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Future of Electronic Communications Networks in Europe

Fact-Pack

September 2023

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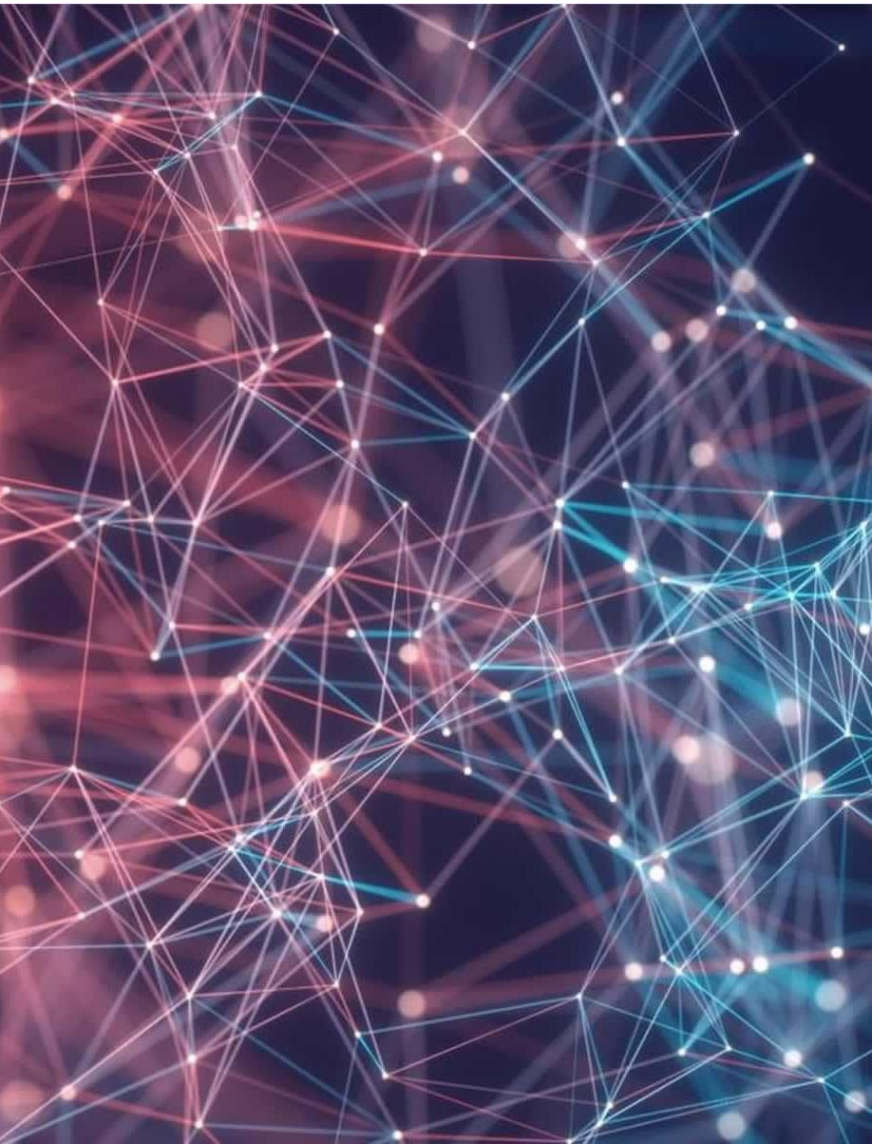


1. INTRODUCTION

The context for this Fact-Pack, its intended purpose and areas covered

Context and Purpose

This Fact-Pack has been commissioned by ETNO and produced by Deloitte. The purpose of this document is to collect analysis and outline considerations of the future of Electronic Communications Networks (ECN) as the telecommunications industry and policymakers consider the future of ECN in Europe.

Areas Covered

The evidence and analysis presented in this document cover:

The high-level context for the industry, including the European Union (EU) strategy context

The potential technologies that may characterize and define the future ECN in the decades to come (a select and non-exhaustive list)

The potential impact of these technologies on the industry and ECN value chain

A policy assessment, including a review of potential policy considerations, that are relevant to the future development of ECN

This Fact-Pack is based on current evidence, analysis and Deloitte sector expertise. It provides high-level analysis on factors that can be considered as part of wider strategic and policy decision-making and does not provide an opinion for or against particular policies or technology choices. It also includes an assessment of potential investment requirements for individual technologies where third-party data or research is available.

This analysis is forward-looking, and so there is inherent uncertainty in presenting these findings.

2. TOWARDS A DIGITALIZED WORLD

This section covers the identification of the EU goals for digital development and the strategic importance of ECN

To reach a more digitalized Europe, ECN is central to accomplishing this goal. Assessing its importance, understanding its pressures and analyzing the main trends are critical for a more connected EU. This analysis comprises:

IDENTIFICATION OF THE EU GOALS FOR DIGITAL DEVELOPMENT

ANALYSIS OF THE IMPORTANCE OF THE ECN

ASSESSMENT OF THE EUROPEAN TELCOS' PRESSURES

ECN VISION FOR THE NEXT DECADE

The European Commission (EC) has set ambitious goals for EU digital development, covering multiple technological domains to which ECN are central

EU GOALS

The EC has outlined its Digital Decade 2030 strategy to accelerate the digital transformation of the EU and safeguard its competitiveness in the global digital economy by establishing clear targets in the following areas:

- *Digitally skilled population and highly skilled digital professionals*
- *Secure and sustainable digital infrastructures*
- *Digital transformation of businesses*
- *Digitalization of public services*

› Regarding connectivity infrastructure, the EU's goal is for Europe to be the most connected continent by 2030. It aims for **all households and businesses to be covered by a gigabit network**, with at least 5G networks deployed in all populated areas **by 2030,** and for the deployment of **10,000 climate-neutral highly secure edge nodes**

› The digital targets provide the foundation for the EU to develop a **Digital Single Market and strengthen its digital sovereignty**, with a clear focus on data, technology, and infrastructure. Ultimately **increasing its global competitiveness** in the digital sphere and **reducing its dependence on foreign technology providers**

The EU recognizes it must invest in and develop its digital infrastructure to establish itself as a digital leader for the coming decades. This will be the fabric that underpins Europe's digital economy and society

KEY INFRASTRUCTURE DOMAINS

- COVERAGE
- CLOUDIFICATION
- AUTOMATION
- SECURITY

ECN are central to achieving these goals

Sources: European Commission, "Europe's Digital Decade", 2023; European Commission, "Digital targets for 2030", 2022

ECN are key to the EC's ambition for a digital future, acting as platforms for new technologies and driving innovation

ECN AS ENABLERS

- **ECN** are critical **innovation platforms** and **enablers of Europe's digital potential** and **green transition**. The **connectivity they provide** is a precondition to realize the potential for digital transformation and EU institutions recognize that ECN and the telecoms industry are a backbone of the Digital Single Market.
  - New ECN technologies, cloudification and automation of network operations and new business models, such as Network as a Service, **lay the platform for broader technological innovation** for business (e.g., factories of the future, extended-realities applications) and public services (e.g., smart cities, transports, smart grids, emergency services)
  - Several **emerging technologies** reduce operators' dependency on a limited number of equipment vendors, thus potentially **driving competition by leading to new entrants in the telecoms supply chain**
  - ECN are an enabler of the green transition by increasing connectivity and improving efficiency supporting **reducing in other industries' emissions. The broader digitalization this enables is well understood to be an enabling factor of increasing sustainability.**

IMPORTANCE OF ECN AS CRITICAL INFRASTRUCTURE

- Day-to-day, ECN underpin our digitalized economy and lives. It is **vital that they continue to provide reliable and effective connections** as businesses and **services in Europe move online** and become increasingly digital, as well as **during times of emergency** to help societies cope with crises and start to recover
- The **COVID-19 pandemic demonstrated the importance of fast, reliable and secure connectivity** to help adapt to global crises. The pandemic also accelerated the digitalization and automation of service provision in order to meet new demand conditions
- At a security level, European's **Critical Network Infrastructure** is **increasingly suffering from physical attacks and cyber-attacks**, some state-sponsored[1]. As the transfer of data and its importance (e.g., to public services) is increasing, and as bad actors become increasingly sophisticated, **maintaining security and resilience becomes more complex**, and the costs of protecting ECN also rise

To maintain ECN as a foundation for Europe's digital ambition and policy priorities such as security and resilience, **continued investment is required** in infrastructure (e.g., FTTH, 5G SA) and technology that will enable innovation and more efficient operations (e.g., virtualization, open networks, edge cloud)

Sources: European Union "European Electronic Communications Code", 2018; (1) ENISA, "Identifying Emerging Cyber Security Threats And Challenges for 2030", 2023

European telcos are facing significant pressures that are making new infrastructure investments challenging

Profitability pressures

The European telecommunication market faces **high pressures on profitability** by global industry standards[1]:

› Firstly, it is a **high CapEx intensity** industry. The European telcos have **invested €500bn** in fixed and mobile networks in the past 10 years. According to EU commissioners, **Europe needs to invest massively in its telecoms network** to catch up with other regions of the world and **the gap to achieve current connectivity targets is estimated at €174bn**[2,3]

› Secondly, it is a **fragmented and heavily regulated market** compared to other regions, with a **low stagnating average revenue per user (ARPU)**, while the average volume of data by user is increasing

› These pressures result in declining net profit and low return on capital, leading to a relatively low market valuation of European Telco companies

Demand and monetization uncertainties

ECN operators face uncertainty in demand and monetization of new investments, impacting commercial cases for future rollouts and technological upgrades:[4]

› Due to heavy investment in infrastructure European telcos are already able to provide customers with high speed connectivity, sufficient for current use cases (even 8K video). In tandem Deloitte research finds that consumers are prioritizing connection stability over increasing speeds for the time being. Demand is also negatively affected by low digital skills

› This means that monetization for additional investment becomes more uncertain, putting pressure on future rollout.

Value erosion

European Telcos are investing heavily in upgrading their infrastructure. However, **returns on investment are depressed** due to OPEX/CAPEX costs, regulation and high levels of competition[1] as well as competition from players such as hyperscalers (e.g. in B2B connectivity and private networks)

Over-the-top services also continue to increase in volume at the expense of traditional telecom services, capturing value while increasing data volumes across ECN

Sources: (1) ETNO, "The State of Digital Communications 2023"; (2) Reuters, "EU's Breton cites telcos' investment gap for Big Tech network fee push"; (3) EC, "Investment and funding needs for the Digital Decade connectivity targets" ; (4) Deloitte, "Decision time for Telcos"

In face of those challenges, European telcos have started to adapt by decoupling their business, a trend that may continue and mature during the next 10 years and have implications for ECN and EU policy goals

The above-mentioned pressures have already led the telecom industry to transform through the **vertical separation of the value chain** undertaken by some players. This trend may continue during the next 10 years and result in a telecommunication industry **decoupled into three layers:** ServCos, NetCos and InfraCos

Decoupling enables telcos to alleviate some of the pressures they face:

› More financing means through increased market capitalization: investors have been placing 20 to 40% capitalization premiums on the sum of the parts

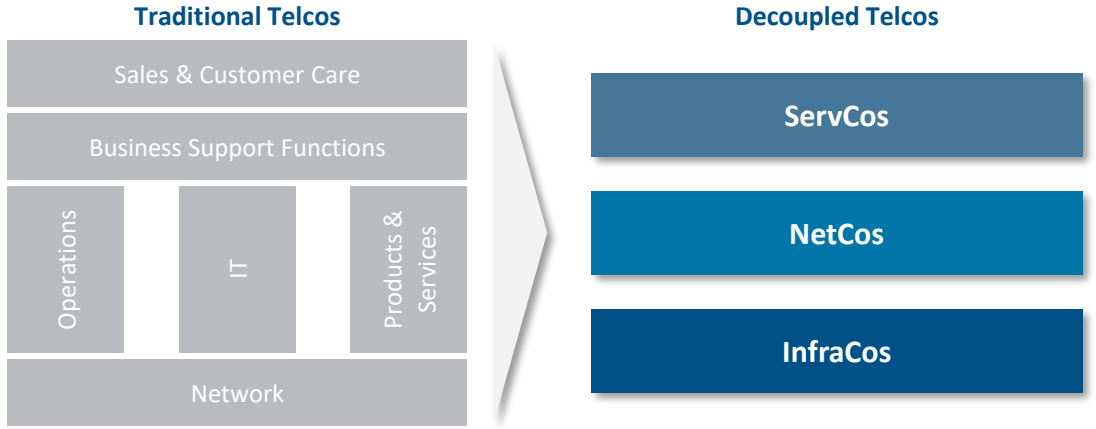
› Less pressures on profit margins through leaner, more efficient business models (e.g., economies of scale, commercial and operational excellence…)

However, decoupling may create additional challenges for the European industry, which may also impact on European digital sovereignty:

› This transformation creates greater opportunity for non-EU players such as **hyperscalers and OTT players to enter the market** and provide broadband services by renting towers, fiber and edge data centers

› In addition, the ECN coordination and orchestration challenges arising from the value chain fragmentation will open the door to **new types of industry players focusing on ECN coordination and orchestration**

Telecommunication's industry evolution



› InfraCos focus on managing and leasing the low-complexity, passive infrastructure (e.g., real estate, towers…), but do not operate the active network components that carry the traffic

› NetCos focus on managing and operating the high-complexity active infrastructure (e.g., active radio-transmission equipment, antennas, fiber, feeders, last-mile connectivity…)

› ServCos have customer facing operations and focus mainly on sales and marketing (e.g., OTT network services, customer-premise equipment, small-cell antennas, last-mile connectivity)

Sources: Deloitte, "The rise of the NetCos", 2021

ECN could be at the center of innovation to ensure European targets are hit. Ultimately, stakeholders must be aligned and investments must be incentivized to deploy emerging technologies

A vision for ECN in the next decades

Secure, sovereign and resilient ECN through **technology and supply chain transformation**

The network layer as a platform for innovation, enabling the implementation of new technologies and Network as a Service, unlocking new sources of revenue

Next-generation of network services widely available**, enabled by efficient** and **flexible networks**

Widespread deployment of digital technology, led by both public and private sector, delivering value to European industry stakeholders and consumers

…and what can be done to support this

- **Policymakers, regulators and industry players can cooperate** on the means to deliver on the European Commission's Digital Decade strategy, including investment support and incentives to address investment gap and development of technologies in key areas (e.g., edge computing, open networks)
- **Regulators, network operators** and **equipment manufacturers** can collaborate on policy, platform and technology **interoperability to unlock scale** at the national and European level, including value chain partnerships. To support this policymakers can pursue the EC's goal of creating a Single Telecoms Market (e.g., through regulatory harmonization and simplification)
- European telcos will require **compelling business cases** to get investors on board, accounting for uncertainty and cost pressures, and secure the **necessary capabilities and skills** to transform and maintain their competitiveness
- Progress on the **broader Digital Decade targets: digital skills**, **digitalization of businesses** and **digital public services,** will be also key to develop the capabilities and demand to support investment in emerging technologies

3. TECHNOLOGICAL DEVELOPMENTS IN ECN

This section covers the identification and selection of key technologies that characterize the future of the ECN

Context and Purpose

In the context of transformation in the sector, there are several technologies that will characterize the future of ECN and that will transform the way in which networks are built, deployed and operated. The purpose of this section is to establish the key technologies that may characterize the future of ECN – based on a set of criteria

The identification of technologies that will shape the future of ECN was determined through a scoring framework based on desk research and expert interviews. This analysis comprises:

DEVELOPMENT OF A SCORING FRAMEWORK TO IDENTIFY THE MOST SIGNIFICANT TECHNOLOGY TRENDS

SELECTION OF THE TECHNOLOGY TRENDS THAT WILL IMPACT MOST THE FUTURE OF THE EUROPEAN ECN

Notes for Readers

The selection method is detailed on the next slide and in the appendix. In addition, the selected technologies are further described in terms of characteristics and drivers in the appendix.

The selection of the technologies resulted in two (current) infrastructure technologies and five (future) enabling technologies. Although it is somewhat arbitrary how many technologies are selected, and notwithstanding overlaps between different types of technologies, this aligns with a recent European Commission consultation that asked respondents to select the five most important technologies for the development of ECN.

A scoring framework based on desk research and expert interviews has been used to identify the most significant technology trends that will influence the future of ECN(1)

DESK RESEARCH + **SUBJECT MATTER EXPERT INTERVIEWS**

READINESS

This assesses the expected operability status and required conditions that must be met to ensure that the technology is successfully deployed[2]

Standard or proprietary	7,5%	How accessible and open the technology may be to the stakeholders, including the presence of standards development *1= Proprietary and non-standardized technology, 5= Non-proprietary and standardized technology*
Global or local	7,5%	Technology that is available globally has higher readiness for adoption, whereas some technology may only be being used or tested in specific locations *1= Locally adopted technology, 5= Globally adopted technology*
Maturity	5%	More mature technologies are more likely to be adopted sooner and so have greater impact on ECN development in the next years *1= Low maturity technology, 5= High maturity technology*

IMPACT ON ECNS TRANSFORMATION AND EFFICIENCY

This considers the enabling potential for innovation and efficiency of networks, as well as the potential impact on market structure

Disruptive to ECN Value Chain	15%	The technology's impact on the vertical separation of the industry's value chain and enabling new entrants *1= Low impact in the decoupling, 5= High impact in the decoupling*
Efficiency enabler	10%	The technology's potential to reduce costs and increasing network efficiency *1= Low impact on network efficiency, 5= High impact on network efficiency*
Innovation enabler	15%	The technology's potential to serve as a platform to drive innovation, by developing new products, services and business models *1= Low impact on innovation, 5= High impact on innovation*

EU OBJECTIVE ENABLEMENT

This assesses the alignment with the EU's Digital Decade goals and policy priorities

Coverage	10%	The technology's potential to increase network coverage and address gaps in underserved or remote areas *1= Low impact on network coverage, 5= High impact on network coverage*
Service quality	5%	The technology's ability to ensure stable and reliable connectivity with minimal interruptions or downtime *1= Low impact on network service quality, 5= High impact on network service quality*
Security	15%	The technology's potential to protect against cyber threats, safeguard sensitive data, and protect critical infrastructure *1= Low impact on network security, 5= High impact on network security*
Digital autonomy	10%	The technology's potential to increase digital sovereignty and reduce dependency on foreign countries *1= Low potential for increasing digital autonomy, 5= High potential for increasing digital autonomy*

→ *detailed analysis in the appendix*

Note: (1) Based on desk research (e.g., ETSI technological standards, Gartner hype cycle..) and SME interviews, each technology trend was given a score of 1 to 5 for each scoring criterion; (2) Readiness is included as technologies trends with higher readiness will be adopted sooner and thus have a greater impact, but the scoring weights are lower as the study focuses on the future.

The scoring framework identified seven technology trends that may be important to the future of European ECN over the next 10-20 years, five are emerging technologies with an additional two existing infrastructure technologies

5G Standalone (SA)

› 5G SA networks boost the deployment of eMBB, mMTC and URLLC(1), effectively creating **faster, more reliable networks** that will serve as **innovation platforms**

› In addition, 5G SA networks will be more **flexible, cost and energy-efficient and secure** through the use of network slicing technologies, virtualization and cloudification technologies

FTTH and FTTx rollout

› Fiber will deliver **faster** and **more consistent internet** speed and latency

› It is also **more secure** (e.g., immune to digital warfare, difficult to wiretap…) and **more energy-efficient and durable** than copper-based networks, creating more sustainable networks

Open RAN

› Open RAN will make ECN more **agile and flexible** by introducing **interoperable hardware, software and interfaces**, thereby enabling hardware and software to be sourced from different vendors

› It is expected to **reduce equipment vendor lock-in** and enable the **decoupling of the telecom value chain**

› However, Open RAN also carries a higher complexity to network management

NFV & SDN

› NFV and SDN will enable ECNs to be more **flexible, cost and energy-efficient and secure** through the use of virtualization and cloudification technologies

› NFV and SDN may also enable progress towards **network automation**, by leveraging AI/ML, as well as Network-as-a-Service (NaaS) through the use of network APIs to enable greater control and optionality of network functions

Edge Computing

› Edge computing enables data processing and analysis to be done **closer to the source of the data**, hence **improving network resilience, efficiency and reducing latency**

› It can also help **reduce dependence on cloud-based services**, usually located outside of the EU, enabling greater resilience through localized processing, improved data privacy, and optimized performance

Quantum Encryption

› Quantum Encryption can **improve network security by providing unbreakable encryption**, reducing the potential for cyber-attacks, in particular in the context of sensitive communications (e.g., military applications)

LEO Sat Connectivity

› LEO Satellite connectivity (e.g., through the IRISS constellation) can help **increase broadband coverage in remote areas**, as well as potentially **increase network stability and resilience** by providing alternative routes for data transmission

› This will require **integration with terrestrial networks** and the potential future creation of a network of networks that allows to combine different types of access technologies

INFRASTRUCTURE TECHNOLOGIES

These technologies are already established as part of European ECN. However, they are expected to continue to define ECN and grow.

ENABLING TECHNOLOGIES

These technologies will enable wider technological transformation in ECN and more broadly in the EU economy and society.

Notes: (1) stands for enhanced mobile broadband, massive machine-type communication and ultra reliable, low latency communications

4. VALUE CHAIN IMPACT ASSESSMENT

This section covers a high-level impact analysis of the potential ECN technologies on the ECN value chain

Context and Purpose

The potential transformation of the ECN and the introduction of new technologies may have broader impacts on the value chain that counteract or reinforce existing trends. This section first considers the impact on categories of players in the value chain and then focusses on European telcos, considering how emerging technologies impact their competitive position via a SWOT analysis, investment pressures and potential growth areas.

ANALYSIS OF IMPACT ON VALUE CHAIN PLAYERS

HIGH-LEVEL SWOT ANALYSIS OF THE EUROPEAN TELCOS

EUROPEAN TELCOS INVESTMENT NEEDS

EUROPEAN TELCOS POTENTIAL GROWTH AREAS

The transformation in the telecommunication industry will impact various legacy stakeholders within the value chain and present an array of opportunities and challenges to new and existing key actors

EQUIPMENT & SOFTWARE VENDORS

L M **H**

These stakeholders **supply the necessary hardware** (e.g., routers, switches, antennas…) **and software systems** (e.g., network management) that are used to build and operate telecommunication networks

INFRACOS

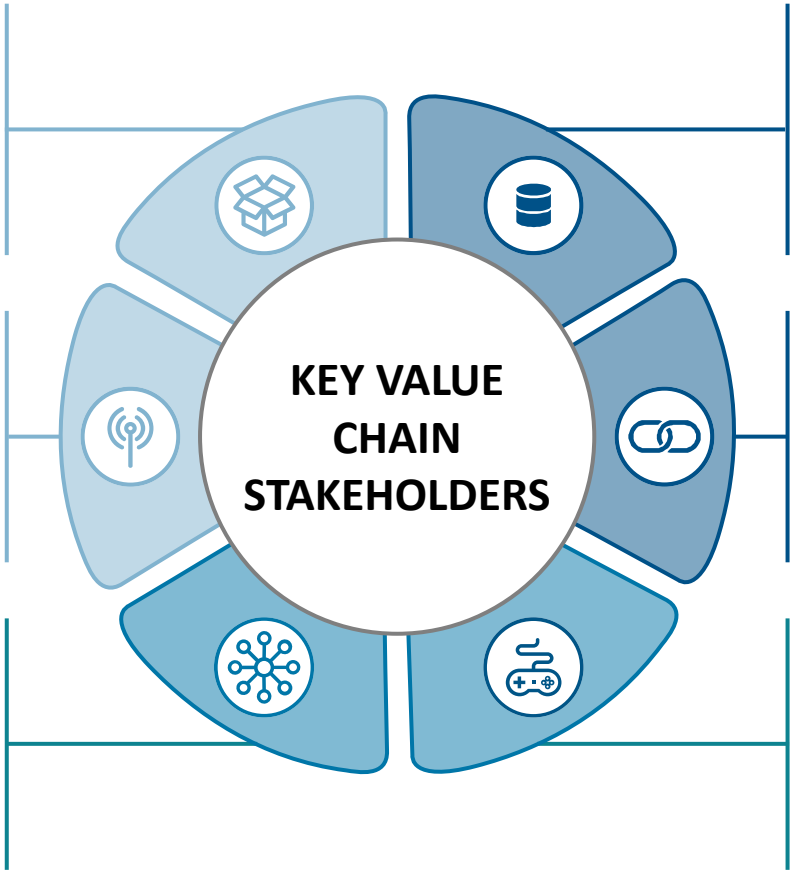
L **M** H

These stakeholders focus on **managing and leasing** the low-complexity, **passive infrastructure** (e.g., real estate rights, physical towers, masts, poles, mounting equipment, surveillance). In the strict sense of the term, they **do not manage and operate the active network components** that carry the traffic

NETCOS & INTEGRATED SERVICE PROVIDERS

L M **H**

These stakeholders focus on **managing and operating** the high-complexity, **active infrastructure part of the network** (e.g., active radio-transmission equipment, antennas and cables, last-mile connectivity, network orchestration…). For the purpose of the analysis that follows this category includes integrated service providers such as the traditional telco players



HYPERSCALERS

L **M** H

Hyperscalers refer to **large scale cloud computing and storage services companies**. As networks become cloudified and edge computing proliferates, these companies are becoming key players and partners in the transformation of ECN, as well as competitors. They also offer services such as **AI, machine learning and big data analytics.**

SYSTEM INTEGRATORS

L M **H**

These stakeholders specialize in **bringing different network components and subsystems into a single, cohesive IT infrastructure**. They can be responsible for ensuring that the intricate IT ecosystem works seamlessly and that technology solutions and services from different vendors can be integrated and deployed effectively, if organizations such as telcos choose to out-source these functions.

SERVCOS & OTT

L **M** H

ServCos refer to **decoupled operators with customer facing operations**, **focusing mainly on sales and marketing** (e.g., OTT network services, customer-premise equipment, small-cell antennas, last-mile connectivity). **OTT providers**, who offer digital services to consumers over the internet (messaging, VoIP, TVoIP…), are **considered as ServCos**

Key: L Low impact M Medium impact H High impact

The transformation in the telecommunication industry will impact various legacy stakeholders within the value chain and present an array of opportunities and challenges to new and existing key actors

EQUIPMENT & SOFTWARE PROVIDERS

L M **H**

- With the transformation of ECN and decoupling of some traditional telcos, both equipment and software infrastructure need to **undergo significant investments**, which represents a **substantial market** for equipment and software vendors
- This creates opportunity for both established and emerging vendors, potentially resulting in increased levels of competition and innovation
- An increase in competitive pressure may occur among equipment and software providers as open networks technologies such as Open RAN are expected to **break vendor lock-in**. Thereby, the **established players may capture less value** as new competitors emerge
- As investment in ECN equipment and software increases, and vendor lock-in reduces, a door will open to niche, specialized players who can potentially **foster innovation** and bring new perspectives to the industry

INFRACOS

L **M** H

- **Passive network infrastructure** is expected to be further spun off from classic, integrated telecom operators and fall **under the umbrella of few InfraCos**, creating an attractive opportunity for infrastructure investors, that will be able to generate value through **significant economies of scale**
- Despite the fact that passive infrastructure is less critical than active parts of the network, **issues around the sovereignty of European ECN could arise** if foreign infrastructure investors would effectively hold control over infrastructure access.
- The increasing complexity in active infrastructure could also represent an opportunity for InfraCos to **offer managed services to NetCos**, although these activities could lead to additional risks and complexities for InfraCos

NETCOS & INTEGRATED SERVICE PROVIDERS

L M **H**

- With ECN becoming increasingly virtualized, NetCos can offer network-as-a-service (NaaS) as a provision model for connectivity, enabling businesses to **outsource the management and operation of their network infrastructure to NetCos**
- Open networks will potentially offer NetCos a **larger sample of equipment and software providers**, enabling them to **pick and choose the most optimal network components**, at lower prices
- However, virtualization and cloudification have opened the market to new players, including hyperscalers, which may lead to **competition for skills** in areas such as Cloud engineers, IT architects (incl. cybersecurity experts), developers… and broader systems integration capabilities
- In addition, there is also the risk that these new players will become increasingly active in network service provision, representing a **shift in market power**

The transformation in the telecommunication industry will impact various legacy stakeholders within the value chain and present an array of opportunities and challenges to new and existing key actors

HYPERSCALERS

L M H

- With **cloud technology** becoming a **central element of networks transformation**, hyperscalers will be in a prime position to establish themselves as **key industry stakeholders** by leveraging their leading cloud offerings and strong capabilities in the area
- However, as networks become virtualized and cloudified, hyperscalers might find themselves increasingly **competing with NetCos for talent** such as cloud engineers, IT architects (incl. cybersecurity experts) developers
- Hyperscalers are **already entering the telco value chain** (e.g. in B2B connectivity, private networks, etc.) and might also **explore expanding in the ServCo market segment**, as the telecommunication value chain decouples, leveraging their strong brands, marketing and digital capabilities to deliver potentially superior customer experiences

SYSTEM INTEGRATORS

L M H

- As networks become more open and the telecommunication value chain decouples, European ECN will become increasingly fragmented. This will **create integration and orchestration challenges**, which traditional telecom operators are not yet equipped to face. While telecom operators might want to develop capabilities in the area, this challenge will open the door to **new players specialized in system integration**
- System integrators will **play a complex, central role** in the ECN of tomorrow, **capturing a significant share of value** from the value chain

SERVCOS (INCL.. OTT)

L M H

- The telecom industry value chain decoupling will most likely **open the door to new players specialized in marketing and customer service**, **increasing the competitiveness** in the ServCo market segment
- Building on their customer excellence capabilities and leveraging enhanced network services enabled by new technologies, specialized ServCos are expected to expand the **types of services offered** (e.g., application-specific connectivity plans, IoT offerings…), **their quality** and create **better customer satisfaction**
- By focusing on customer excellence, ServCos may start to expand into **adjacent segment** and explore **business models beyond connectivity**, mainly in the **B2B space**

This high level SWOT analysis cover European telecom operators' strengths, weaknesses, opportunities and threats

STRENGTHS

Established infrastructure

› Existing players own and maintain **large networks of communication infrastructure** (towers, fiber optic cables…), which to replicate would require significant investments for new entrants.

Licensed spectrum

› Telecom operators hold **licenses to a substantial amount of spectrum**, which are limited. Obtaining licenses is highly competitive and expensive, and enable holders to provide retail and wholesale services

Market reputation

› Established telecom operators have built **strong brand recognition** over time, leveraging their experience and expertise to be recognized as **trusted and secure players** in the provision of communication services

Traditional skills

› The workforce of established telecom operators has **strong capabilities in key skills such as network engineering**. It is therefore more challenging for new entrants to secure the necessary talent when entering the market

WEAKNESSES

Low profit margins

› Telecom operators' services are becoming **increasingly commoditized**, with consumers finding it increasingly difficult to differentiate between them

› Due to intense competitive pressures and the perception of connectivity services as a commodity by the European consumers, **European telecom operators have a lower ARPU** when compared to other markets (some with lower numbers of competitors). Besides, operators rely on **heavy discounting to attract new customers and limit churn**, resulting in price wars

› CAPEX requirements to maintain and upgrade ECN to meet targets on coverage creates **financial pressure** on telecom operators due to **significant capital investment requirements** in infrastructure and new technologies

› As a result of the above-mentioned competitive pressures, commoditized services and high CAPEX intensity, telecom operators has put pressure on **profit margins**

Evolving customer needs

› Customer satisfaction may be a key challenge for some traditional telecom operators as **customer expectations for service have been increasing** significantly in recent years and competition with OTT providers partially based around customer service

B2C market focus

› With a historical focus on the B2C market as a driver of growth, telecom operators may require an increase in enterprise partnerships and culture shift **to address the B2B market** with value-oriented solutions

This high level SWOT analysis cover European telecom operators' strengths, weaknesses, opportunities and threats.

OPPORTUNITIES

More efficient networks

› By leveraging network **cloudification, virtualization and 5G enabled network slicing**, networks can be made **more efficient and flexible** to market conditions, supporting cost reduction. This approach can help telecoms operators reduce costs and improve the network performance

AI and data analytics

› Operators can leverage AI and data analytics to **improve network management**, **enhance customer experience**, and potentially optimize **their CAPEX expenditures**

Improvement in service quality

› Building on network **cloudification, virtualization and connectivity improvement technologies** (5G SA, FTTH…), telecom operators will be able to offer **higher performance and resilient ECN**, as well as **additional on-demand and integrated services** (e.g., network slicing, NaaS and API integration)

Potential demand for high bandwidth, low latency services

› Demand for high-speed connectivity services with high bandwidth and low latency is still uncertain considering current consumption habits and preferences

› With the potential **growth of B2B market services, such as Industry 4.0, IoT and Smart Cities**, telecom operators can become key stakeholders and partners within those ecosystems, ultimately capturing a large share of the value created by those advanced infrastructure

Partnerships

› The transformation of ECN and diverse capabilities that emerging players bring create **opportunities for new partnerships**. For example, cloudification and expansion of edge computing is already the basis of partnerships between operators and hyperscalers

THREATS

Emergence of new players

› **Eroding industry boundaries, new entrants and new types of players** (OTT providers, system integrators) increase competitive pressures on operators

Evolving capabilities

› As new technologies and data analytics are being employed to run ECN, operators will need to **restructure their workforce to acquire the required skills**, which are scarce in Europe. This is exacerbated by competition with potential new entrants and adjacent industries for this limited pool of skilled workers

Cybersecurity threats

› ECNs are under **pressure from rising cybersecurity threats**, increased criticality of ECN and a context of rising geopolitical tensions

Demand and monetization uncertainty

› Telecom operators face demand and monetization uncertainty in terms of the future preferences for higher bandwidth. This can potentially **impact operators' ability to monetize new investments**

Limited scale

› In comparison to other markets (e.g. North America and Asia), European operators have **lower user bases, lower scale economies and higher competitive pressures**, compounded by a more fragmented markets and strict regulation

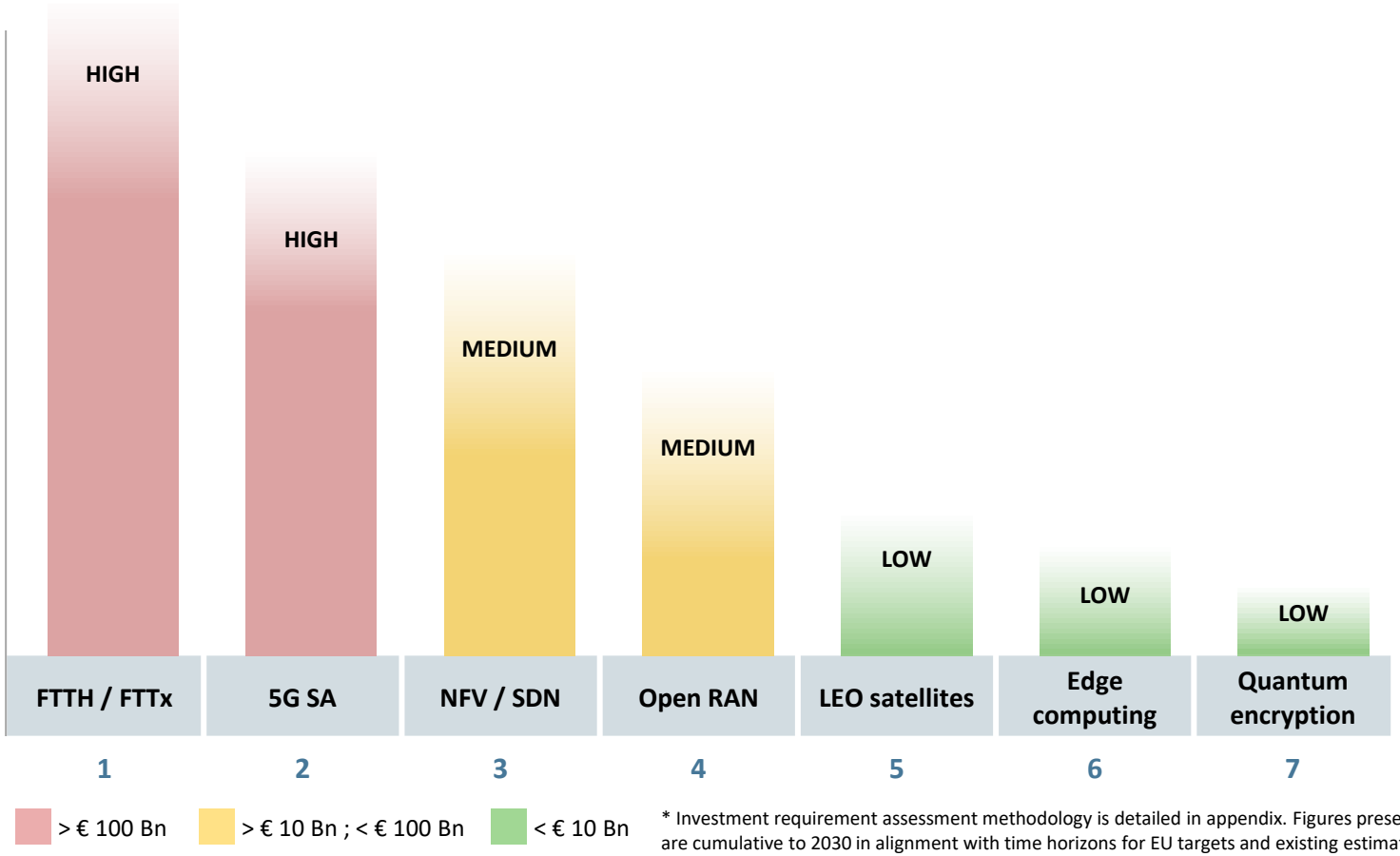
Economic conditions

› High inflation in cost drivers such as energy, labor, and materials like fiber, may increase pressures on operators **profit margins**

Two out of the seven highlighted technology trends may require investment levels of approximately € 100 Bn or above from European telecom operators until 2030

High-level assessment of investment requirements for European telecom operators, per technology trends (2023-2030)*

Scales are illustrative only and are not indicative of actual point estimates



* Investment requirement assessment methodology is detailed in appendix. Figures presented are cumulative to 2030 in alignment with time horizons for EU targets and existing estimates of investment requirements and market size.

Key takeaways

- **Investment requirements in upcoming technology** trends will be high and represent a significant **financial challenge** for European telecom operators
- **Infrastructure technology** (FTTH / FTTx and 5G SA) will represent the **most significant technology investment area** until 2030 for European telecom operators, with investments levels beyond €100 Bn for each
- **NFV / SDN and Open RAN** may require the most investment among *enabling technologies*, with investment levels between € 10 to € 100 Bn for each. LEO satellites, edge computing and quantum encryption will represent smaller investment requirement, in comparison

With the prospect of significant investment requirements in the next 10 years and limited revenue growth opportunities in consumer markets, operators could consider higher growth B2B opportunities as sources of future value

With significant investments foreseen in infrastructure and technology development in the next 10 years, and with flat revenue grow caused by saturated B2C markets[1] and market fragmentation, telecommunication operators are challenged to demonstrate a **strong business case for investors**, pointing at positive return on investments. However, the ECN technologies identified in this fact-pack (e.g., 5G SA, NFV / SDN…) also present **opportunities for revenue growth in the B2B segment,** supported by existing capabilities and their strong trusted brands to generate synergies with existing business activities.

Revenue growth area	Major underlying technologies	Description
Network-as-a-Services (NaaS)	• 5G SA • NFV / SDN • NaaS Edge cloud	With the progress in cloud computing technology, and with the increasing difficulty for a business to deploy its own network, NaaS represents a significant opportunity for telecom operators, and especially NetCos, to capture new revenue sources **by lending their expertise and resources in network management to businesses willing to deploy agile, state of the art networks**. The global NaaS market is expected to grow at a **33.2% CAGR** until 2030[2].
Internet of Things (IoT)	• FTTH / FTTx • 5G SA • NFV / SDN • Edge computing	With a growth forecast of **26.1% CAGR** in the global IoT market until 2030[3] and in light of obvious synergies with their core business activities, there is an opportunity for telecom operators, and especially ServCos, to **expand into the IoT market** (e.g., asset monitoring services, data analytics, PaaS/SaaS solutions...)
Professional IT (managed) services provider	• NFV / SDN	With the global IT professional services market expected to grow at a **9.1% CAGR** until 2030[4], there is an opportunity for telecom operators, and ServCos in particular, to **further tap into this growing B2B segment** by leveraging their existing capabilities and trusted brands to deliver professional services (e.g., Cloud services, cybersecurity services, managed services…)

Sources: (1) Deloitte, The rise of the NetCos; and Deloitte, Decision time for Europe's telcos (2) Straits Research, Network-as-a-Service market report; (3) Fortune Business Insights, Internet of things market report; (4) Grandviewresearch, IT professional services market report

The key takeaways from the value chain analysis demonstrate the dynamic and challenging environment in which European telcos are operating and developing ECN

The whole value chain is undergoing transformation, driven by, and reinforcing technological advancements

- Transformation of the value chain opens up new opportunities for players such as hyperscalers and systems integrators
- Traditional value chain players, in particular telcos and equipment vendors, will be highly impacted by transformation of the value chain, having to adapt their business models and contend with competition from, and potential partnerships with, emerging players, in order to deliver technological development of ECN

European telcos face a challenging environment in which to support development of ECN

- For European telcos, while retaining traditional strengths they face increasingly challenging circumstances manifesting in pressures on profitability while having to contend with evolving capability requirements, uncertainty and cybersecurity threats, amongst others to support ECN development

The technologies that will characterize ECN development present a large investment challenge but also create opportunities for telcos

- The ECN technologies highlighted in this fact-pack will place substantial investment requirements on the value chain, particularly telcos
- However, these new technologies also create greater growth opportunities for telcos in the form of B2B services, supported by expanded network functionality

5. EU POLICY ASSESSMENT

This section looks at how EU policy and the emerging technologies impact one-another in the context of key EU policy goals and policy considerations based on international benchmarking

Context and Purpose

The transformation of the ECN is taking place in a landscape heavily impacted by EU policy and is of key focus to EU strategic development. This section sets out the policy context and key EU goals, then considers how the emerging technologies identified support these goals using an impact assessment. Then the results of a benchmarking exercise are set out to provide examples of policies being employed in other countries to meet ECN-related goals.

EU AMBITIONS SUPPORTED BY NETWORKS OF THE FUTURE

IMPACT OF TECHNOLOGIES ON EU AMBITIONS

BENCHMARKING

POLICY EXAMPLES

The EU is taking an active role in shaping the development of ECN and broader digitalization, common themes across relevant policy can be summarized as: autonomy and resilience, sovereignty and competitiveness and sustainability

EU policy examples (not exhaustive)

Digital Decade policy program[1]

The Digital Decade policy program 2030 is a strategic vision for Europe's digital economy, which sets objectives and targets in four key areas: digital skills, infrastructure including connectivity and edge computing, the digitalization of businesses, and online public services.

The future of the telecom sector[2]

The EC has launched a consultation exploring the future of telecoms, focusing on the necessary infrastructure and associated investment needs. The consultation also includes exploration of how to build a Single Telecoms Market.

NextGeneration EU[3]

The NextGeneration EU economic recovery package is intended to fund EU member recovery from the COVID-19 pandemic. The core is the Recovery and Resilience Facility (RRF), which is being used to fund Member States' initiatives to build a greener, more digital and more resilient Europe.

Gigabit Infrastructure Act[4]

The Gigabit Infrastructure Act (GIA) is proposed legislation with the aim to support faster deployment of gigabit-capable connectivity infrastructure. The legislation would support measures to reduce costs in the areas of infrastructure access, permits, in-building etc.

Digital Markets/ Services Acts[5]

The Digital Markets and Services Acts (DMA and DSA) are EU regulations that aim to make the digital economy more competitive and protect users of digital services. The DMA sets out rules for how large online platforms can operate while the DSA aims to ensure transparency, user safety and accountability for online platforms.

Digital Industrial policy[6]

The EU is pursuing several policies to develop digital industry to support broader digitalization, EU sovereignty and competitiveness. This includes semiconductors and cloud (including edge computing).

Key Goals: Common themes

1. Enabling autonomous and resilient networks

The ECN that form the backbone of the EU's digital transformation must be secure, not subject to non-EU influence and mitigate risks to ECN services and development.

2. Secure digital sovereignty and industry competitiveness

ECN development must ensure EU digital development is sovereign and enables EU digital and industrial competitiveness.

3. Focus on sustainable networks

ECN development supports the twin digital and green transitions, while becoming more sustainable itself.

In this context, this is intended to inform the current debate on how the EU best supports the European connectivity sector

Sources: (1) European Commission, Europe's Digital Decade: digital targets for 2030; (2) European Commission, Setting the grounds for the transformation of the connectivity sector in the EU; (3) Deloitte, NextGenerationEU funding and the future of Europe; (4) European Commission, Commission presents new initiatives with Gigabit Infrastructure Act Proposal; (5) Deloitte, The DSA and the DMA are here; (6) CERRE, Digital Industrial Policy for Europe

This policy assessment is comprised of characterizing EU ambition, assessing how each technology will impact that ambition, benchmarking with what other countries are doing and what are potential policies for the EU to consider

How can the EU meet its ambitions for future digital development, supported by ECN?

1. What are the EU ambitions supported by the Networks of the Future?

A. Enabling autonomous and resilient networks

B. Secure digital sovereignty and industry competitiveness

C. Focus on sustainable networks

What are the **key goals** to secure each EU ambition?

2. How each of selected technologies impact those ambitions and promote its reachability?

	A. Autonomy and Resilience	B. Sovereignty & Competitiveness	C. Sustainability
	List of variables that translate the ambition		
5G Core			
FTTH/FFTx			
Open RAN			
NFV/SDN			
Edge Computing			
Quantum Encryption			
LEO Sat			

What is the **impact of each technology on the key goals**? *(Based on Subject Matter Experts' insights)*

3. How other countries are meeting those ambitions?

What are the **key policies adopted by other countries**?

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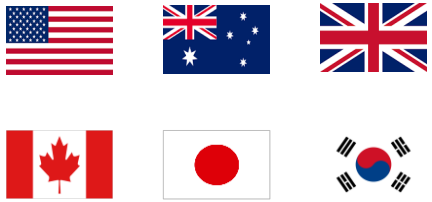


4. What are the potential policies for the EU to adopt in order to meet those ambitions?

What are the **current EU policies**?

A. Enabling autonomous and resilient networks

B. Secure digital sovereignty and industry competitiveness

C. Focus on sustainable networks

What are **potential policies and barriers**, as well as **how do they impact EU ambitions**?

5.1 EU AMBITIONS SUPPORTED BY NETWORKS OF THE FUTURE

The EU policy ambitions lay mostly on enabling autonomous and resilient networks that secure digital sovereignty and industry competitiveness, as well as, in parallel, acknowledge the importance of sustainability

EU policy ambitions	*Key ECN goals*			
Enabling autonomous and resilient networks	Increase availability, resilience and redundancy	Assurance of industry's standards	Guarantee that security measures are in place	Supply chain resilience
Secure digital sovereignty and industry competitiveness	Connectivity for all	Migration to high-speed networks	Increase the EU's digital competitiveness and capacity for innovation	Digitalization of the economy by enabling new services
Focus on sustainable networks	Usage of less and greener energy in network related assets	Reduction of the carbon footprint emissions across the entire value chain	Increase the adoption of circular economy principles	Leverage networks to promote and enable more sustainable use cases and services in other industries

Note: The EU' key goals were primary identified by desk research (e.g., EU documents..) and SME interviews

The EU must guarantee uninterrupted bandwidth coverage and continuously promote the adoption of standards to ensure network interoperability, ultimately boosting European's network resilience

Enabling autonomous and resilient networks

Secure digital sovereignty and industry competitiveness

Focus on sustainable networks

Increase availability, resilience and redundancy

- The European Gigabit Society sets the EU's ambitious connectivity objectives for 2025. **Uninterrupted 5G coverage should be available in all urban areas** and all primary terrestrial transport paths to connect people and objects (1)
- Indeed, in order to reinforce the **EU's strategic autonomy and guarantee continuous availability and minimal downtime** despite disruptions or failures, network operators must employ redundancy strategies, traffic management mechanisms, and rapid fault detection and recovery measures

Assurance of industry's standards

- The European Electronic Communications Code (EECC) (2) states that standardization should remain primarily market-driven. However, there may still be situations where **compliance with specified standards at the EU level is required to improve interoperability** and freedom of choice for users and encourage interconnectivity in the internal market. By establishing and standing by industry-accepted standards, the EU aims to promote a common framework that enables the development and deployment of autonomous and resilient networks
- Therefore, the **EU encourages the development and adoption of European standards or specifications** for the provision of services, technical interfaces or network functions to the extent of ensuring the interoperability of services, end-to-end connectivity, facilitation of provider switching and portability of numbers and identifiers, and to improve freedom of choice for users, ultimately, aiming to meet consumers' needs, boosting technological development, as well as stimulate the competitiveness of the European industry
- Indeed, standards can be drawn up by European standardization organizations, such as the European Committee for Standardization (CEN) and European Telecommunications Standards Institute (ETSI)

Sources: (1) EU's Gigabit Society (2) European Electronic Communications Code

In order to promote the EU's network strategic autonomy, European operators are encouraged to consider their supply chain resilience while guaranteeing the implementation of security measures throughout the operations

Enabling autonomous and resilient networks

Secure digital sovereignty and industry competitiveness

Focus on sustainable networks

Guarantee that security measures are in place

- The EU's Digital Decade targets are measurable goals for various areas, stressing the importance of secure and sustainable digital infrastructures, as well as the safety and security of the digital environment (1). Particular emphasis is placed on secure (and sustainable) cloud and edge computing
- Technical guidance is issued to national regulators by ENISA, however beyond this the EU network security landscape is fragmented (e.g., in terms of 5G security, supply chain, etc.).
- The EU stresses the importance of developing and implementing **robust cybersecurity measures to protect its ECN** against any potential threats and vulnerabilities, addressing any concerns related to data security and data sovereignty by **promoting secure data storage solutions within the EU** and guaranteeing the protection of personal and sensitive data

Supply chain resilience

- The European Commission seeks a more significant role in protecting the EU's critical infrastructure given the increase in geopolitical tensions globally and potential threats. It becomes essential to establish clear **guidelines to identify and mitigate risks associated with the ECN supply chain** ensuring the resilience and security of telecommunication networks
- The EU coordinated risk assessment of the cybersecurity of 5G networks report (3) has **identified several factors to assess a vendor's risk profile**, such as the vendor's **capability to guarantee supply**, the **overall quality of its products** and followed **cybersecurity practices**, including the degree of control over its own supply chain, as well as the **likelihood that the supplier is subject to interference from a non-EU country**
- In addition, EU digital industry policy aims at creating a more sovereign digital supply chain by developing EU capabilities in key areas such as cloud (including edge nodes) and semiconductors

Sources: (1) EU's Digital Decade (2) EECC (3) NIS Cooperation Group, "EU coordinated risk assessment of the cybersecurity of 5G networks report"

The EU aims to secure its digital sovereignty, guaranteeing high-speed broadband connectivity for all Europeans, including rural areas, as well as strengthening the control of the digital infrastructure within the EU

Enabling autonomous and resilient networks

Secure digital sovereignty and industry competitiveness

Focus on sustainable networks

Connectivity for all

- The EU's Digital Decade stresses the connectivity importance. Indeed, the EU aims for Europe to be the most connected continent by 2030 (1), with **very high capacity network access for all citizens, connecting all main socio-economic drivers** such as schools, universities, research centers, transport hubs, hospitals, public administrations, and enterprises relying on digital technologies.
- Particularly, to end the digital divide in rural and remote areas, the EC published a Communication on the long-term vision for rural areas, developing a Rural Pact and EU Rural Action Plan with tools that will help achieve the Commission's plan to make **Europe's rural and remote communities better connected by 2040** (2). Indeed, connectivity has been identified as critical for revitalizing local communities, and telecom operators are the main driver in deploying and upgrading broadband networks
- Nevertheless, the commercial investment of operators initially focuses on the more profitable areas where the return on investment is quicker. In contrast, in certain areas, particularly rural and remote zones, public financial support may be required to ensure gigabit network access to all citizens. Therefore, the **EU financially supports Member States and private investors (3) to bridge the connectivity divide in rural and remote geographies**
- For example, the EU **promotes digital inclusion** through the WiFi4EU Programme (3), with a budget of €130 million, municipalities are granted a voucher of €15,000 to install free access to Wi-Fi hotspots in local communities throughout Europe. Additionally, the EU has also taken action in various areas to improve connectivity for its citizens such as ending roaming charges (4)

Migration to very high capacity networks

- The **GIA and Digital Decade focuses on the ambitious goal of widespread fiber roll-out across Europe** (3), encouraging investment in fiber infrastructure by creating an attractive investment environment and facilitating access to public and private funding sources

Sources: (1) EU's Digital Decade (2) EU's Rural Vision (3) EU's Gigabit Society (4) EC "End of roaming charges for all travelers in the European Union: How will it work?" (5) EECC

To boost fair industry competitiveness, the EU has fostered public incentives for investment in new, very high-capacity networks, particularly in the migration from legacy infrastructure to next-generation networks of high-speed fiber-based

Enabling autonomous and resilient networks

Secure digital sovereignty and industry competitiveness

Focus on sustainable networks

Increase the EU's digital competitiveness and capacity for innovation

- The digital decade targets set out key transformations in digitalization encompassing infrastructure, businesses, skills and public services, all of which are important for the EU's digital competitiveness
- In supporting this, the GIA aims to make rollout of high speed networks more cost efficient
- In addition, EU Industrial policy, particularly related to cloud and digital supply chains (i.e. semiconductors) is intended to make European ECN and digital industry more competitive and resilient. This is captured in the Strategic Technologies for Europe Platform, Important Projects of Common European Interest related to cloud infrastructure services and alliances focusing on industrial data, edge and cloud, as well for processors and semiconductor technologies

Digitalization of the economy by enabling new services

- Europe's Digital Decade sets ambitious digital targets for 2030 (3) to reach the digitalization of the economy, namely the **digitalization of public services**, the **digital and cloud transformation of businesses**, as well as attaining a **digitally skilled population**
- Indeed, the EU aims to accelerate the digitalization of **public services** across Europe, making them more **accessible, efficient, and citizen-centric by leveraging digital technologies** and hence creating new services
- Additionally, the **digital transformation of businesses** in Europe involves promoting the **adoption of digital technologies and innovative practices** across industries. The aim is to enable businesses to leverage technology trends, for instance, softwarization and cloudification, ultimately embracing digital transformation, allowing them to innovate, expand their reach, and adapt to evolving market demands
- Nevertheless, having a digitally skilled population is crucial to reach such goals. Hence, the EU has set the target to have 80% of the people with basic digital skills by 2030 and has created initiatives to improve **digital education and upskilling opportunities for its citizens**. For instance, it has funded **online training courses to improve the population's digital skills** under the NextGenerationEU program, aiming to equip them with the necessary digital skills to leverage the potential of technology for societal and economic growth (4)

Sources: (1) European Electronic Communications Code (2) EU's Gigabit Society (3) EU's Digital Decade (4) NextGenerationEU

The rapid growth of data traffic and emerging technologies has increased the urgency to operate more sustainable networks as well as leverage all their potential

Enabling autonomous and resilient networks

Secure digital sovereignty and industry competitiveness

Focus on sustainable networks

Usage of less and greener energy in network related assets

› Several studies predict that ICT energy consumption and emissions will increase if not curbed, and the volume of data traffic highly impacts ICT energy consumption and consequent emissions (1). The European Commission, in the Green Deal, announced to consider measures "to improve the energy efficiency and circular economy performance of the sector itself, from broadband networks to data centers and ICT devices" and toward "more transparency on the environmental impact of electronic communication services." (2). **Adopting energy-efficient practices and optimizing network infrastructure to reduce energy consumption have intrinsic limits**, given the rapid growth of data traffic and emerging technologies (e.g., blockchain, IoT, metaverse) that may further impact ECN's energy consumption (2). Indeed, some network technologies such as FTTH and FTTx and 5G enable greater efficiency of networks

› Additionally, **renewable energy sources**, such as solar and wind power, **is also stressed as required** for powering telecommunication infrastructure, data centers, and network operations. These measures may help curb ICT emissions as energy requirements for data traffic increase

Reduction of the carbon footprint emissions across the entire value chain

› To comply with the EU's climate targets, industries must act to prevent increased GHG emissions. Considering the **high pace of the annual rise in digital consumption** (i.e., data volume, number of devices), the **EU stressed the need to track the trajectory of emissions closely for the entire value chain**, for instance, on their suppliers' emissions (2), hence stressing the importance of each direct company emissions, as well as the indirect emissions along its supply chain.

Increase the adoption of circular economy principles

› The EU has expressed its goal of continuously **transitioning to a circular economy model in the telecommunication sector** (2). The principles of a circular economy run along the entire value chain from the design of sustainable products and services to the reuse, recycling and proper disposal of electronic waste (e-waste), as well as in the extension of digital products' lifespan.

Leverage networks to promote and enable more sustainable use cases and services in other industries

› The telecommunications industry is a **substantial enabler of the transition to the EU Green Deal**, regarding the focus laid on **energy-efficient** and **high-speed network infrastructure**, as well as in the **growth of digitalization** (3). Indeed, digitization is expected to disrupt all parts of the economy over the next decade, having the potential to be a key driver of low-carbon development by reducing the physical infrastructure and increasing energy efficiency, for instance, on data center operation

Sources: (1) Madlener et al, 2022 (2) BEREC Report on Sustainability (3) The Enablement Effect The impact of mobile communications technologies on carbon emission reductions

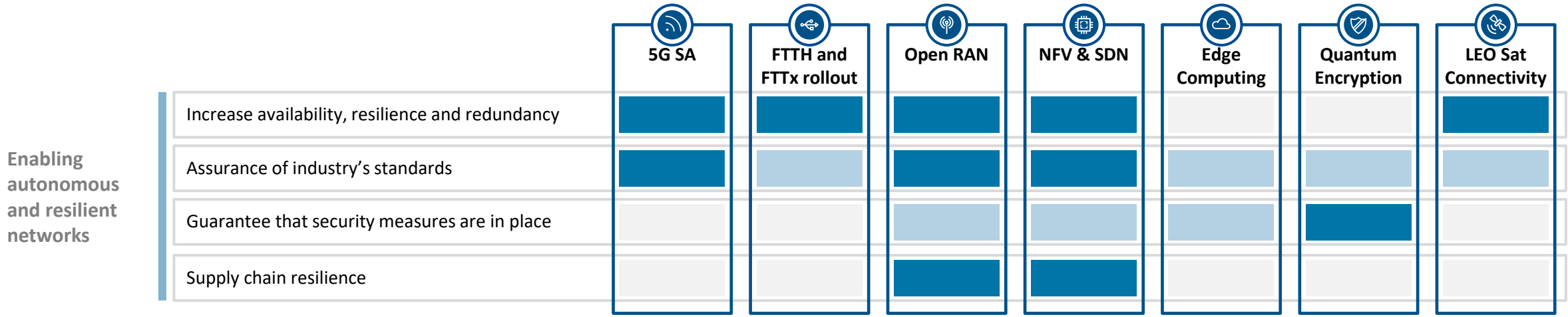
5.2 IMPACT OF TECHNOLOGIES ON EU AMBITIONS

Technologies, such as Open RAN and NFV & SDN strengthen the network's autonomy, while 5G SA, Fiber, and LEO satellites primarily impact the network's resilience capacity

Strengthen the EU's strategic autonomy and resilience

› Various technologies must be combined to ensure **the network's availability and resilience**. Indeed, **FTTH and FTTx**, **5G SA, NFV & SDN**, **LEO Satellite Connectivity** and **Open RAN** have a high impact on achieving this goal. Nevertheless, these trends by being jointly implemented, they can promote an increase in vendor diversification, guarantee uninterrupted coverage and minimal downtime by building redundancy between fixed and mobile networks as well as access to remote areas through satellite communications

› In parallel, the EU promotes the **adoption of security measures**, leading **Quantum Encryption** to stand out compared to the remaining technologies. Nevertheless, **Open RAN** and **NFV & SDN** allow greater visibility and control over network traffic, making detecting and responding to security threats easier, even though the networks may become more complex and harder to manage, given the increasing number of potential points of failure and lack of accountability in the supply chain. Network control will gain relevance in a scenario where the number of devices connected to the network increase exponential, for instance with new IoT services, as mentioned in section 4. Lastly, **Edge Computing** also promotes secure data storage by enabling data to be processed closer to the source, reducing the risk of data breaches during transit

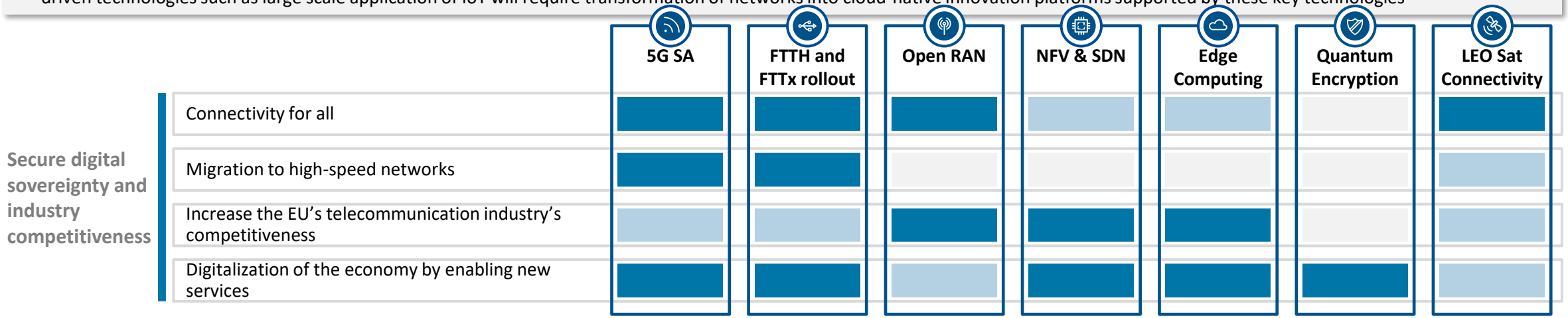


 Key: Lowest impact Medium impact Highest impact

To promote the EU's digital sovereignty, 5G SA, Fiber, Open RAN and LEO Connectivity are the trends with the most impact, while Open RAN, NFV & SDN and Edge Computing boost industry competitiveness

Fortify the EU's digital sovereignty and industry competitiveness

- To continuously **promote European digital sovereignty**, the EU must **guarantee connectivity to all European citizens regardless of socioeconomic background or region** (i.e., urban vs rural). Hence, the joint investment of various technologies will enable greater connectivity, such as **5G SA, FTTH and FTTx**, **Open RAN** (i.e., enabling a cost reduction leading to a higher rollout) and **LEO Satellite Connectivity** (i.e., to reach remote areas). In a scenario where extended realities, eventually in combination with Web 3.0, are adopted massively (as referred in section 2), Edge Computing and 5G SA are particular relevant to enable services that comply with the required experience
- Further, by investing in next-generation networks, **5G SA** and **FTTH and FTTx rollout** technologies are indeed the trends with the most impact. Though, both **Open RAN** and **LEO Satellite Connectivity** can also contribute for this goal
- Moreover, technologies such as **Open RAN, NFV & SDN** and **Edge Computing** present the most significant impact on **boosting the EU's industry's competitiveness** by enabling the entry of new European players into the ecosystem, raised by the value migration to non-traditional players, although currently these spaces are dominated by non-European players. Also, cloudification technologies will enable new services by exposing network components to be leveraged by Third Parties, for example, via Network API to developers and customers, hence contributing to the industries competitiveness with new sources of revenue. Nonetheless, **5G SA, Fiber** and **LEO Sat Connectivity,** can also boost competitiveness by enabling the deployment of innovative applications and expanding their market reach
- Lastly, the **digitalization of the economy**, including digitalization and cloudification of businesses also aims to foster competition by allowing the creation of new services. In this regard, **all assessed technologies contribute to a certain extent,** though **5G SA, FTTH and FTTx**, **NFV & SDN**, **Edge Computing** and **Quantum Encryption** have the highest impact. For example, data driven technologies such as large scale application of IoT will require transformation of networks into cloud-native innovation platforms supported by these key technologies



 Key: Lowest impact | Medium impact | Highest impact

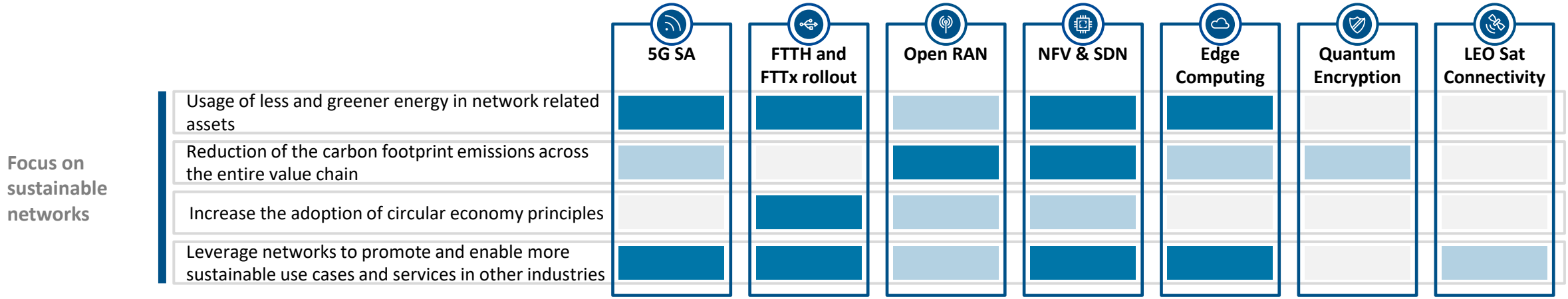
Virtualization technologies, as well as 5G SA and Fiber, reduce energy consumption and promote more sustainable use cases and services in other industries

Increase sustainability in the EU's networks

› Investing in **5G SA**, as well as **FTTH and FTTx** enable lowering the energy required per bit than 4G (1) and copper cables (2), respectively. Further, through infrastructure sharing, **Open RAN** and **NFV & SDN** allow more efficient resource allocation and energy consumption, in part through increased automation and the use of AI-based applications. **Edge Computing** enables data processing and storage to be done closer to the final user, reducing the required network's resources.

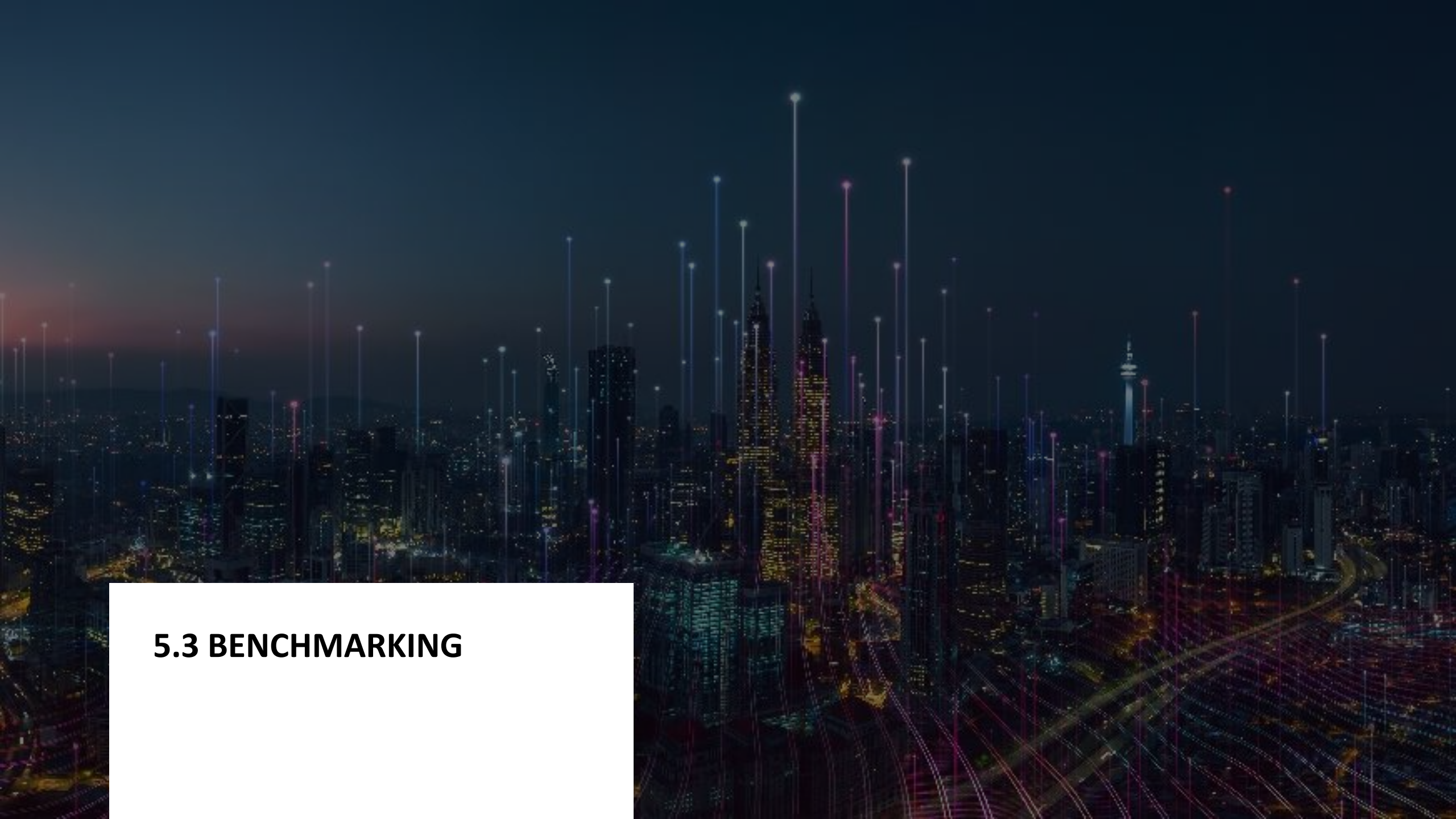
› The **carbon footprint emissions along the value chain** include the indirect emissions generated by upstream and downstream activities. Indeed, open networks, namely **Open RAN**, **NFV & SDN** and more disaggregated technology stacks with virtualized functions, offer more flexible ecosystems that allow operators to choose more sustainable players along the entire value chain, enabling them to reduce their indirect carbon footprint emissions. Also, **5G SA** and **Edge Computing**, by reducing latency, enable remote control of operations, hence removing the need to travel, while **Quantum Encryption** reduces the energy consumption of data centers by optimizing data transmission

› Fiber optic cables have a longer lifespan than traditional copper cables, decreasing e-waste generation. Thus, **FTTH and FTTx rollout** has the highest potential impact on **adopting circular economy principles**. Further, by enabling infrastructure sharing, **virtualization technologies** can reduce e-waste generation, and **Open RAN** standardization eases the recycling and recovery of materials when equipment reaches the end of its life, promoting resource efficiency. Lastly, a combined investment in implementing technologies, such as **5G SA**, **FTTH and FTTx**, **Edge Computing** and **virtualization technologies**, in telecommunication networks will ultimately boost energy-efficient high-speed network infrastructures and growth on digitalization, hence **promoting more sustainable use cases and services in other industries.** Though technologies such as **Open RAN** and **LEO Sat Connectivity** may also contribute, the latter can address white spot connectivity



 Key: Lowest impact Medium impact Highest impact

Sources: (1) European Parliament – Research Service 5G Technology (2) Europacable "Fibre: the most energy-efficient solution to Europe's bandwidth needs"



5.3 BENCHMARKING

The benchmark analysis reveals a widespread alignment among nations regarding the EU's key goals, focusing on ensuring access to all citizens while maintaining the critical infrastructure secure

detailed analysis in the appendix

Benchmarking policies from other countries can be used to identify the key goals that are best addressed by examples from these other countries, as summarized in the table below.

	ENABLING AUTONOMOUS AND RESILIENT NETWORKS				SECURE DIGITAL SOVEREIGNTY AND INDUSTRY COMPETITIVENESS				FOCUS ON SUSTAINABLE NETWORKS			
Key Goals	Guarantee security measures	Industry's standards	Increase availability and redundancy	Supply chain resilience	Connectivity for all	Migration to high-speed networks	Increase the industry's competitiveness	Digitalization of the economy	Usage of less and greener energy in assets	Reduction of emissions across the value chain	Adoption of circular economy principles	Networks as enablers to sustainability
🇺🇸	●	◐	◐	●	●	◐	●	●	◐	◐	◐	○
🇨🇦	●	○	○	●	●	○	◐	●	○	○	○	○
🇯🇵	◐	○	◐	◐	◐	◐	●	○	◐	◐	○	○
🇰🇷	●	○	○	○	◐	◐	●	●	◐	○	○	○
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🇬🇧	●	●	◐	●	●	○	◐	◐	○	○	○	○
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Note: *Each assessed policy can be pinpointed with more than one key goal*

Note: While Spain and Sweden are EU countries the benchmarking includes the national policies of these countries in order increase the geographic diversity of the analysis so that it includes another large European economy (Spain, in addition to the UK) as well as a European technology innovator (Sweden).

Key: ○ No policy found in this country is aligned with this key goal ◐ One policy found in this country is aligned with this key goal ● More than one policy found in this country is aligned with this key goal

The key takeaways from the benchmarking focus around common themes: connectivity for all, security, digital sovereignty and a lack of sustainability policies specific to ECNs

detailed analysis in the appendix

All countries implement policies to ensure connectivity for all citizens

› All analyzed countries are setting various initiatives to **increase coverage and ensure affordable prices to guarantee connectivity to all its citizens**, thus **ending the digital divide**, particularly in **remote areas**

- The Internet for All, a USA program, funds affordable Internet access programs for low-income citizens

Security is a priority in national policies

› The rise of **emerging technologies increases the complexity of the ecosystem**, leading to **more vulnerabilities**. Countries are implementing various security measures

- For instance, the UK aims to remove Huawei technology from the UK's 5G public networks by the end of 2027
- Most countries have taken a step forward by developing their own national Cyber Security Strategy

Policies boosting industry competitiveness aim to enhance digital sovereignty

› Global leaders in digital and ICT, including the US, Japan and South Korea are pursuing policies aiming to boost the competitiveness of digital sectors, including the telecoms sector, with the aim of enhancing digital sovereignty

› Policies supporting telecoms competitiveness can be focused on innovation in new technologies, enabling adoption within the value chain, and are based on international partnerships and collaboration

Lacking sustainability policies specific to ECNs

› The reviewed **documentation set broader sustainability policies and targets** encompassing multiple industries, **not addressing the sustainability challenge specifically for the telecommunication industry**

› The general policies include energy-efficiency measures, usage of green energy and circular economy practices. Though most telecommunication providers have established their sustainability initiatives

A set of criteria was employed to the benchmark results in order to consolidate into a list of policies that could augment the existing approach of EU policy

KEY SELECTION CRITERIA

1 **Initiatives that are encompassed within the five of the most selected EU's key goals**:

- *Increase availability and redundancy*
- *Guarantee security measures*
- *Supply chain resilience*
- *Connectivity for all*
- *Digitalization of the economy by enabling new services*

2 Most **transversal policies to the benchmarked countries**

3 Initiatives that **impact more than one key goal**

POLICIES CONSOLIDATED LIST

SECURITY

1. Investment to **improve the security and resilience** in networks
2. Standards and requirements to **improve security and supply chain resilience**

BROADBAND FOR ALL

3. Investment in **high-speed internet infrastructure**
4. Investment to **promote digital equity and affordable connectivity**
5. **Network usage fees** for large content application providers

DIGITAL SOVEREIGNTY AND DIGITALIZATION OF THE ECONOMY

6. Funding **education programs** to develop IT expertise
7. Investment in the **cloudification of the public services**
8. Investment to **support new technologies**

REGULATORY SIMPLIFICATION

9. **Simplification of merger control process** and adaptation of assessment to facilitate consolidation that supports policy goals

5.4 POLICY APPROACHES

The majority of the gathered policies aim to address the significant investment requirements while others address administrative, legal and regulatory frameworks. Among these there are already examples of use in the EU

detailed analysis in the appendix

	POLICY EXAMPLES	RATIONALE AND POTENTIAL IMPACT	BENCHMARK EXAMPLES
1	**Investment to improve the security and resilience in networks**	› Policies and strategies to improve ECN security and resilience come with a financial cost and deliver important benefits to the EU, therefore investment support (and incentives to encourage private investment) can accelerate progress to improve security and resilience › Investment in technologies such as quantum encryption and LEO satellite connectivity, which are already being pursued, can support greater security and resilience, and international examples target parts of ECN critical in times of emergency	› The USA has made a public investment to **improve the security and resilience of its Wireless Network**[1]
2	**Standards and requirements to improve security and supply chain resilience**	› Common standards and requirements regarding security and supply chains support network integrity and resilience. Alignment across Member States may facilitate the development of ECN and component technologies to common standards as well as harmonization of the EU ECN › Currently, ENISA publishes technical guidance to national regulators on security measures to be implemented › Particular technologies within the ECN can support this, such as 5G SA and Open RAN › Stringent requirements, however, can impose significant costs on the industry and act as constraint on ECN development. Implementing and managing supply chain security requirements can also involve complex bureaucratic processes coordination among multiple national and regional stakeholders and navigating national regulatory compliance procedures	› The UK government outlined a **5G Supply Chain Diversification Strategy, including security standards to be adopted by all operators and suppliers** and ensure UK's network resilience[2]
3	**Investment in high-speed internet infrastructure**	› Building and upgrading high-speed internet infrastructure requires significant financial investments, currently the EC estimates an investment deficit of at least €174bn to rollout high speed networks across Member States › Support for public and private investment can help address this deficit and indeed funds released as part of the RRF and CEF Digital already being used in this way at the local and national level	› USA government provides $42.45 billion **to expand high-speed Internet access in all 50 states**[1]

Note: These policies are derived from examples seen in the benchmarking that are being used in other countries to support the development of ECN. They are not recommendations for EU policy, which would require a detailed analysis of the impacts of individual policies.

Sources: (1) Federal Communications Commission, 2022 (2) UK Government, 2020

The majority of the gathered policies aim to address the significant investment requirements while others address administrative, legal and regulatory frameworks. Among these there are already examples of use in the EU

Detailed analysis in the appendix

	POLICY EXAMPLES	RATIONALE AND POTENTIAL IMPACT	BENCHMARK EXAMPLES
4	**Investment to promote digital equity and affordable connectivity**	› Improving digital infrastructure coverage and affordability can boost digital equity in poorer and hard to reach areas › Rollout of infrastructure in rural areas and implementation of affordable connectivity program requires substantial investment. Indeed, investment gaps to achieving wider EU goals related to connectivity are partly driven by challenges in developing digital infrastructure in rural areas › Allocation of financial resources or private investments are required for programs to achieve sufficient scale to reach their intended beneficiaries. Consideration of the role of emerging technologies, can help address this. › Also, welfare policies are a national policy are and so a cross-EU approach to affordable connectivity relies on national coordination with the understanding that local and national governments are best placed to understand the needs of the communities they serve	› Spanish government has invested €88.3 million in **affordable broadband connectivity in rural areas**[2]
5	**Network usage fees for large content application providers**	› Large content application providers (CAPs) may pay network usage fees under a 'sender pays' framework › Large CAPs are argued by ECN operators and some policymakers, including the European Parliament, to be a key driver of data traffic growth, benefitting without contributing towards the development of ECN. Telcos and some academics argue that contribution by large CAPs could incentivize lower prices for connectivity and greater network investment › However, other industry stakeholders (such as regulators) and analysts have identified risks to such a policy that include a lack of market failure being addressed and potential harm to consumers (e.g. lower service quality) and market incentives (e.g. innovation). Further detailed analysis of the impact of such a policy can establish the nature of these risks and whether they can be overcome or mitigated	› South Korea has a **model of application providers paying network use fees to ISPs**[1]
6	**Funding education programs to develop IT expertise**	› An enabler of the ECN will be the skills to a) develop and maintain the ECN and b) promote wider implementation and use of digital technologies to support the business case for investment and transformation. Currently the EU identifies a lack of IT skills as a key challenge to overall digital development › Education programs are already being funded by the RRF to address IT skills and expertise and could inform future efforts to expand digital skills in the EU	› Sweden is **investing in creating opportunities for digitalization**, achieving a high level of competence and promoting knowledge development[2]

Note: These policies are derived from examples seen in the benchmarking that are being used in other countries to support the development of ECN. They are not recommendations for EU policy, which would require a detailed analysis of the impacts of individual policies.

Sources: (1) National Telecommunication and Information Administration (NTIA), 2022; (2) European Commission, 2020 (3) Government of Canada, 2021

The majority of the gathered policies aim to address the significant investment requirements while others address administrative, legal and regulatory frameworks. Among these there are already examples of use in the EU

Detailed analysis in the appendix

POLICY EXAMPLES		RATIONALE AND POTENTIAL IMPACT	BENCHMARK EXAMPLES
7	**Investment in and promoting the use of cloud services**	› Cloud computing is a key pillar of the Digital Decade targets**, investment is required** to cover the costs associated with migrating and maintaining cloud infrastructure, considering return on investment, and optimizing resource utilization › The EU is already allocating €25m to support cloud development as part of the Important Project of Common European Interest (IPCEI) › In particular the EU's edge computing target of 10,000 edge nodes being built by 2030 supports greater use of cloud by enabling cloud based operations to run closer to the edge (i.e. with lower latency). However there are significant infrastructure requirements to achieve this	› **Canada's government** has launched a White Paper on Data Sovereignty and Public Cloud, **promoting the use of public clouds, ensuring their data security measures**[3]
8	**Investment to support new technologies**	› Development of new technologies, for example those highlighted in this report such NFV & SDN, Open RAN and Quantum Encryption, can suffer low investment due to uncertainty in returns. Public investment and incentives for private investment can accelerate development and rollout. Similarly, insufficient funding allocated to support new technologies can pose a barrier to implementing innovation-focused policies › **At the same time, developing and adopting new technologies introduces potential new elements of risk to ECN,** necessitating robust measures to protect critical infrastructure › Support for new and emerging technologies may also interfere with the allocation of resources determined by market forces, potentially introducing risk of sub-optimal technologies being preferred	› **South Korea's** Ministry of Science and ICT **established a 6G R&D implementation plan, investing approximately $194 million** by 2025[1]
9	**Simplification of merger control process and adaptation of assessments to facilitate consolidation that supports policy goals**	› Building scale allows ECN operators to operate more efficiently, whether in the form of consolidation, partnerships or joint ventures and can support broader development of ECN, subject to regulatory and competition considerations. The ecosystem is also evolving, with traditional ECN operators decoupling and new players taking more prominent roles, while EU telco markets remain fragmented relative to markets such as the US › Simplification of procedures and protocol for assessing proposed consolidation etc. could help support the industry, however any proposals would need to assess the impact on consumer protection › This would also require multi-stakeholder engagement and management the EU's and Member States' **complex legal and institutional framework** and fragmented market structure	› In Canada, the Competition Bureau offers a **"no-notifiable transaction" process for non-complex mergers** based on financial thresholds and size of the transaction[2]

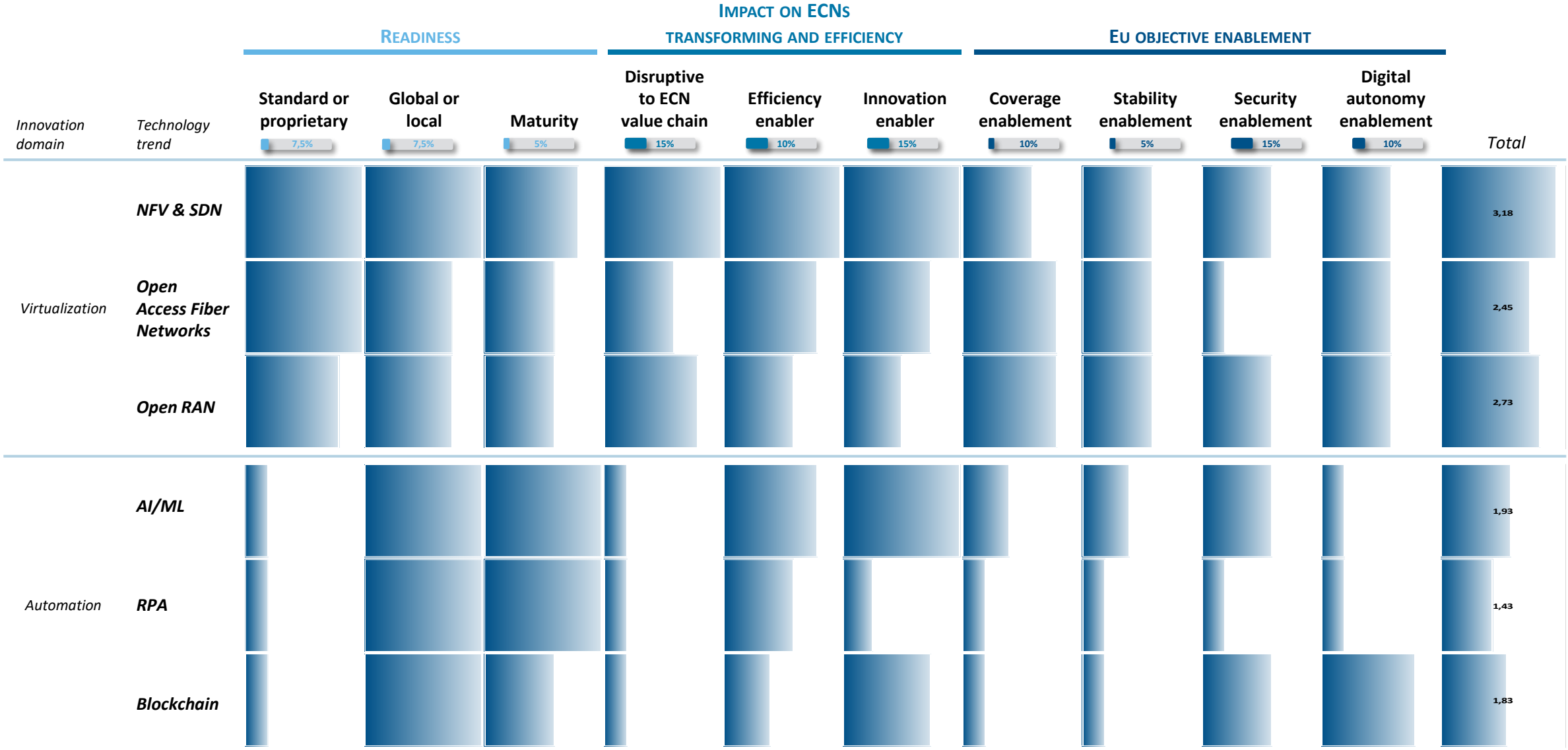
Note: These policies are derived from examples seen in the benchmarking that are being used in other countries to support the development of ECN. They are not recommendations for EU policy, which would require a detailed analysis of the impacts of individual policies.

Sources: (1) South Korean Government, 2021 (2) Government of Canada, 2022

6. APPENDIX

6.1 ECN TECHNOLOGY SELECTION

The below table summarizes the selection of the key technologies analyzed in this Fact-Pack



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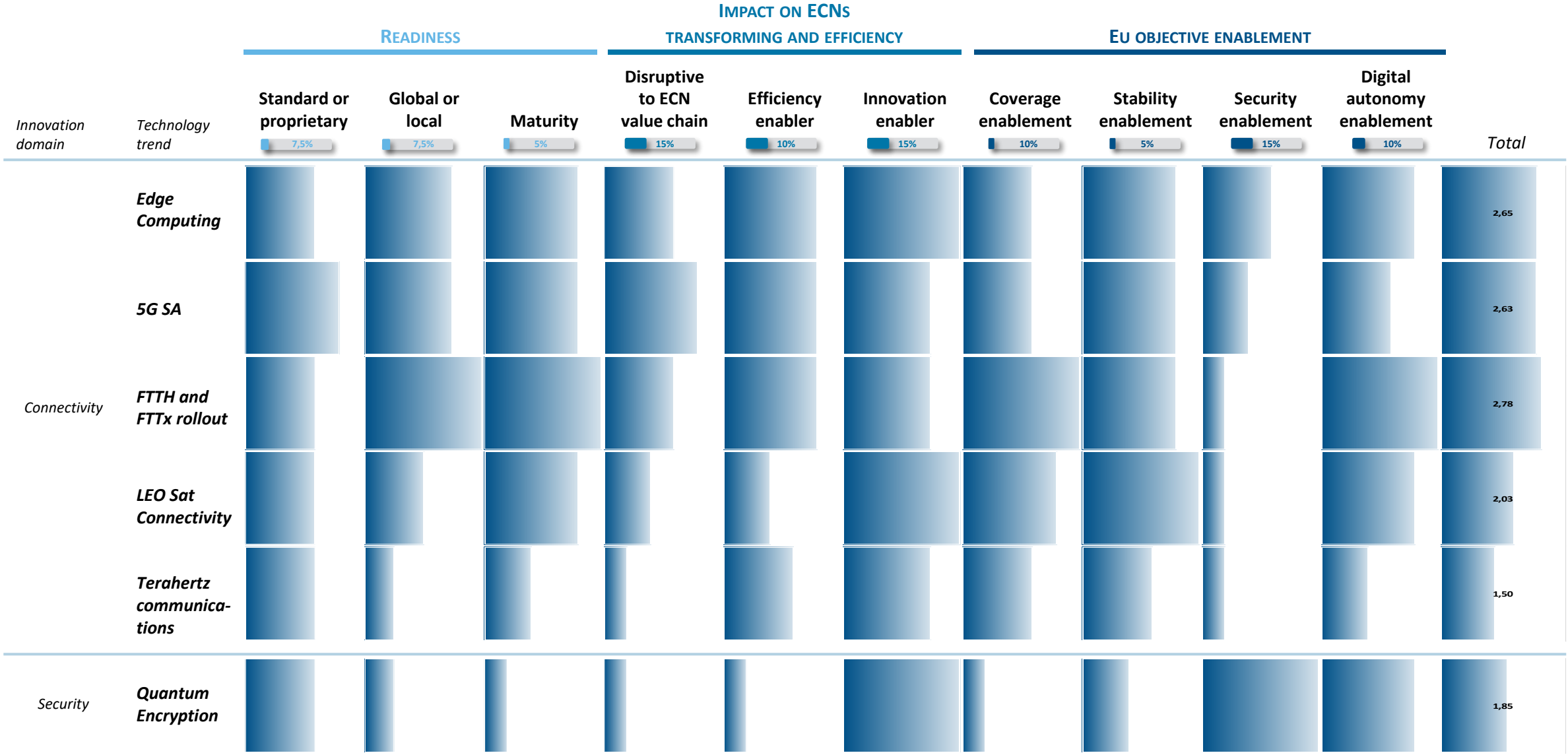

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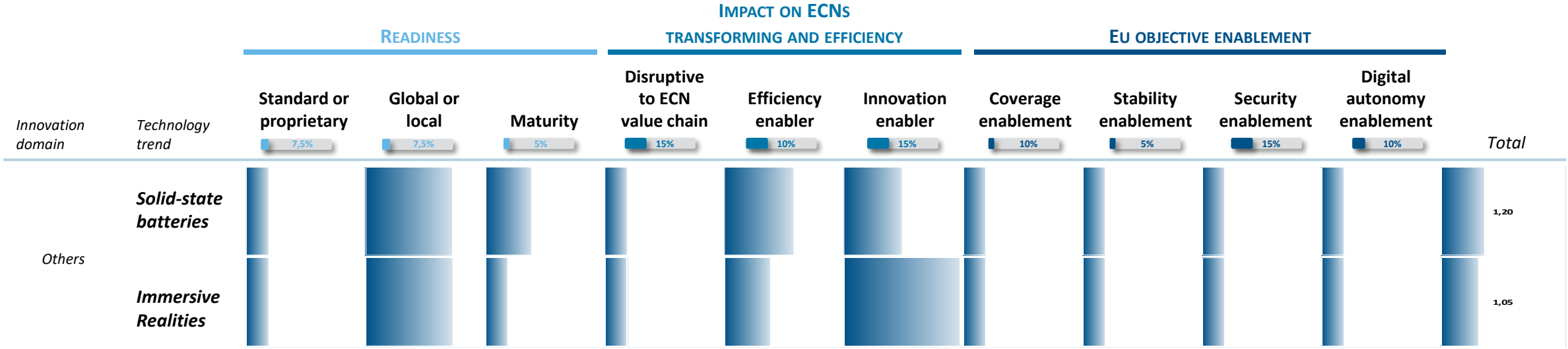
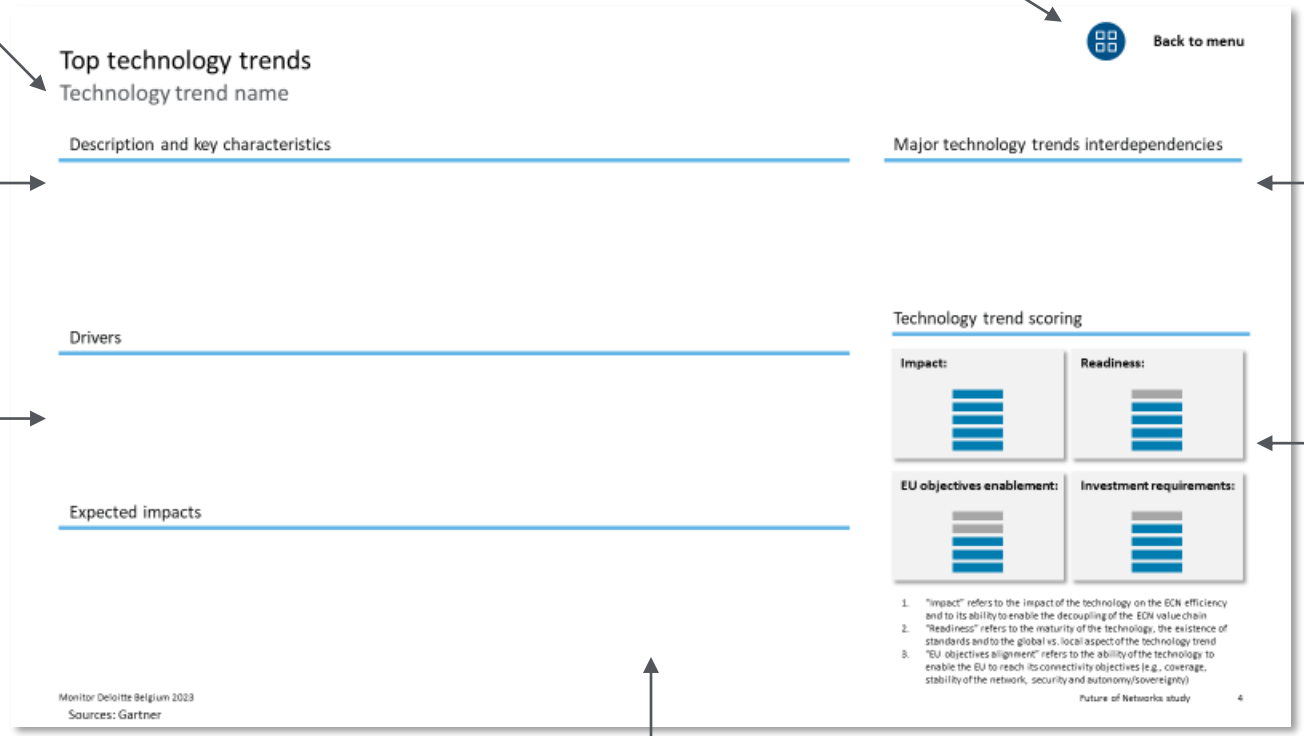


6.2 TECHNOLOGY ONE SLIDERS

The technology trends one pagers include a technology trend description, key characteristics, drivers, expected impacts and will highlight major interdependencies with other top technology trends

Technology trend name

Use this button to navigate to the home page



The description of the technology trends are high-level descriptions detailing the **key characteristics** of the technology from a **business standpoint**. As such, descriptions are relatively non-technical

This section highlights **major interdependencies** of the technology trend in question with other technology trends from our selection
Interdependencies arise as the technologies in question are often not developed in isolation and rely on each other to some extent (e.g., they are not mutually exclusive)

The "Drivers" section refers to **external drivers** and **market trends** (e.g., market pull conditions) that are responsible for driving the developments in the technology trend in question

The "Technology trend scoring" provides a **high-level summary** of the **scoring** that was assigned to each technology trend.
In addition, this section provides an indication of the **relative investment requirements** expected by ECN operators for each technology (e.g., order of magnitude)

The "expected impacts" section focuses on the high-level impacts that can be expected from the technology trend. We adopt a specific focus on the impacts on the ECN, as opposed to broader impacts on the consumers and economy as a whole

Sources: Gartner

Click on an icon to navigate to the technology description

Back to menu

NFV & SDN

Description and key characteristics

Network function virtualization (NFV) is a network architecture model that virtualizes and automates network functions, such as firewalls, load balancing and routing, that can be deployed as software on open server platforms or universal customer premises equipment (uCPE) platforms — as opposed to dedicated physical appliances. Virtual network functionality can be deployed both on-site and off-site, in branch offices, internal data centers, providers' point of presence, cloud services or hosting facilities

Software-defined networking (SDN) is a networking approach that directs network traffic by using software controllers to communicate with the hardware infrastructure. SDN enables operators to create and operate a series of virtual overlay network that run on top of the physical underlay network. The technology offers agility and extensibility benefits by minimizing the hands-on time needed to manage a network and making the entire network programmable

Drivers

- Pressure on ECN operators margin prompting initiatives to reduce operational costs and capital expenses
- Convenience brought by simpler, more agile and scalable ECN (ability to tailor services to specific market needs, improved ECN performance, reduced operating cost…)
- Increasing importance of ECN security

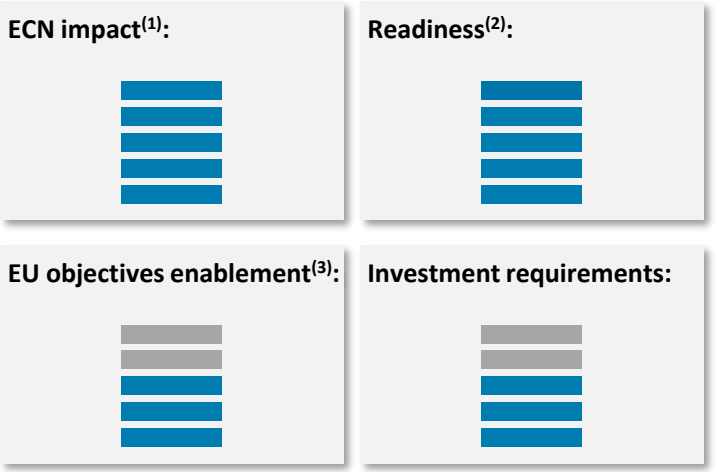
Expected impacts

- Reduced capital expenditures on network equipment and related expenses (space, energy…) for ECN operators by virtualizing network functions
- Reduced operational expenditures for ECN operators: networks can be deployed, modified and decommissioned in a centralized, flexible and programmable way
- Improved ECN performance, latency and security: managing network functions and traffic centrally, enables operators to quickly adapt to changing market conditions and potential security threats
- Increased flexibility and dynamism of the ECN value chain: virtualized functions can run on top of existing hardware, enabling the decoupling of the value chain in the InfraCo, NetCo and ServCo layers

Major technology trends interdependencies

- N/A

Technology trend scoring



1. Assesses the technology potential to enable ECN as innovation platform and improve their efficiency, as well as its potential to enable the decoupling of the telecom value chain
2. Assesses the current operability status and required conditions that must be met to ensure a technology is successfully employed
3. Assesses the alignment with EU's Digital Decade goals and policy priorities

Sources: Gartner

FTTH / FTTx

Description and key characteristics

FTTH stands for "Fiber to the Home" and refers to a type of broadband internet service that uses fiber-optic cables to connect individual homes or buildings directly to the internet. With FTTH, the fiber-optic cable transmits data from the internet service provider's (ISP) network to the customer's premises using light signals, providing high-speed and reliable internet connectivity. Compared to legacy infrastructure (e.g., copper wires), FTTH offers much faster and more consistent internet speeds, as well as lower latency and better reliability

FTTx refers to an intermediary step in the FTTH rollout, where fiber-optic cables run from the ISP to a relay point that is close to the customer's premises. In a FTTx rollout, an alternate broadband technology (Copper, 5G, Wi-Fi…) must cover the 'last mile' between the relay point and the customer's premises. As such, FTTx is an important component of Fixed Wireless Access (FWA) technology

Drivers

- Government funding, targets and requirements (e.g., European Gigabit Society, Connecting Europe Facility, local requirements to include fiber in new real estate developments…)
- Demand for more reliable high-speed internet services (Gaming, video streaming, cloud computing…) and high bandwidth applications (IoT, AR…)
- Competitive pressures to provide better, more reliable services at competitive prices between ECN operators
- Replacement of ageing legacy infrastructure (e.g., copper)

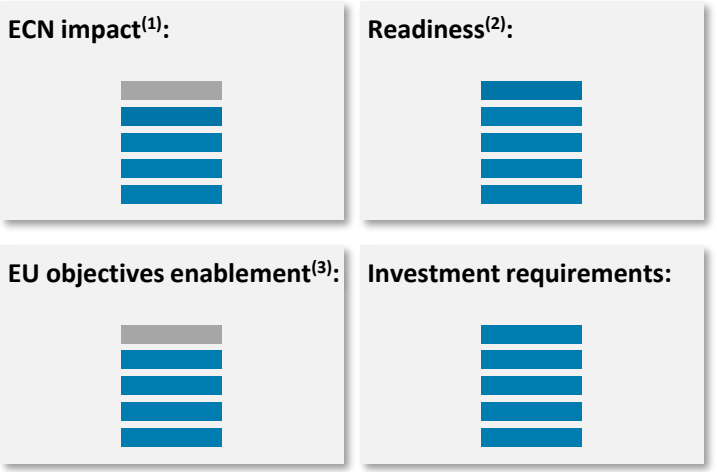
Expected impacts

- Increased broadband coverage and improved ECN reliability by delivering consistent internet speed and latency
- Increased ECN security compared to copper-based networks
- Increased resilience and "future proofness" of the ECN as fiber may be less prone to wear and tear compared to copper-based networks, and can handle larger traffic
- Reduced operating costs stemming from fewer maintenance requirements and increased energy efficiency

Major technology trends interdependencies

- N/A

Technology trend scoring



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Sources: Gartner, FTTH Council Europe, Deloitte SME interviews

5G SA

Description and key characteristics

5G is the next-generation cellular standard by the 3rd Generation Partnership Project (3GPP). The standard targets maximum downlink and uplink throughputs of 20 Gbps and 10 Gbps, respectively. Latency is as low as 4 milliseconds in a mobile scenario and can be as low as 1 millisecond in ultrareliable low-latency communication scenarios, down to 10 m precision positioning and massive IoT scalability. New system architecture includes network slicing as well as wireless edge

5G SA (standalone) is the architecture of a 5G network that operates independently of legacy 4G LTE networks (non-standalone). The 5G SA is designed to support the full range of 5G capabilities, including enhanced mobile broadband (eMBB), massive machine-type communications (mMTC), and ultra-reliable and low-latency communications (URLLC)

Drivers

- Increasing 5G-capable device penetration along with industrial demand for high-speed, ultrareliable and low latency communications
- Increasing data generation and consumption requiring dedicated infrastructure
- Increasing demand for massive machine-type communications (IoT)
- Competitive pressures to provide better, more agile services at competitive prices between ECN operators
- Pressure on ECN operators margin prompting initiatives to reduce operational costs by simplifying their operations

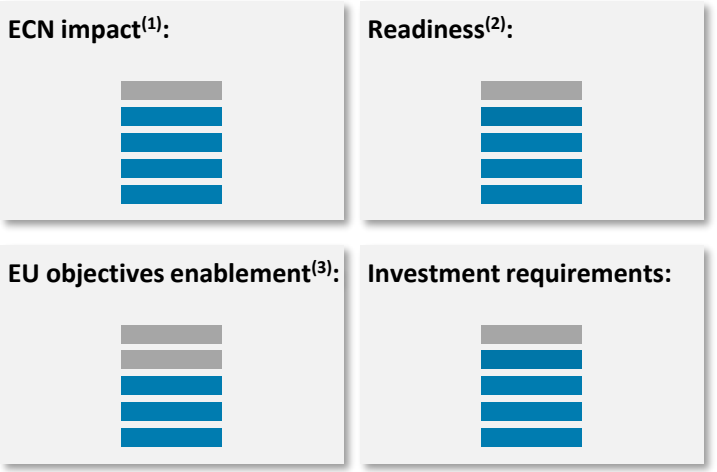
Expected impacts

- Deployment of eMBB for HD video, mMTC for large IoT deployments and URLLC, effectively creating an innovation platform
- Increased flexibility of the network through the implementation of cloud-native deployments, service-based architecture and simplified network orchestration, enabling ECN operators to run networks more efficiently and in line with the actual demand
- Increased scalability of the network through cloudification, enabling ECN operators to run networks more efficiently
- Decreased operational costs for ECN operators through network simplification, virtualization and automation

Major technology trends interdependencies

- NFV & SDN
- Edge computing

Technology trend scoring



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Sources: Gartner

Edge computing

Description and key characteristics

Edge computing is a distributed computing architecture that enables data processing and storage to be done closer to the edge of the network, rather than in centralized data centers. The edge refers to endpoints of the network or Internet, such as sensors, mobile devices, servers and other devices that generate and/or consume data. Edge computing involves deploying computing resources, such as servers and storage devices, closer to the network edge, such as at cell towers or base stations, to support low-latency, high-bandwidth applications and services

Drivers

- Growth in real-time data processing requirements (e.g., Autonomous vehicles, IoT devices, AR/VR…)
- Increasing data traffic pushing for optimizing ECN
- Pressure on ECN operators' margin prompting initiatives to reduce operational costs
- Growth in cloud computing services
- Growing ECN security and data privacy concerns

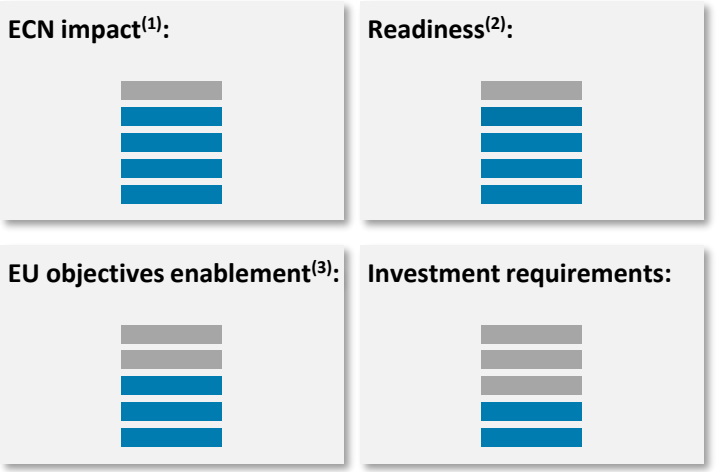
Expected impacts

- Reduced latency and enablement of real-time data processing by bringing the computing power closer to the edge of ECN
- Increased network resources management efficiency, reduced network congestion and improved network resilience, security and performance through the redistribution of the processing load to distributed data centers at the edge of the network, instead of a centralized data center
- Increased network resources and energy management efficiency leading to decreased operating expenses

Major technology trends interdependencies

- FTTH / FTTx
- 5G SA
- NFV & SDN

Technology trend scoring



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Sources: Gartner

Open RAN

Description and key characteristics

An Open Radio Access Network (Open RAN) is a nonproprietary version of the Radio Access Network (RAN) system that allows interoperation between cellular network equipment provided by different vendors (hardware, software and interfaces). This allows operators to mix and match components from different vendors, rather than being locked into proprietary end-to-end solutions from a single vendor

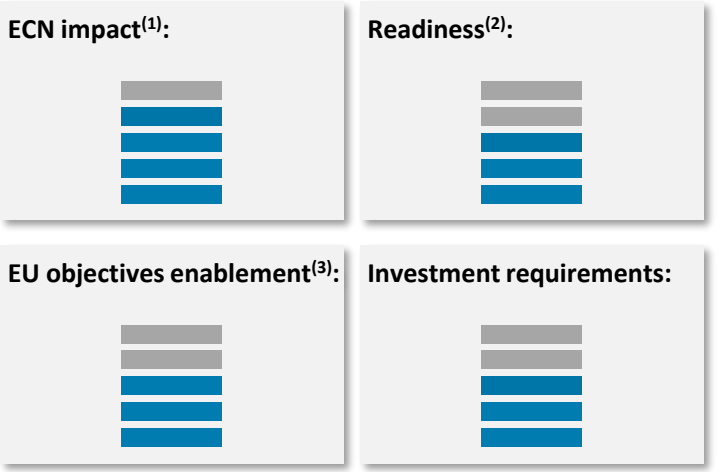
Major technology trends interdependencies

- 5G SA
- NFV & SDN

Drivers

- Promotion of Open RAN by standardization bodies and related consortiums
- Governmental efforts to promote more diversified (and competitive) and/or local vendor ecosystems
- Pressure on ECN operators margin prompting initiatives to reduce operational costs and capital expenses
- Network equipment replacement cycles and current vendor contract duration

Technology trend scoring



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Expected impacts

- Improved ECN flexibility and agility: ECN can be tailored to specific use cases as network components become interoperable and ECN operators can achieve best-of-breed vendor selection by balancing features and costs
- Reduced ECN equipment vendor lock-in, leading to increase competition between equipment providers and greater cost efficiency and innovation
- Increased flexibility and dynamism of the ECN value chain: virtualized functions can run on standard hardware, enabling the decoupling of the value chain the InfraCo, NetCo and ServCo layers
- The fragmentation of the ECN value chain is expected to create new roles specialized in network integration and orchestration

Sources: Gartner, O-RAN Alliance, Cisco

LEO Satellites connectivity

Description and key characteristics

LEO (Low Earth Orbit) satellite connectivity is a type of satellite-based communication technology that involves deploying constellations of small satellites in low Earth orbit, typically at an altitude of 500 to 2000 kilometers. LEO satellite connectivity could provide high-speed, low-latency data and voice connectivity to users located in remote or hard-to-reach areas

Drivers

- Government initiatives (e.g., IRISS), targets and requirements pushing for better connectivity (e.g., EU Digital society…) while parts of the world are still not connected to the internet
- Demand for high-speed internet services (Gaming, video streaming, cloud computing…) and high bandwidth applications (IoT, AR…) in underserved areas

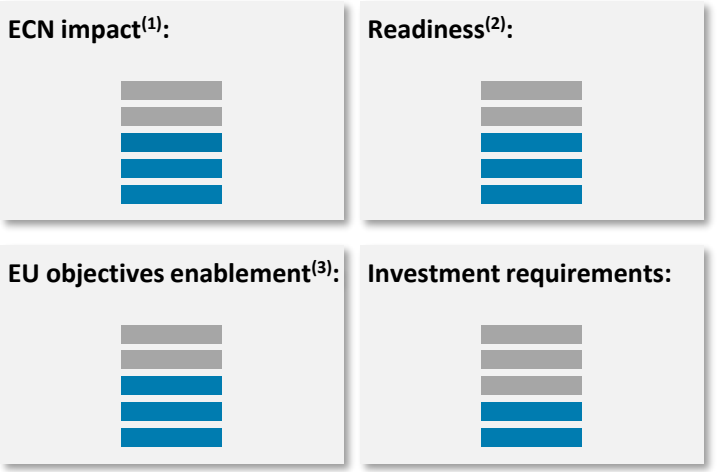
Expected impacts

- Enablement of new services for ECN operators who could provide high-speed, low latency connectivity to remote and underserved areas
- Improvement of ECN resilience and disaster response by providing a layer redundancy to the existing network

Major technology trends interdependencies

- FTTH / FTTx

Technology trend scoring



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Sources: Deloitte TMT predictions, Gartner

Quantum encryption

Description and key characteristics

Quantum encryption (or communication) takes advantage of the laws of quantum physics to protect data. These laws allow particles—typically photons of light for transmitting data along optical cables—to take on what is called a state of superposition, which means they can represent multiple combinations of 1 and 0 simultaneously. The particles are known as quantum bits, or qubits. From a cybersecurity perspective, if a third party tries to observe them in transit, their super-fragile quantum state "collapses" to either 1 or 0. This means hackers can't tamper with the qubits without leaving behind a telltale sign of the activity

Quantum key distribution (QKD) is the most widely used method in quantum cryptography, where the sender and receiver of a message share a secret key, that is used to encrypt and decrypt the message. This key is generated using quantum properties of the photons and is transmitted separately from the message itself. By comparing measurement taken at either end of the transmission, users will know if the key or the message has been compromised

Drivers

- Increasing importance of cybersecurity in telecommunications
- Promising technology developments in quantum computing

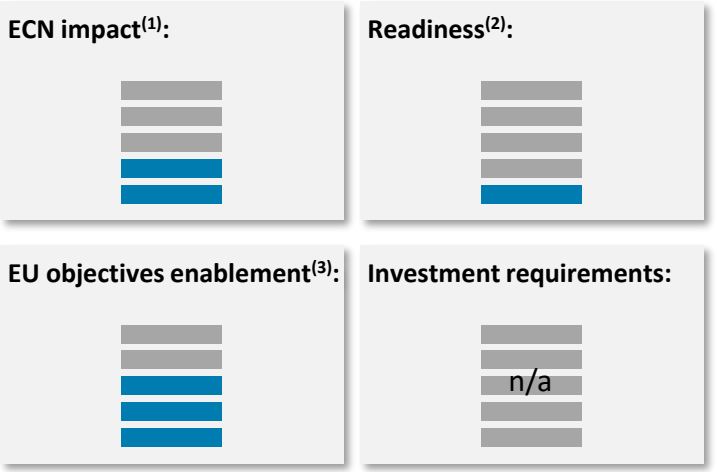
Expected impacts

- Improved cybersecurity of ECN, depending on extent of adoption
- Opportunity for ECN operators to provide new services: as trusted actors in electronic communications, ECN operators will be well positioned to introduce innovative security-related services to niche actors requiring high-security encryption services

Major technology trends interdependencies

- FTTH / FTTx
- Quantum communication and computing

Technology trend scoring



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Sources: Gartner, MIT Technology review, Caltech

6.3 INVESTMENT ASSESSMENT APPROACH AND SOURCES

The high-level assessment of investment requirements for the technologies is based on outside research, reports and inputs from Deloitte SMEs

Technology trend	High-level methodology
FTTH / FTTx	Investment assessment is based on existing estimates from FTTH Council, Analysys Mason and BCG, corroborated with Deloitte SMEs and factoring in potential impacts of increasing costs to connect the unconnected (e.g., rising costs in more remote areas) and input cost inflation Drivers of higher cost are worth bearing in mind such as rising costs in remote areas, input cost inflation (e.g., fiber optic cable, labour etc.) and additional fiber rollout to support wider technological advances (e.g., smart cities)
5G SA	Investment assessment is based on investment estimates from the joint report “Connectivity & Beyond” from BCG and ETNO, as well as Ericsson and Analysys Mason estimates for emerging markets. Limitations in how these can be applied to Europe were identified, but order of magnitude appears consistent with industry experience of Deloitte SMEs and factoring in input cost inflation and densification to support new technologies
NFV / SDN	Investment assessment is based on third party NFV / SDN market sizes and projections estimates, considering a rough estimate of 25% for the European share of global telco CAPEX (based on ETNO and GSMA estimates) and considering that this market share may be lower due to none-telco buyers of the technology
Open RAN	Investment assessment is based on Open RAN market sizes and projections estimates, considering a rough estimate of 25% for the European share of global telco CAPEX (based on ETNO and GSMA estimates) Important factors and limitations are that mobile operators are committed to existing providers for a certain period, which might limit Open RAN investment in the next decade and the share of European telecom providers may be different depending on uptake in different regions and other markets for the equipment beyond operators

The high-level assessment of investment requirements for the technologies is based on outside research, reports and inputs from Deloitte SMEs

Technology trend	High-level methodology
Edge computing	Investment assessment is based on an approximate cost per node for edge computing being from €40k to €100k (approximate) and considering that 10,000 are targeted to be built in EU-27, consistent with EU targets and assumed the higher-end equipment will be used This estimate does not consider the number already built for which information could not be found at time of writing
LEO satellites	Investment assessment is based on input from SME discussions which considered additional investments for telecom operators, on top of EU's IRISS € 6 Bn program (e.g., additional constellations, backhaul connectivity…)
Quantum encryption	Sufficient information to make an assessment is unavailable, however investment requirements are potentially small relative to the investment requirements of the other technologies A potential framework would be the number of 'repeaters' for connections supporting quantum encryption and the cost per 'repeater'

6.4 COUNTRIES POLICIES BENCHMARK

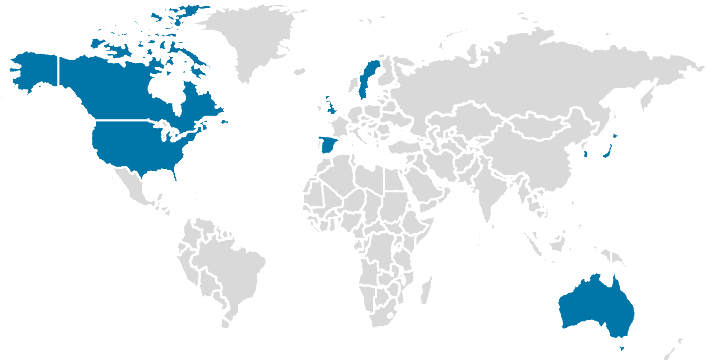
A comprehensive benchmarking exercise was conducted for selected countries to analyze their current established policy landscape on the previously identified EU's ambitions and key goals

COUNTRY SELECTION

The following criteria were considered for the identification of countries:

- The countries should **cover at least three regions** to ensure geographic diversity
- A mix of countries that include **large economies, technology leaders** and **innovators**, as well as countries that already **tackle the digital divide** challenge adequately, should be considered

Selected countries:



- **USA** — *Technology leader*
- **Canada** — *Digital divide expert*
- **Japan** — *Technology leader*
- **South Korea** — *Technology leader*
- **Australia** — *Digital divide expert*
- **UK** — *Large European economy*
- **Spain** — *Large European economy*
- **Sweden** — *Technology innovator*

DOCUMENT SELECTION

The following criteria were considered for the identification of documents to analyze within each country:

- **Documents no older than 5 years** (until 2018) can be considered
- **Government documents and regulatory requirements** should be prioritized

Methodology

Approximately **5 documents** (e.g., governmental, regulations) will be chosen per country within the given timeframe

The documents will then serve as a basis to **illustrate each country's initiatives** (i.e., policies, programs) **against the identified key goals within the three EU policy ambitions aforementioned**

Documents examples:

NON-EXHAUSTIVE

- UK's 5G Supply Chain Diversification Strategy
- Digital Spain 2025
- USA's Internet For All

→ *detailed analysis in the appendix*

Appendix | Countries Policies Benchmark (2|6)

Country	Document	Initiative/Policy	A. Enabling autonomous and resilient networks				B. Secure digital sovereignty and industry competitiveness				C. Focus on sustainable networks			
			Guarantee that security measures are in place	Assurance of industry's standards	Increase availability and redundancy	Supply chain resilience	Connectivity for all	Migration to high-speed networks	Increase the telecom industry's competitiveness	Digitalization of the economy by enabling new services	Usage of less and greener energy in network related assets	Reduction of the CF emissions across the value chain	Increase the adoption of circular economy principles	Leverage networks to enable more sustainable use cases
	Internet for All[1]	Funding program to promote digitalization to all citizens					✓			✓				
		Public investment in high-speed internet infrastructure			✓			✓	✓					
		Public investment in affordable connectivity programs					✓							
		Public investment to promote digital equity and inclusion in rural areas					✓							
	Report and order and further notice of proposed rulemaking[2]	Public investment to improve the security and resilience in wireless networks	✓		✓									
		Guidelines to improve network resilience during disasters	✓		✓									
	Bipartisan Secure Equipment Act of 2021[3]	Legal notice to ban communication equipment deemed as a risk to national security	✓			✓								
	Public Wireless Supply Chain Innovation Fund[4]	Creation of an innovation fund to develop and implement open and interoperable networks		✓					✓					
	Broadband, Security SCs and Wireless Research[5]	Public investment in advanced wireless research, expanding the use of broadband and spectrum			✓				✓	✓				
	Sustainable States Network[6]	Promotion of state-wide sustainability programs and initiatives									✓	✓	✓	

Sources: (1) National Telecommunication and Information Administration (NTIA) (2) Federal Communications Commission, 2022 (3) FCC, 2021 (4) NTIA, 2023 (5) NTIA, 2022 (6) Sustainable States Network, 2023

Appendix | Countries Policies Benchmark (3|6)

Country	Document	Initiative/Policy	A. Enabling autonomous and resilient networks				B. Secure digital sovereignty and industry competitiveness				C. Focus on sustainable networks			
			Guarantee that security measures are in place	Assurance of industry's standards	Increase availability and redundancy	Supply chain resilience	Connectivity for all	Migration to high-speed networks	Increase the telecom industry's competitiveness	Digitalization of the economy by enabling new services	Usage of less and greener energy in network related assets	Reduction of the CF emissions across the value chain	Increase the adoption of circular economy principles	Leverage networks to enable more sustainable use cases
	Secure and Resilient Mobile Network Infra. & Emergency Comm., R&D Program[1]	Public investment to improve security and resilience of 5G infrastructures[1]	✓											
	BroadbandUSA[2]	Public investment to broadband deployment on tribal lands to reach digital inclusion					✓			✓				
	National Low Earth Orbit Research and Development Strategy[3]	Public support for LEO Satellite technology research and development			✓		✓		✓					
	United States and Finland Cooperation in Advanced Wireless Communications[4]	US-Finland partnership on 6G research and development	✓	✓		✓		✓	✓					
	U.S.-Japan Policy Cooperation Dialogue on the Internet Economy[5]	US-Japan partnership on the Internet Economy	✓		✓	✓		✓	✓	✓	✓	✓		✓
	Improving the reliability and resilience of the digital infra.[6]	Guidelines to improve the reliability and resilience of the Digital Infrastructure			✓									
	Canada's Connectivity Strategy[7]	Public investment in high-speed internet access for all citizens					✓							
	Government: Data Sovereignty and Public Cloud[8]	Public investment in the cloudification of the public services	✓							✓				
	Telcom. Network Resiliency: A Path Forward[9]	Identification of resilience improvement guidelines for Telecom Networks	✓		✓									
	Competition Act[10]	Consolidation and merger process simplification							✓	✓				

Sources: (1) National Terrorism Advisory system, 2023 (2) NTIA, 2023 (3) National Science and Technology Council, 2023 (4) US Dept. of State, 2023 (5) US Dept. of State, 2023 (6) Canadian Forum for Digital Infrastructure Resilience, 2023 (7) Government of Canada, 2022 (8) Government of Canada, 2020 (9) Government of Canada, 2023 (10) Government of Canada, 2022

Appendix | Countries Policies Benchmark (4|6)

Country	Document	Initiative/Policy	A. Enabling autonomous and resilient networks				B. Secure digital sovereignty and industry competitiveness				C. Focus on sustainable networks			
			Guarantee that security measures are in place	Assurance of industry's standards	Increase availability and redundancy	Supply chain resilience	Connectivity for all	Migration to high-speed networks	Increase the EU's telecom. industry's competitiveness	Digitalization of the economy by enabling new services	Usage of less and greener energy in network related assets	Reduction of the CF emissions across the value chain	Increase the adoption of circular economy principles	Leverage networks to enable more sustainable use cases
	Canada's Connectivity Strategy[1]	Public investment in Telesat supporting the future of connectivity			✓		✓							
	Digital Garden City Nation[2]	Public investment in the rollout of optical fiber and achieving full 5G coverage until 2030			✓		✓	✓	✓					
	Guidelines concerning telco. Procurement[3]	Guidelines to enforce the ban of high-risk foreign entities from critical infrastructures	✓			✓								
	Partnership between the European Union and Japan[4]	Connectivity Partnership based on sustainability as a shared value							✓		✓			
	Carbon Neutrality[5]	Public investment to support new innovations to reach carbon neutrality										✓		
	Promotion of digitalization due to the impact of the coronavirus pandemic[6]	Beyond 5G, Society 5.0 and New IT strategy	✓	✓				✓	✓	✓				✓
	UK/South Korea Open RAN R&D collaboration[7]	Collaboration to to establish the priority area of Open RAN network power efficiency							✓	✓				
	Network cost contribution[8]	Model of fair contribution to network financing							✓		✓			
	6G R&D implementation plan[9]	Public funding to support new technologies, particularly LEO satellite connectivity			✓		✓			✓				

Sources: (1) Government of Canada, 2021 (2) Government of Japan, 2022 (3) European Union External Action, 2019 (4) EU-Japan Center for Industrial Cooperation, 2023 (5) Government of Japan, 2021 (6) Japan External Trade Organization (7) UK Government, 2022 (8) European Parliamentary Research Service, 2023 (9) Ministry of Science and ICT

Appendix | Countries Policies Benchmark (4|6)

Country	Document	Initiative/Policy	A. Enabling autonomous and resilient networks				B. Secure digital sovereignty and industry competitiveness				C. Focus on sustainable networks			
			Guarantee that security measures are in place	Assurance of industry's standards	Increase availability and redundancy	Supply chain resilience	Connectivity for all	Migration to high-speed networks	Increase the EU's telecom. industry's competitiveness	Digitalization of the economy by enabling new services	Usage of less and greener energy in network related assets	Reduction of the CF emissions across the value chain	Increase the adoption of circular economy principles	Leverage networks to enable more sustainable use cases
	5G+ Strategy[1]	Public investment in 5G global market			✓			✓		✓				
	Sustainability Principles: Infra. Australia's approach to sustainability[2]	Guidelines on the role of infra. networks play in promoting a sustainable community											✓	✓
	Better Connectivity Plan for Regional Australia[3]	Public investment in digital connectivity for all citizens					✓							
	Improving resilience of Australia's telcom. networks[4]	Public investment to improve the resilience of telecommunication network	✓		✓									
	National Cyber Strategy 2022[5]	Public investment to improve the Cybersecurity	✓	✓										
	5G Supply Chain Diversification Strategy[6]	Legal notices issued to remove high risk vendors from UK's 5G telecoms networks	✓	✓		✓								
		Public investment to develop and implement open interface architectures		✓					✓					
	Investment in telecoms innovations and R&D[7]	Public Investment for satellite connectivity			✓		✓							
		Public investment for 5G-enabled services			✓									
		Public investment to have 5G coverage for the UK by 2030			✓		✓							

Sources: (1) Ministry of Science and ICT, 2019 (2) Australian Government, 2021 (3) Australian Government, 2022 (4) Australiana Government, 2022 (5) UK Government, 2022 (6) UK Government, 2020 (7) UK Government, 2023

Appendix | Countries Policies Benchmark (5|6)

Country	Document	Initiative/Policy	A. Enabling autonomous and resilient networks				B. Secure digital sovereignty and industry competitiveness				C. Focus on sustainable networks			
			Guarantee that security measures are in place	Assurance of industry's standards	Increase availability and redundancy	Supply chain resilience	Connectivity for all	Migration to high-speed networks	Increase the EU's telecom. industry's competitiveness	Digitalization of the economy by enabling new services	Usage of less and greener energy in network related assets	Reduction of the CF emissions across the value chain	Increase the adoption of circular economy principles	Leverage networks to enable more sustainable use cases
UK	UK Wireless Infrastructure Strategy[1]	Public investment to extend gigabit broadband to rural/remote areas			✓		✓							
UK	The UK Gov. Resilience Framework[2]	New strategic approach to resilience networks			✓					✓				
ES	Digital Spain 2025[3]	Public investment in high-connectivity networks to all citizens			✓		✓			✓				
		Public investment increasing the heigh of Cybersecurity	✓											
		Public investment in the digital transformation of the Public Sector								✓				
ES	Affordable broadband connectivity in rural areas of Spain 2022[4]	Public investment in providing affordable broadband connectivity in rural areas					✓			✓				
SE	Broadband in Sweden[5]	Public investment to provide high-speed broadband access to all citizens			✓		✓							
SE	The National Agency for Education's follow-up of digitalization strategy 2021[6]	National Digitalization Strategy for the School System					✓			✓				

Sources: (1) UK Government, 2023 (2) UK Government, 2022 (3) Gobierno de España, 2022 (4) European Commission, 2022 (5) European Commission, 2023 (6) Skolverkets, 2022

6.5 POLICIES BENCHMARK – USE CASES

United Kingdom’s promotion of Open RAN development and adoption to diversify the supply chain

ISSUE

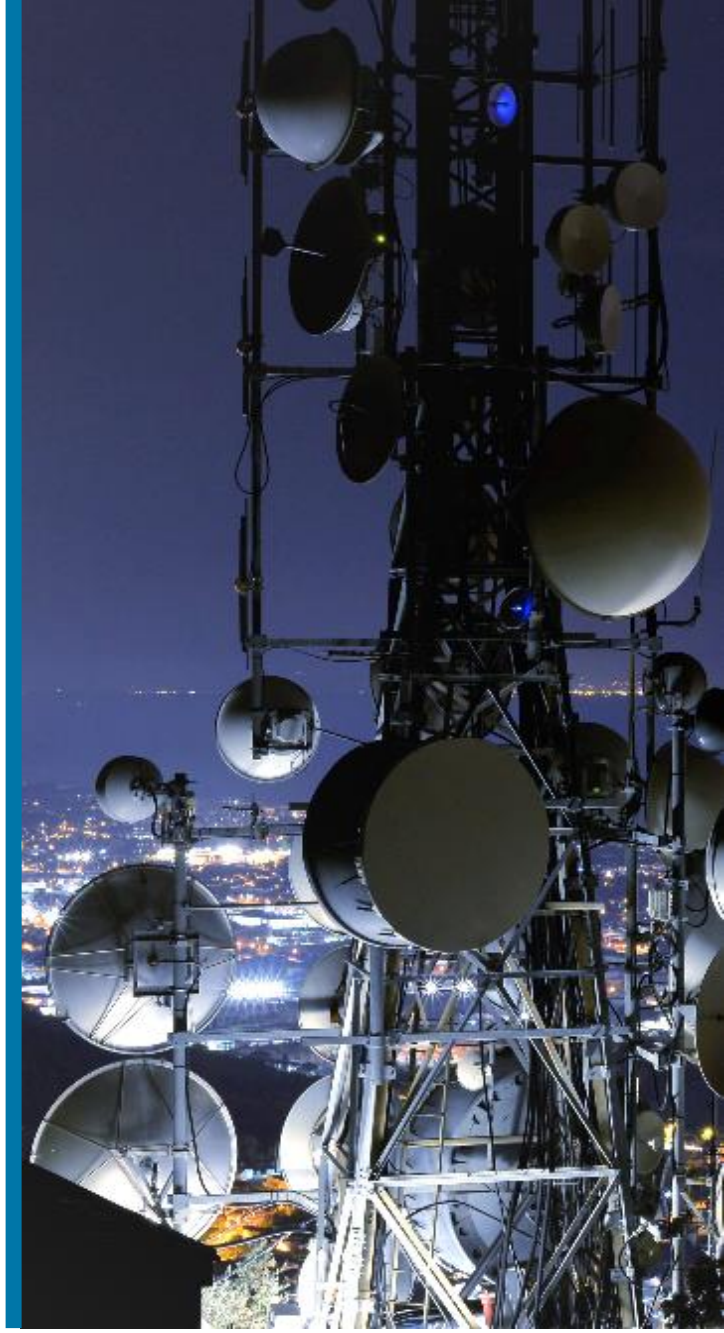
- Following the US sanctions against high-risk vendors (e.g., Huawei) and the heavy reliance on a limited number of vendors in the UK telecom infrastructure, concerns were raised regarding potential security risks and the need for diversification to ensure a resilient and competitive market
- The UK market does not have open-interface architectures, which usually may represent a lack of competition, innovation, and vendor ecosystem in the telecom industry's radio access network (RAN) segment

SOLUTION

- By promoting Open RAN, the UK sought to encourage the entry of new vendors into the market, reduce dependency on specific suppliers, and foster innovation and competition. The strategy aimed to create a more diverse and robust supply chain ecosystem for 5G infrastructure, reducing the potential risks associated with overreliance on a single vendor
- UK government has made significant investments in Open RAN through programs like the £250 million Open Networks R&D program, which awarded funding to successful applicants for projects related to radio access networks and supported the goals of the 5G Supply Chain Diversification Strategy

IMPACT

- Accelerating the adoption of Open RAN as one of the key areas to deliver the government's ambitions. Diversification of the supply chain in Open RAN involved enabling multiple vendors to provide interoperable and standardized components, such as radios, baseband units, and software
- This approach will allow operators to mix and match components from different vendors, fostering competition and reducing the barriers to entry for new players



Source: UK Government, 2020

US's measures to improve the reliability and resiliency of wireless networks

ISSUE

- The US annually suffers various winter storms, hurricanes and wildfires, which impacts communications infrastructure

SOLUTION

- The US government took decisive measures to improve the reliability and resiliency of mobile wireless networks that are a significant lifeline for those in need during disasters and other emergencies
- Introducing the Mandatory Disaster Response Initiative (MDRI), which expands the criteria that trigger its activation and introduces new provisions requiring providers to test their roaming capabilities and report on the performance of their implementation of the MDRI to the Commission after disaster events
- This agreement commits mobile wireless service providers to an approach to enhance coordination during an emergency by:
    - Providing for reasonable roaming under disaster arrangements when technically feasible
    - Fostering mutual aid among wireless providers during emergencies
    - Enhancing municipal preparedness and restoration by developing best practices
    - Increasing consumer readiness and preparation through the development and dissemination
    - Improving public awareness and stakeholder communications on service and restoration status

IMPACT

- This action breaks new ground to improve the resiliency of the US's communications networks and achieve near-term benefits in anticipation of future disaster events

Source: Federal Communications Commission, 2022

UK's promotion for mandatory security standards

ISSUE

- There is a need for authorities and operators of critical infrastructures to work together to develop standards that enable effective security responses in the face of acute threats and overcome the obstacles related to structure, technology, and business practices that hinder competition and variety in the supply of network equipment and services

SOLUTION

- UK's 5G Supply Chain Diversification strategy has the vision to provide standards that are set transparently and independently, promoting quality, innovation, security and interoperability
- The goal is to introduce a new, robust security framework for telecoms and raise the height of the security bar and set out tough new standards for telecoms operators to meet in the design and operation of their networks
- The UK government also works with standards and industry bodies, intellectual property licensors and licensees and others to optimize the licensing regime for telecoms standards to enable the modularization of networks

IMPACT

- The UK government believes that these measures will bring about enduring and substantial transformation, establishing the foundation for a vibrant, innovative and dynamic market
- Networks will become more flexible and composed of a diverse range of suppliers. Additionally, all operators and suppliers will adopt security standards to ensure the strength and resilience of networks

Source: UK Government, 2020

US's public investment to expand high-speed internet access

ISSUE

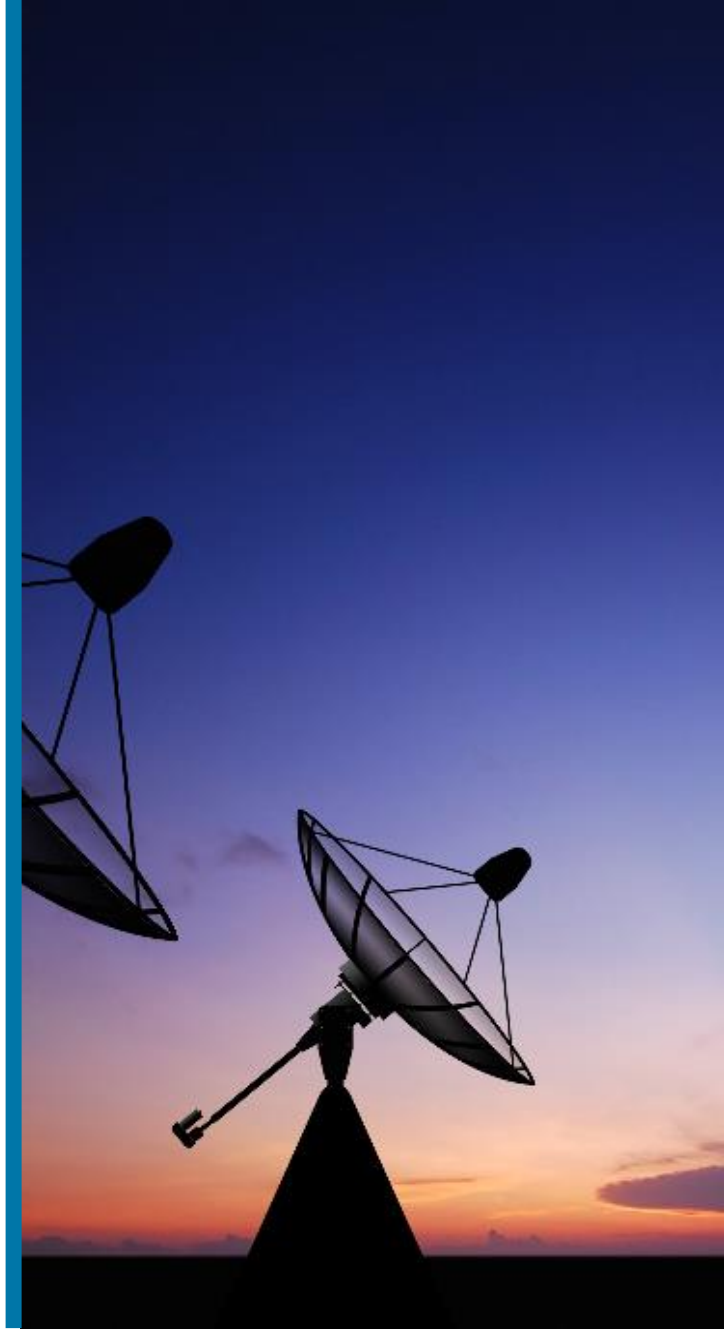
- Many American citizens currently lack access to the countless opportunities facilitated by high-speed Internet. Hence there is a need for infrastructure deployment and access to technologies essential to connect communities

SOLUTION

- US's Broadband Equity, Access, and Deployment (BEAD) Program allocates a total of $42.45 billion to enhance and extend high-speed internet connectivity across the entire United States, including all 50 states
- Funds are allocated to individual states according to their need to increase Internet capacity and speed. The program prioritizes unserved locations that have no or very poor Internet access
- This program funds projects that help expand high-speed Internet access and use. It supports planning and capacity-building, as well as it supports outreach and coordination with local communities on infrastructure deployment by, for example, deploying and/or upgrading broadband network facilities to provide or improve the service to an eligible community anchor institution;

IMPACT

- The primary objective of the program is to ensure that all Americans without broadband access can connect to the Internet without duplicating existing networks or subsidizing government-owned networks in competitive markets



Source: National Telecommunication and Information Administration (NTIA), 2022

Spain's measures to promote affordable connectivity in rural areas

ISSUE

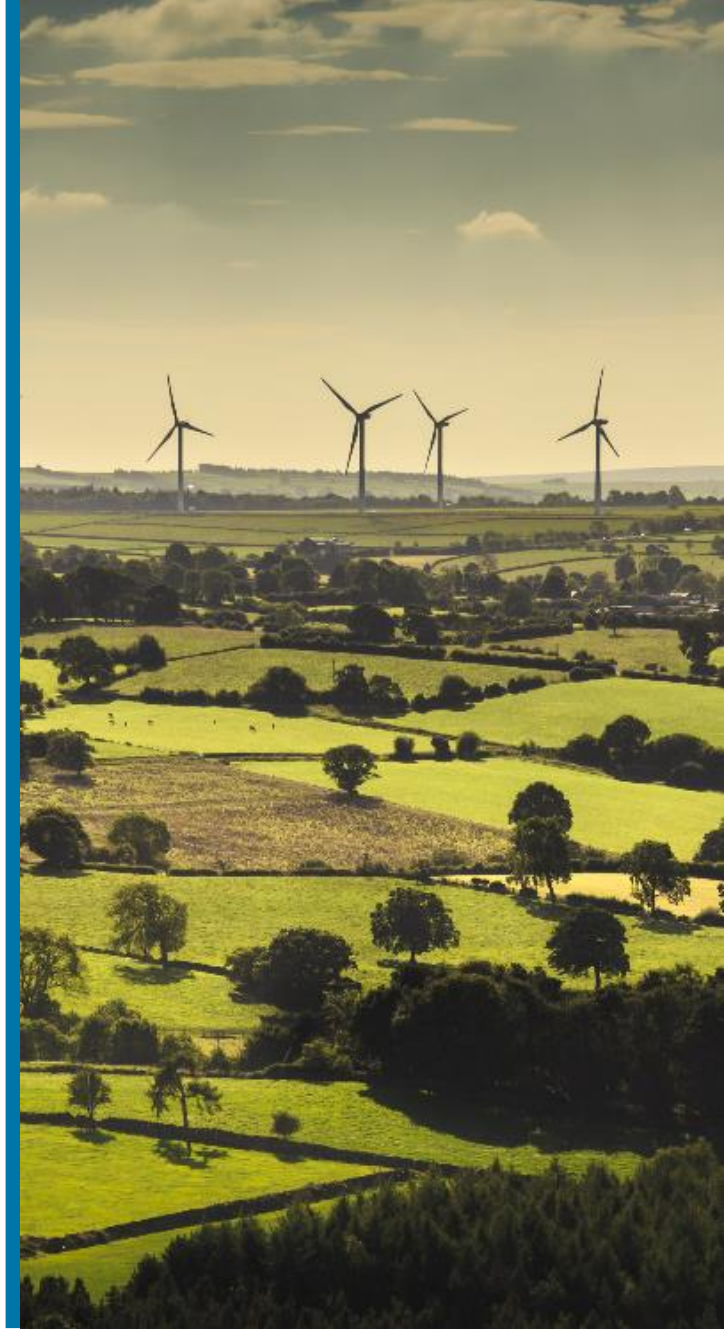
- Spain is taking measures to address market failures, such as the absence of affordable broadband services in remote and sparsely populated regions

SOLUTION

- Spain has introduced a system under the Recovery and Resilience Facility (RRF), making available €88.3 million to facilitate wholesale and retail broadband services in remote, dispersed, and thinly populated rural areas where access to such speeds at affordable prices is currently unavailable. This initiative aligns with Spain's broader strategy to meet the digital needs of its citizens and businesses as the country embraces digital transformation
- The program has been developed as a short-term strategy to expedite and enhance access to high-quality fixed broadband services at affordable rates. Its objective is to facilitate the provision of wholesale services, thereby enabling the availability of affordable retail broadband services at a fixed location
- The program will run until 31 December 2027 and cover part of the wholesale price, reducing it to a level comparable with wholesale prices in more profitable areas. The operators benefitting from lower wholesale prices will, in turn, provide retail services at a price no higher than a predefined maximum price per month subscription to the relevant retail broadband services

IMPACT

- The program will support the take-up by end users of broadband services in areas where the prices are much higher than the prices charged in more populated areas. It also aims to ensure wider availability of high-performing mobile networks capable of delivering high-quality and reliable electronic communication access services, satisfying their current and evolving needs



Source: European Commission, 2020

Canada's investment in LEO satellite constellation to promote the end of the digital divide in rural areas

ISSUE

- The COVID-19 pandemic has highlighted the existence of Canada's digital divide challenge, which is deeply rooted and poses a significant risk to the country's development efforts

SOLUTION

- Canada's government's commitment to providing all Canadians with access to high-speed Internet has led to an investment of $1.44 billion into Telesat's advanced low Earth orbit (LEO) satellite constellation, the Telesat Lightspeed
- Telesat Lightspeed was provided financing through a combination of a $790-million repayable loan and a $650-million preferred share equity investment for which the government would receive a dividend
- As part of this investment, the government obtains warrants that can be converted into common shares in Telesat. This initiative aims to provide Canadians with an opportunity to partake in the financial advantages arising from Telesat Lightspeed

IMPACT

- Starting in 2024, after the public investment, Telesat Lightspeed will facilitate broadband Internet and long-term evolution (LTE) and 5G connectivity across Canada, thereby connecting around 40 thousand households in rural and remote areas
- Telesat has committed to invest $3.6 billion in capital expenditures within Canada and allocate over $1.6 billion towards operating expenses over the next 15 years
- Besides, Telestat is also committed to maintaining up to 700 jobs and supporting post-secondary students, namely devoting $800,000 in scholarships

Source: Government of Canada, 2021

South Korea's network use fees from application providers to ISPs

ISSUE

- Korean Internet Service Providers (ISPs) campaigned for large Content Application Providers (CAPs) to contribute towards the costs of running and expanding their networks. As these content and application services grow in popularity, they generate increasing data flows

SOLUTION

- In 2016, the Korean telecommunications regulator mandated "network use fees", where the fees were to support the investments on three large telecommunications companies' networks that most Koreans depend upon
- The Sending Party Network Pays (SPNP) billing principle became a legal requirement for internet traffic among ISPs. It mandates that fees can be determined by the amount of traffic delivered to an ISP's customers upon content requests
- In 2020 Content Application Providers (CAPs) were legally obliged to pay network fees to ISPs if they have an average daily number of users of more than 1 million or if their traffic accounts for more than 1% of the total traffic in South Korea
- Since 2021, multiple bills have been proposed to enforce contractual obligations between ISPs in South Korea and both local and foreign content providers. These contracts would entail specifying usage fees, duration of usage, available network capacity, and other relevant terms
- An additional bill introduces a prohibition on content providers utilizing an ISP's network without providing "fair consideration" for its usage

IMPACT

- While some industry stakeholders and analysts argue the implementation of SPNP will lead to drawbacks (e.g. less-efficient traffic flows, higher content prices, and lower content quality), others argue it would improve the balance in negotiations between CAPs and telecom operators and lead to benefits (e.g. more network investment capacity, better quality of connectivity services)
- The impacts of the policy are being debated and analyzed. There is not a consensus currently on whether the policy has resulted in net gains or losses for all stakeholders

Source: European Parliamentary Research Service (EPRS), 2023; ; ETNO and KTOA Joint Statement, 2023

Sweden's national digitalization strategy for the school system to develop IT expertise

ISSUE

- Sweden's government recognizes the importance of digital competence in the context of younger generations. Hence, it aims to equip them with the necessary skills to participate in a digitalized society and create further opportunities for digitalization in education, ensuring all students can access digital tools and resources

SOLUTION

- Sweden's National Digitalization Strategy aims to create further opportunities for digitalization and achieve a high level of digital competence among students
- Ensuring equal opportunities for accessing and using digital technologies in the school system, it aims to bridge the digital divide and provide equal access to digital tools and resources for all students

IMPACT

- The strategy has contributed to the progress of digitalization in schools, with school heads reporting an increase in the use of digital tools and resources
- Besides, the follow-up report suggests that efforts have been made to ensure equitable access to digital tools and resources for all students

Source: Swedish Government, 2021

Canada’s government promotion of business cloudification

ISSUE

- There are various risks associated with using commercial, public cloud environments, namely security concerns and data sovereignty, particularly on the control and ownership of data

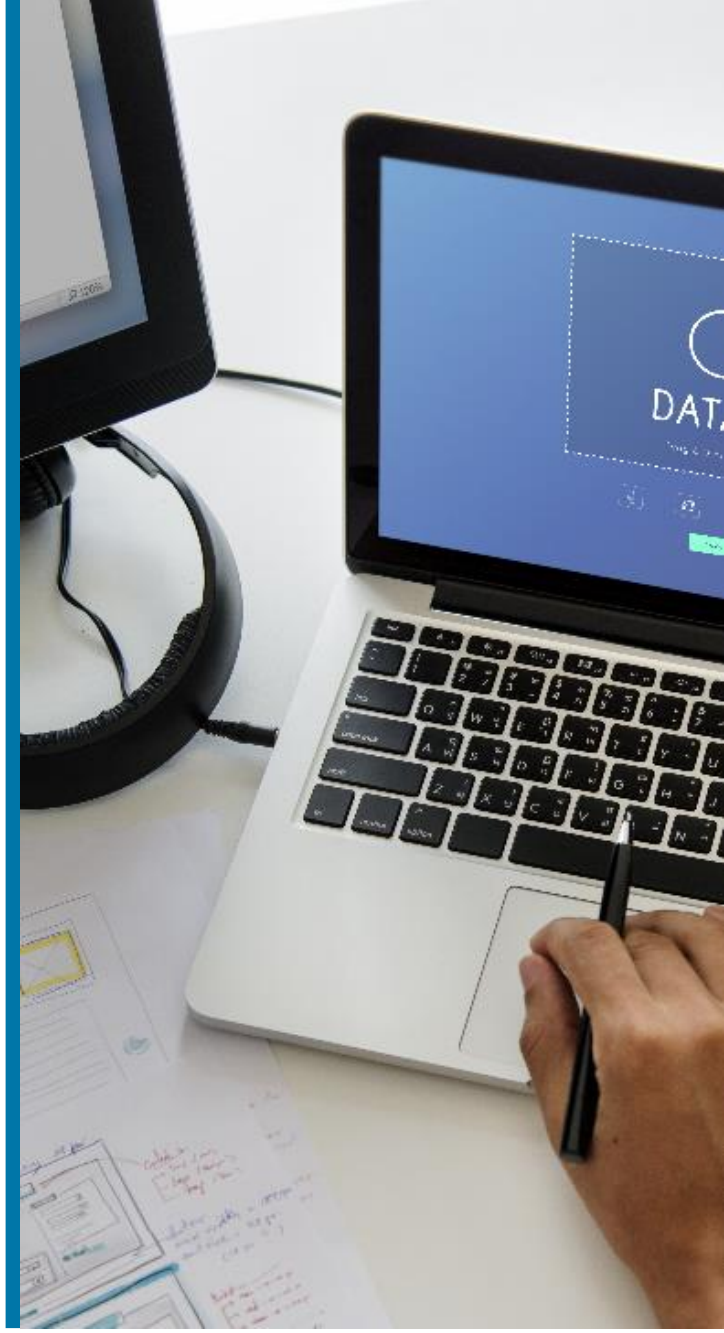
SOLUTION

NON-EXHAUSTIVE

- Canada’s government has launched a White Paper on Data Sovereignty and Public Cloud, promoting public clouds’ use and ensuring their data security measures. Indeed, it explores the challenges related to data residency and security and proposes mitigation measures to address these risks
- The government's cloud-first strategy prioritizes using cloud services in its IT investments and initiatives. The strategy outlines a preference for the following deployment models in order of priority: public cloud, hybrid cloud, private cloud, and non-cloud solutions
- The Treasury Board of Canada Secretariat has determined that a commercial, public cloud can offer sufficient data protection for data up to and including the Protected B level (the second of a 3-levels scale), under certain conditions

IMPACT

- The government of Canada's competent organization will begin reviewing all cloud requests from both an architecture perspective and a risk perspective to ensure that the risks identified in this paper are mitigated to the greatest extent possible, limiting the Government of Canada's exposure to risk



Source: Government of Canada, 2018

South Korea’s investment in new technologies, particularly 6G R&D

ISSUE

- South Korea has recognized the increasing demand for 6G telecommunications and sought to strengthen its competitiveness in the global future technology development. This initiative aligns with South Korea's ambition to be the first country to launch 6G networks and secure its future competitiveness in the telecommunications sector

SOLUTION

- The South Korean Ministry of Science and ICT (MSIT) plans to invest around $194 million in super performance, hyperspace, super precision standards, and other 6G-related research and development activities. This funding will support the development and commercialization of 6G networks, focusing on core technology research and aiming to achieve standardization by 2025. Indeed, the MSIT has designated university R&D research centers, to train experts in the field of 6G and enhance the country's research capabilities
- South Korea aims to lead in international standard discussions related to 6G. The country has secured chairpersons' positions in international standard organizations (e.g., ITU, 3GPP), enabling active participation in shaping global 6G standard
- Besides, South Korea and the US have signed a memorandum of understanding for joint research in 6G. This collaboration, involving an investment of approximately $10 million

IMPACT

- The 6G R&D investment is expected to yield tangible research outputs regarding scientific publications, patents, and intellectual property by fostering collaboration between universities, industry, and government institutions

Source: South Korean Government, 2021

Government of Canada's simplified process for non-complex consolidations and mergers

ISSUE

- Mergers can be highly complex processes and may require investigation to assess potential competition harms including increased prices, reduced output, lower quality of goods or services, or stifling of innovation. Canada's government aims to ensure that the guidelines and regulations are clear and provide a simple framework to facilitate the merger process

SOLUTION

- The Competition Bureau Canada, an independent law enforcement agency in charge of regulating competition in Canada, has published guidelines that outline its general approach to administering the two-stage merger review process, and guidance to businesses involved in merger transactions
- Canada's two-stage merger review process aims to simplify the overview of the merger review process. The first stage involves a preliminary assessment to determine whether a proposed merger raises competition concerns that warrant further examination. If concerns arise during the initial review, the Competition Bureau may move to the second stage, which involves a more in-depth analysis of the merger's potential impact on the competition
- Some mergers are not subject to mandatory pre-merger notification. Whether a proposed transaction is notifiable depends on if certain financial thresholds related to the size of the parties and the transaction are met, as set out in the Canada's Competition Act

IMPACT

- The time required for the merger review process can vary depending on the transaction's complexity and potential competition concerns. The Competition Bureau aims to complete most merger reviews within 30 days, but the timeline can be extended if further analysis is required or there is a need to negotiate. Efforts have been made to enhance the efficiency and transparency of the merger review process

Source: Government of Canada, 2022