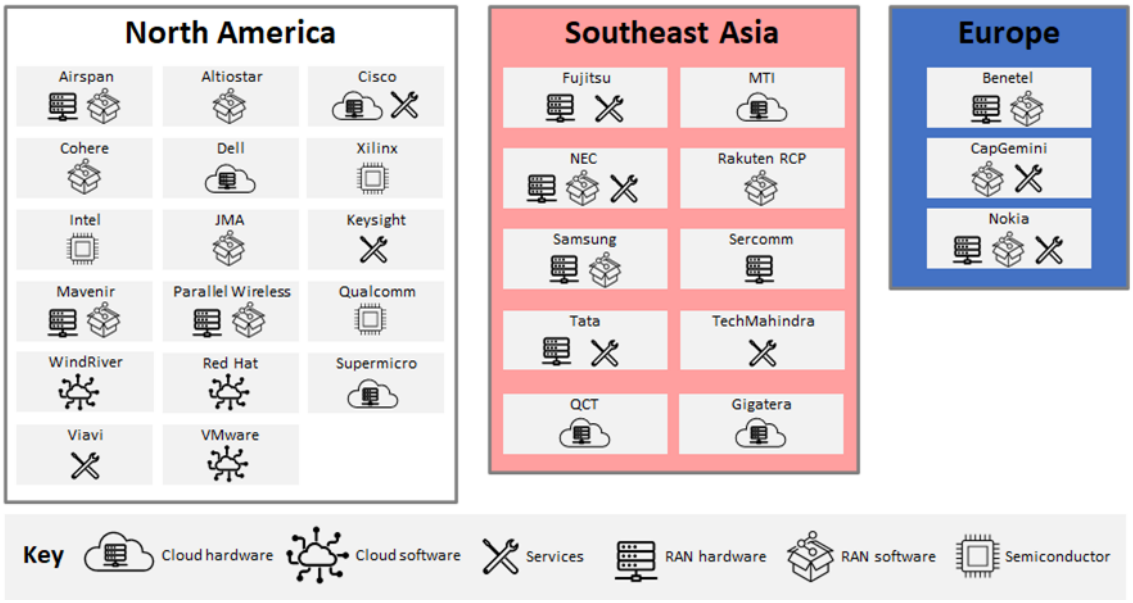

Figure 5: Open RAN vendor distribution showing companies who had commercial contracts to supply Open RAN networks in March 2021. There may have been developments since then. Source Analysys Mason and Bloomberg, March 2021.

The European ecosystem has significantly greater strengths and investment in some value chain elements than others. In many cases, these arise from existing excellence in technologies such as active antennas, RAN hardware and systems integration, in the traditional RAN market. The challenge is to adapt technologies and business models in order to apply them successfully to Open RAN, and especially to networks that are based on open cloud platforms.

Europe has high degrees of excellence and innovation in certain foundational areas, supported by large operators, universities, and the community of organisations around Nokia and Ericsson, but this is not currently translating into a strong commercially deployable ecosystem or significant commercial contracts in the emerging Open RAN space.

Overall, there is a large gap between US and European providers in different areas of Open RAN technology. Higher levels of funding are needed to enable promising start-ups to reach scale more quickly and to fill gaps in the ecosystem, which will otherwise be filled by non-European companies. This funding should come from multiple sources – direct grants and matched awards, tax incentives for larger companies to support start-ups, contracts for government networks and policies to encourage investment in Open RAN.

Large European companies such as chipmakers, systems integrators and industrial organisations can add weight to the ecosystem and would benefit from incentives to become active in Open RAN.

Europe's large non-telecoms industries may drive investment in Open RAN and can identify their own requirements, which can influence the vertical sector globally, e.g. industrial players such as Bosch or Siemens.

Some opportunities that Europe should analyse are:

- Create an open network technology roadmap clearly defining targets to fill supply chain blind spots and linking relevant major players, SMEs/start-ups and RTOs needed to reach those targets.
- Attract major chip suppliers from adjacent sectors on the basis of RAN synergies and provide high value chips to enhance global platforms.
- Encourage development of antennas optimised for expanding Open RAN sectors e.g. in manufacturing.
- Provide funds and open labs to boost rate of innovation by start-ups.
- Testing and SI are more critical in Open RAN, so Europe should strive to be a global center of excellence in these areas.
- Develop stronger collaboration frameworks for projects across Europe.
- Contribute to the next wave of Open RAN specifications and support standardisation.

Chapter 3 – Europe at a Crossroads

To date Europe appears to be lagging behind other international markets, despite billions spent by public network operators in 5G auctions and investments of €56bn in 2020 for radio network and transmission links[6]. The European Commission (EC) estimated in 2016 that a total of €500bn would be needed to meet the EC's 2025 connectivity targets, including 5G coverage in all urban areas[7]. Europe's Recovery & Resilience Facility (RRF) identifies 5G as a flagship area for a significant share of its targeted €150 billion digital budget to finance 5G network infrastructures[8], and Europe's Digital Compass target aims to deliver 5G for all by 2030.

These ambitions demand that networks are deployed quickly and extensively, with a high level of resilience and flexibility to respond to user needs, with support for the most advanced capabilities. However, if operators use the same supply chains and platforms as used for 4G, there will be significant barriers in terms of cost, supply chain robustness, delays and choice hampering the achievement of EC connectivity targets and thus of Europeans getting the advanced networks they need to secure social and economic prosperity. Therefore, European operators are taking a leading role in setting deployment goals for Open RAN. However, while they have embarked on trials and major commitments, and contributed to standards and specifications, early projects with the most significant impact are being led by non-European companies, especially those from the USA, Japan and South Korea. In fact, to date European operators have no choice but to select non-European partners for their initial trials and deployments.

As stressed throughout this paper Europe is well-placed to build on its existing capabilities and know-how and therefore can play a leading role in driving innovative network architecture, but the key difference is that Europe has not yet identified Open RAN as a strategic priority, whilst other countries, most notably the US and Japan, are strongly pushing for the new paradigm of open network architectures focusing on the development of Open RAN. This is likely to increase the gap in areas where these players already have an advantage and reduce the gap where Europe has an existing advantage today.

- In the US, in December 2020, Congress passed the USA Telecommunications Act, as part of its annual National Defence Authorization Act (NDAA), establishing the Public Wireless Supply Chain Innovation Fund. Through this program, grants may be used to offset the cost of procuring Open RAN equipment, multi-vendor integration, deploying security features on open networks, or deploying network function virtualization to manage an open network. In addition, the legislation created the Multilateral Telecommunications Security Fund, which establishes a common funding mechanism with foreign partners to promote the international adoption of secure and trusted telecoms equipment. Congress is presently considering the levels of funding for these two programs. The Senate has passed the US Innovation and Competition Act (USICA), which would fund the Public Wireless Innovation Fund at $1.5 billion and the Multilateral Telecommunications Security Fund at $500m. The legislation is now

[6] https://digital-strategy.ec.europa.eu/en/library/5g-deployment-could-bring-millions-jobs-and-billions-euros-benefits-study-finds

[7] https://www.europarl.europa.eu/RegData/etudes/IDAN/2019/631060/IPOL_IDA(2019)631060_EN.pdf / https://ec.europa.eu/commission/presscorner/detail/en/IP_16_3008

[8] https://digital-strategy.ec.europa.eu/en/library/5g-europes-digital-and-green-recovery

pending in the House of Representatives and is expected to pass at similar levels of funding at some point this year.[9]

- In Japan, the Government's the *Act on Promotion of Development, Supply and Deployment of Specified Advanced Information and Communication Technology Utilization System* offers financial incentives and tax benefits to companies that develop, supply or deploy 5G equipment that meets certification criteria in terms of security, supply and openness. The Government cites the need for equipment to be interoperable based on open architecture and utilise international standards to be certified[10]. It has also provided a testing environment through its development of testing techniques as verification tools for multi-vendor interoperability, which helps save time and reduce costs. Japanese companies are also becoming active in relation to Open RAN in Europe. In November 2020, for example, NEC opened an Open RAN Centre of Excellence in the UK, which will provide engineering support for its global business[11]. NEC is also building a multi-vendor interoperability testing facility as part of the centre to contribute to enriching the Open RAN ecosystem.

- In April 2021, the US and Japan pledged USD 4.5 billion for a 'Competitiveness and Resilience (CoRe) Partnership' to be invested in the research, development and deployment of next-generation mobile networks ('6G' or 'Beyond 5G'), including advancing access to 5G networks via Open Radio Access Networks (Open-RAN)[12].

- In July 2021, the UK launched a GBP30 million Future RAN Competition to fast-track Open RAN development, and discover and fund talented Open RAN specialists. The competition is organized by the Department for Digital, Culture, Media and Sports as part of the UK Government's 5G diversification strategy[13].

With such strong commitments, the US, UK, Japan and India are bound to drive global demand for Open RAN, and these countries are supporting their industries in building new ecosystems ready to compete in future network technology. Critics claim that Open RAN will allow non-EU players into European markets and therefore put Europe's digital sovereignty at risk. This is misleading as it ignores the fact that Open RAN is coming regardless of what Europe decides; it is a matter of when, not if. The real question is whether Europe wants to lead this new approach or become a follower. If Europe does not act now, it risks yet another technology gap that would harm Europe's future competitiveness in innovative and efficient next generation networks, and ultimately also risk its leadership and sovereignty in its own region. **In fact, Analysys Mason's June 2021 forecast shows that 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.**

[9] https://www.govtrack.us/congress/bills/116/hr6395/text; https://www.ntia.gov/report/2021/ntia-report-congress-competitiveness-and-sustainability-trusted-suppliers-wireless

[10] ORPC, Case Study in 5G Technology World; https://www.5gtechnologyworld.com/roadmap-helps-governments-promote-fund-and-implement-5g-open-ran/

[11] Chatham House: "UK-Japan digital cooperation on the 5G agenda and beyond";https://www.chathamhouse.org/2021/03/uk-japan-digital-cooperation-5g-agenda-and-beyond

[12] https://www.whitehouse.gov/briefing-room/statements-releases/2021/04/16/fact-sheet-u-s-japan-competitiveness-and-resilience-core-partnership/

[13] https://www.gov.uk/guidance/future-ran-diversifying-the-5g-supply-chain

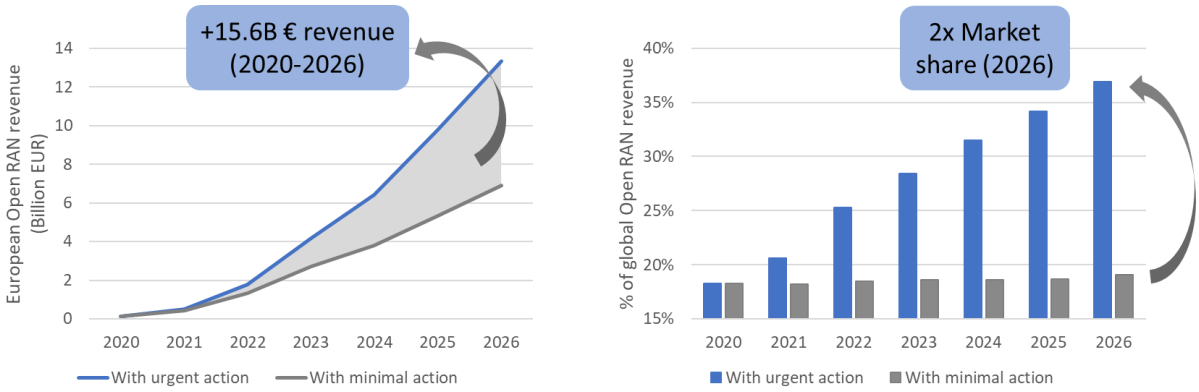

Figure 6. European Open RAN ecosystem revenues 2020-2026, with and without policy interventions[14]

To meet future demands for innovative and tailored solutions in a digital economy, Europe needs a resilient, stable, innovative and competitive selection of vendors for central elements of Critical National Infrastructure (CNI). The EU's strategic autonomy interests are therefore best served by pre-empting another innovation gap. Speed of innovation will be crucial for Europe's future competitiveness.

[14] Source: Analysys Mason forecasts June 2021

Chapter 4 – Policy Recommendations

Europe should have the political and industrial ambition to lead in the development and deployment of next generation mobile networks, encompassing Open RAN initiatives to build resilient, scalable, interoperable and virtualised Radio Access Networks (RANs) that leverage cloud technologies, a diverse vendor landscape and flexibility that comes from the open architecture paradigm.

Supporting the transition towards open and interoperable equipment and networks across the telecommunications value chain holds the potential to generate significant positive spill-over effects for the EU's technology and industrial capacity, most notably in the areas of telecommunications, cloud, software and microelectronics.

We strongly support the EU's efforts to reduce current dependencies in these technology areas, as manifested in the EU's recent industrial and digital strategy updates, its Digital Compass Targets and the creation of two new Alliances on industrial data, edge and cloud as well as on processors and semiconductors. However, digital sovereignty cannot be limited to catching up. Most importantly, the EU needs to be ready to proactively consider technology areas where Europe might still be in a strong position today but risks being increasingly challenged or even disrupted in the future. In this context, building EU capability in Open RAN is essential to guarantee that Europe can maintain control over vital areas of its critical infrastructure.

When it comes to mobile network technology, the EU can build on the legacy and the strength of its equipment vendors and mobile operators. If it can focus efforts on a common objective, Europe will continue to have a leading role in the global race for next generation communication infrastructure. However, for Europe to become a leader in Open RAN, targeted investments, a strategic outlook and the right policy framework are needed. Political support is necessary in the form of an ambitious industrial policy that stimulates and helps create market scale for both industry operators and vendors. An umbrella initiative at EU level with a clear roadmap could kick-start a European ecosystem around Open RAN technology.

Open platforms that are supported consistently by all vendors and industry operators are the only way to achieve an ecosystem that can support diverse operator and industry requirements while retaining common foundations, which are necessary for achieving economies of scale, competition and attractive pricing. Closed platforms that favour a smaller set of vendors will eventually lead to reduced availability of innovative functions and capabilities and throttle the full potential that a wider ecosystem would bring regarding innovation. An open platform on the contrary enables many vendors and solutions, each tailored to different requirements and use cases.

Targeted investments and coalitions are needed in relevant areas, where strategic value is generated and where Europe is well-positioned to take a leading role. With the following recommendations, we aim to provide an inclusive and ambitious roadmap with concrete measures to establish EU leadership in the Open RAN space while also supporting the EU's industrial strategy and Digital Decade objectives.

Recommendations for a strong European Open RAN Ecosystem

We call on policymakers and Administrations to:

1. **Ensure high-level political support for Open RAN**: European policymakers should recognise the importance of supply diversification and actively promote the development of an innovative, open and interoperable telecommunications ecosystem. This should also be reflected in future updates of the EU Digital Compass, by including the development of Open RAN as a strategic priority for the EU's Digital Decade. The European Commission together with EU Member States can take an active role in bringing together relevant stakeholders, including MNOs, traditional vendors, start-ups and wider industry to safeguard and promote Europe's competitiveness and technical leadership as a basis for future European digital sovereignty. It is recommended that a dialogue between the EU Commission, Member States and industry stakeholders leads to a joint public statement supportive of Open RAN. Europe needs to talk with "a common voice" related to Open RAN, and the consolidated view has to be made public and promoted.

2. **Create a European roadmap for network innovation**: We encourage the European Commission to create a European Alliance on Next Generation Communication Infrastructures as it has done for Cloud and Semiconductors, which are all vital enablers for a whole range of industries and therefore critical for fostering European innovation and building a greener, inclusive and more competitive future.

   The European Alliance on Next Generation Communication Infrastructures would assess network technologies that are of utmost importance to Europe's future, and create a strategic roadmap and action plan to embrace emerging technologies starting with Open RAN. The roadmap and action plan should implicitly drive and be reflected in European associations and initiatives such as the IPCEI on Microelectronics & Communication Technologies, the 5G Industry Association, Joint Undertaking on Smart Networks & Services and multi-country projects. This would identify and guide strategic policy and funding activities at national and EU level to:

   - Ensure a coherent strategy for the development of a strong EU ecosystem around innovative network technologies such as Open RAN, supporting R&D projects and collaboration between large and small companies in the EU (as recommended by the EC 5G Supply Market Trends report August 2021).
   - Define IPCEIs and other funding opportunities in a way to allow the implementation of projects related to modern communication technologies such as Open RAN.
   - Provide a European development and system integration platform to support supplier options for smaller operators (as recommended by the EC 5G Supply Market Trends report August 2021).

3. **Incentivise and support EU Open RAN development**: This paper identifies a number of specific technology areas which are strategically significant for the future of the EU communications industry and which promise to generate significant economic benefits and positive spill-over effects. Policymakers should reduce investment risk for EU vendors and start-ups, and support EU partnerships, testbeds and trials with local and EU funding (for example through Horizon Europe) and tax incentives (helping to address

the lack of venture capital in the European small business ecosystem as recommended by the EC 5G Supply Market Trends report August 2021). This can guide EU vendors and start-ups in prioritising capabilities that are important to Europe, mobilise vendors by investing in foundational technologies and developing ecosystems around them (at the same time investing in local skills and jobs). Annex-A describes areas that can serve as priorities for investment, public funding, incentives and policy support. Across all areas it will be important to examine strategic take-overs of European companies, including start-ups, by large non-European companies (as recommended by the EC 5G Supply Market Trends report August 2021). Finally, in order to translate the more detailed recommendations for Open RAN development set out in Annex-A into concrete actions, it is recommended that the European Commission and National Governments allocate funds for consortium projects that allow European companies to create strong partnerships and become viable players in the Open RAN value chain.

4. **Promote European leadership in O-RAN standardisation**: Promote and support formal cooperation between 3GPP, ETSI[15] and the O-RAN Alliance (as recommended by the EC 5G Supply Market Trends report August 2021) by supporting adoption of O-RAN specifications as voluntary standards by ETSI, in complement to existing 3GPP specifications. Support the introduction of a globally harmonised set of standards for Open RAN (as recommended by the EC 5G Supply Market Trends report August 2021), which ensures the openness and interoperability of network equipment. The upcoming EU strategy on standardisation should also provide new impetus for a stronger and more structured strategic dialogue between government and industry on standardisation, for example, by providing funding to support European contributions to O-RAN standards. Establish pan-European certification for Open RAN interoperability and quality to build deployer and ecosystem confidence. This will support risk assessment schemes for vendors in the 5G supply chain based on clearly operationalized and transparent security measures.

5. **Engage in international partnerships**: Work with international partners to promote a secure, diverse, and sustainable digital and ICT supply chain. The EU should make use of formats such as the G7, the EU-US Trade and Technology Council and the Japan-EU ICT Dialogue to advance the development and deployment of open and interoperable network architectures, alongside key allies and partners. To this end, the EU should consider supporting the creation of a multilateral fund for the adoption of secure, open and interoperable network equipment in third countries. Develop a vision for next generation mobile networks (e.g. 6G) and use cases, not just for short term deployments, and channel R&D funding and resources towards projects and start-ups that will support that vision e.g. EU funding for RISE-6G and Terapod projects, among others.

[15] ETSI and O-RAN cooperation agreement should expand to include a fast-track procedure to accept O-RAN Alliance specifications as ETSI standards

Chapter 5 – Conclusion

COVID-19 has accelerated the digitalisation of almost every single aspect of our lives and jobs. It is now undeniable that communications networks are fundamental infrastructures that can be considered the backbone and heart of our economies as every process in the digital age relies on them. There is a wide consensus that future networks will represent a revolution instead of a mere evolution. An open architecture philosophy is needed to support this.

In a digitised world, companies from all sectors will thrive where they have access to next generation networks enabled by a dynamic and innovative ecosystem. It is of utmost importance for Europe's digital sovereignty, technological leadership and economic and competitive progress to foster the development of an Open RAN ecosystem.

This requires a forward-looking strategy that allows for the development of modern network architecture such as Open RAN, which increases resilience, stabilises the supply chain and allows innovation to cater for the diverse connectivity needs that 5G and 6G will introduce. An open platform enables many vendors and solutions, each tailored to different requirements and use cases. Moving from a closed to an open architecture is essential if Europe wants to continue leading in the telecoms industry and avoid a technology gap that will be hard to close. Its best opportunity to defend and grow its place in the global 5G and 6G industry lies with **building a broad and deep European Open RAN ecosystem.**

The Open RAN ecosystem is in its early stages. Some standards have yet to be developed and the first phase of deployments and trials are largely small-scale. Therefore, Europe has an opportunity to shape Open RAN and defend or increase its traditional position of strength in the mobile networks market. It has a significant base of large and small companies that are active in Open RAN or have the skills to enter the market quickly. To build a strong European ecosystem, however, requires urgent action: **Europe needs to make Open RAN a strategic priority**, include it as a pillar in its Industrial Policy and Digital Decade and underpin it with the right policy framework.

If we make sure the right conditions are met, it is possible to nurture a European Open RAN ecosystem that safeguards Europe's competitiveness and leadership in network technology and contributes to Europe's digital sovereignty. This is a unique and time sensitive opportunity for European industry and policymakers. Engaging early will ensure that Europe maintains a crucial global role in the next generation of mobile network technology, which is why the MNOs who signed a MoU on Open RAN encourage European policymakers and Administrations, industry and vendors(both new and existing) to participate and, together, help build a vibrant ecosystem. In addition, strengthening competences in the Open RAN value chain in Europe will have favourable spill over effects for fixed line disaggregated network infrastructure and other vital technology areas such as cloud, software and chipsets. This will significantly contribute to the wider technology ambitions of a digital Europe.

Priorities for investment, public funding, incentives and policy support based on the structure & taxonomy in Chapter 2.

Semiconductor (Chips and Components)

- There are increased opportunities for specialist chip providers to achieve growth by contributing to a multi-vendor chip platform for RAN elements, or to license specialist IP. This can be facilitated by supporting common platforms at the semiconductor level.
- Synergies between 5G and the automotive industry may help to attract suppliers with a large presence in the automotive sector, such as Infineon, into the RAN market, and this would help safeguard Europe's access to semiconductor suppliers across sectors. These should be actively explored and encouraged via cross-industry initiatives and funding, and potential tax incentives for tier one developers and foundries.
- To support Europe's fabless semiconductor suppliers, the EU could invest in local foundry capacity and foster strong alliances with multiple global foundries in multiple locations, in order to secure multiple supplies of RAN chips. In March 2021, the European Union set a target of producing 20% of the world's semiconductors by 2030, including the most advanced technologies (most European manufacturers focus on mature technologies).
- The IPCEI on Microelectronics (ME) and Communication Technologies is a potential vehicle to support Open RAN within the broader ME industry and to facilitate synergies between the telecommunication industry and chip providers already addressing other industries such as automotive.

RAN Hardware

- There are increased opportunities for specialist radio or antenna providers to achieve growth by contributing to a multivendor platform, or to license specialist IP. These can be facilitated by supporting common platforms and facilitating alliances with global partners via testbeds and labs.
- As non-telco industries increasingly use 4G/5G networks, there will be opportunities to drive new revenues for European technology through enterprise channels and ecosystems. For instance, the German and Dutch manufacturing industries are actively planning 5G networks and creating their own supply chains to support that. They could be encouraged to buy local technology with tax credits or other incentives.
- Some countries, such as India, are adopting rules to try to force operators and other industries to buy local technology. Mandates would be unwelcomed in Europe, but in some areas where the region does have leading edge technology, there may be financial or other incentives to be considered, to encourage large buyers to choose local partners.
- As in the semiconductor sector, it is important for a strong hardware ecosystem to have manufacturing and assembly capacity that is secure and local. This reduces cost and improves technical self-sufficiency for the region. Policymakers should consider ways to fund local contract manufacturers such as Philtronics to be able to support large-scale requirements and to focus on Open RAN.
- Some European companies such as Picocom and Accelleran are leading development of Open RAN small cells that support O-RAN and Small Cell Forum interfaces. Policymakers should support such efforts in order to secure differentiation in the small cell and private network platforms, especially to address the demand for a choice of interfaces between radio unit and baseband.

RAN Software

- Fund operator-led creation of a European Open RAN software framework and offer incentives for start-ups to develop xNFs (software components for RAN agnostic to hardware). The same approach could be taken specifically for the RIC, with development of a standards-based RIC platform optimised for European needs and with active encouragement of start-ups to develop xApps.
- If traditional vendors fully embrace Open RAN interfaces and develop AI based optimisation, it will unlock a significant global opportunity.
- Facilitate building of Open RAN software ecosystems that extend beyond telecoms e.g. forge ties between industrial Open RAN supporters like Bosch and software developers; provide grants to accelerate some companies' migration of specialised protocol stacks that have strengths in vertical markets, for Open RAN (e.g. SRS in public safety and satellite).

Cloud

- In this early stage of the market, it is possible that a Europe-centric Open RAN cloud platform could be created with active support from operators and governments in the form of testbeds, R&D credits and funding. For instance, key enablers such as Canonical Linux could form the framework for a telco-optimised cloud, and this would encourage far greater levels of development of RAN software by local suppliers.
- Provide incentives for enterprises and industries to use this cloud to support their Open RAN deployments, where they want to use a third-party cloud, rather than the public cloud. It would provide the cross-border capabilities that individual national telco clouds or other providers may not.
- Provide funding for innovators with leading technology in the traditional RAN market to accelerate their migration to cloud platforms.
- Identify gaps in the current cloud platform and ecosystem, when it comes to the specialist performance requirements of RAN, and support start-ups or academic projects that could address those gaps.
- Start considering the likely requirements and use cases of 6G and identify areas in which Europe could establish leadership, then actively fund initiatives, projects and vendors to compete on equal footing with US cloud companies.

Services

- Consider establishing a European certification scheme for Open RAN interoperability and quality, which could build confidence among European ecosystem players and deployers, but also become a globally recognised scheme.
- Facilitate strong links between the telecoms industry and Systems Integrators in vertical markets that are focused on 5G, to build expertise and excellence that can be exported to these verticals elsewhere. International players such as CapGemini, Bosch and Siemens could leverage their global ecosystems to support European Open RAN developments, provided these are optimised for their industry's purposes (compare GE's similar activity with IoT platforms in the 2010s, which received US government funding and heavily favoured local partners).
- Use the global influence of the EU to position Europe as global testing hub for Open RAN and multivendor 5G, which would build new links with government and industry initiatives elsewhere. Use these links to support R&D investments in areas such as security standards and certification, across the whole supply chain (as recommended by the EC 5G Supply Market Trends report August 2021).
- Plan major government and public sector Open RAN projects and prioritise local integrators provided they, in turn, prioritise European suppliers, in order to build confidence and real-world experience.

Development

- Take best practice from funding and technology transfer mechanisms in markets where Open RAN development is progressing quickly such as the USA's National Science Foundation (e.g. Open RAN projects at the Universities of Utah and Michigan funded by the PAWR programme), and DARPA. Note that several European start-ups said their largest funding was coming from the USA, especially DARPA.
- Continue the Enhanced EIC programme (including the EIC Accelerator) and explicitly open it to applications from young, high-risk, R&D-intensive entrepreneurs that focus on 5G-related technologies and business models (as recommended by the EC 5G Supply Market Trends report August 2021)
- Establish more government-funded or public/private testbeds, trials and incubators to accelerate the rate of innovation and enable larger numbers of innovations, such as enhanced R&D on the use of renewable energy sources for supplying network elements and reduction of the environmental footprint of mobile networks (as recommended by the EC 5G Supply Market Trends report August 2021).
- Identify gaps in the current Open RAN platform and ecosystem, and specifically fund and support start-ups or academic projects that could address those gaps such as funding audits for critical open-source technologies and might require specific security-related improvements through public resources (as recommended by the EC 5G Supply Market Trends report August 2021)
- Start considering the likely requirements and use cases of 6G and identify areas in which Europe could establish leadership, then actively fund projects and start-ups in these areas.
- Ultimately, increase opportunities for specialist providers to achieve growth by contributing to common platforms, foster alliances with global partners to increase capacity across multiple locations, encourage EU manufacturing industries that use 4G/5G networks to use the same ecosystem for added scale and facilitate strong links between the telecoms industry and systems integrators in vertical markets that use 4G/5G.

End

Glossary

3GPP	3rd Generation Partnership Project
5G	5th Generation
6G	6th Generation
AI/ML	Artificial Intelligence/Machine Learning
CNF	Cloud native Network Function
cNF	containerized Network Function
CoRe	Competitiveness and Resilience
CP	Control Plane
CPRI	Common Public Radio Interface
CU	Central Unit
DARPA	Defence Advanced Research Projects Agency
DU	Distributed Unit
EIC	European Innovation Council
ETSI	European Telecommunications Standards Institute
EC	European Commission (EC)
GDP	Gross Domestic Product
GPP	General Purpose Processors
GSMA	Global System for Mobile Communications Association
ICT	Information Communication Technology
IPR	Intellectual Property Rights
Massive MIMO	Massive multiple-input multiple-output
MEC	Multi-access Edge Computing
MNO	Mobile Network Operators
NF	Network Function
NIST	National Institute of Standards and Technology
NR	New Radio
NR-RIC	Near Real Time RIC
O-RAN	Open Radio Access Network
ORPC	Open RAN Policy Coalition
PAWR	Platforms for Advanced Wireless Research
PNF	Physical Network Function
RF	Radio Frequency
RAN	Radio Access Network
RIC	RAN Intelligent Controller
RRH	Remote Radio Head
RRU	Remote Radio Unit
RT-RIC	Real-Time Radio Intelligent Controller
SMO	Service Management and Orchestration
TCO	Total Cost of Ownership
UE	User Equipment
VNF	Virtualized Network Function
xAPP	AI/ML based applications for Near Real time RAN Intelligent Controller
xNF	Containerized and virtual network functions