WORLD ECONOMIC FORUM

COMMITTED TO IMPROVING THE STATE OF THE WORLD

Community Paper

Global Future Council on New Network Technologies

5G: Society's Essential Innovation Technology

June 2020

Contents

World Economic Forum
91-93 route de la Capite
CH-1223 Cologny/Geneva
Switzerland
Tel.: +41 (0)22 869 1212
Fax: +41 (0)22 786 2744
Email: contact@weforum.org
www.weforum.org

Foreword

Many challenges faced by society today will be addressed and supported by advanced technologies that are able to harness, analyse and connect massive datasets. One of these will be fifth-generation mobile networks, or 5G, which will provide a new foundational communications capability that brings humans and devices into a common orbit built around distributed, near instantaneous interactions. By bringing the power of computing closer to data sources through 5G networks, previously unsolvable problems can now become a reality.

The World Economic Forum's Global Future Council on New Network Technologies, during its 2018-2020 term, focused on the benefits to society and the role of partnerships between government and the private sector when it comes to network technologies. It also explored the incentives for network development and the distribution of value throughout the 5G environment, as well as the role of new systems in driving value and innovation.

This document reflects the various discussions among Council Members and its extended community. Policy examples have been provided for reference and are not necessarily endorsed by all members.

May 2020

Introduction

5G will be the "end of the Gs'" as we know it. Previous mobile generations centred upon very specific – and foundational – use cases to deliver baseline services for voice, texting and data. These use cases were first centred on the subscriber and later incorporated mobile broadband data. Licensed spectrum, allocated and granted by national agencies, formed the vital basis of this new and novel commercial endeavour.

Industry delivered these prior generations through long development cycles punctuated over multi-year or decade-long timeframes. To an extent, this process is somewhat analogous to a large-scale R&D waterfall development process typified by that technology period. What was reflected in the corresponding network deployments can be best described as monolithic equipment platforms often combining multiple functions together with very specific interacting pathways. Looking back, this resulted in many vendor-specific products, slower innovation timelines dictated by fewer and ever similar roadmaps. With resource-intensive and finely balanced network planning, operators were still able to construct high quality mobile networks and services, but at the cost of high operational expenditures and overprovisioned networks.

5G marks a pivotal departure in that model[1] to the extent that devices now become centre stage along with new core foundational technologies incorporating cloud and IT principles. It is the first instance whereby 5G connectivity enables diverse use cases on a truly global and massive scale across licensed, unlicensed and shared spectrum. It enables ubiquitous connectivity of any end user device or sensor using strict performance metrics that are predicated upon a cloud native service-based architecture. This implies also considering the challenges and advances in the radio spectrum as the main basis for the development of the 5G ecosystem.

This construct invites a faster innovation cycle that in its purest form embraces a DevOps operating culture. In other words, discrete functional components cast within an open, micro-services framework evolve independently, providing a vehicle for incremental innovation as compared with prior "big bang" cycles. Instantiation and configuration of unitary resources into tailored network slices permits a much wider environment of innovators to create, deliver and manage services in an entirely new fashion.

5G will not be just another next decade generation upgrade, but a sustaining architecture that will enable 5G and beyond – and reduce the need for a next "G" generation upgrade. It should be, and is expected to be, continuous.

Making Communications and Cloud Indistinguishable

The process and standardization of 5G has been different from prior releases as described above. To meet the dynamic requirements for ubiquity, massive scale and flexibility, the 5G network architecture has been defined as a series of independent and discrete resources from core to access. To achieve these degrees of freedom, the industry elected to define logical network functions that can be designed, built and managed as small modular entities, both hardware and software. Put differently, the prior monolithic structures that dominated earlier mobile generations have been disaggregated into more open, granular components each with a potential innovation track of its own.

Bringing this vision to reality naturally required a fresh approach, leading to a convergence of multiple communication, cloud and IT capabilities into a singular construct known as 5G.[2]

Consider the proposed infrastructure layer as envisioned from the network core to far edge locations (for example, a point of presence near the cellular tower). This novel architecture is premised upon numerous, proven cloud-native and virtualization technologies by incorporating network functions virtualization as a 5G prerequisite. In this model, infrastructure resources deployed to a location are provided through virtualized storage, compute and networking with attention paid to industry norms such as system availability, high performance throughput requirements and industry-specific certifications.

Deployment, configuration and lifecycle management of such highly distributed infrastructure resources and associated workloads require cloud orchestration platforms, which differ dramatically from traditional operational support systems. For remote, unmanned locations deploying this infrastructure presents challenges, and so, the industry is rapidly moving towards an "infrastructure as code" methodology borrowed from the DevOps community.[3] Put another way, target environments are instantiated by descriptive models or blueprints that ensure a consistent and stable operating setting for applications.

Following this cloud-centred trend, at the application layer, mobile network functions now become a software-based application workload that can be deployed anywhere within this virtualized network as needs arise. These workloads are packaged into software instances either as virtual machines or, more recently, as containers, a more flexible option popularized by Docker.[4] Hence, the labels virtual network functions and cloud-native network functions. A natural feature of these different structures is a wealth of real-time data telemetry from every layer and stack component. Collecting, analysing and surfacing event-driven insights set the stage for emerging and future artificial intelligence-based operations and automation.

Automated workload mobility across multiple clouds, managed and orchestrated by cloud management platforms like those found in major data centres, unite all these software-defined technologies together to form an advanced 5G mobile network. Unlike the more restrictive 3G or 4G "monolithic" systems, 5G resources can be dynamically "carved up" into multiple discrete functions, and then repackaged as a network slice designed to provide a service to a unique set of use cases.

By assigning software-defined resources to a specific use case, the same 5G network can deliver more targeted outcomes more efficiently. We can now use one network to deliver multiple, unique services to users or devices according to their specific preferences through cloud management tools that translate the users service intentions into resource fulfillment.

While the flexibility of the 5G network architecture opens a wide variety of new use cases, it also brings with it a new set of challenges. As the virtualization and slicing of the network is designed to support many differing, and concurrent, service requirements in terms of functionality (for example reliability, security, latency and capacity), the orchestration of such a network is inherently more complex than in previous generations and will require new capabilities to allow for efficient, and secure, resource utilization.

It all sounds complex, but the core tenet behind 5G is straight forward. Picture a highly flexible, automated and elastic set of intelligent services moving in concert as demand profiles dictate. Unlike before, the network is not “static”. Through self-monitoring, it has a basic understanding of the external subscribers and devices’ network experience in addition to its own resources, health and ability. If we are to instill the requirement for intent-based services as a worthwhile industry objective, then the preceding functional description must become reality. As such, 5G is not a once-in-a-decade infrastructure upgrade cycle as seen with previous generations, but will possess a DevOps-like environment that can be continuously updated with new functions and capabilities.

Unlocking the "Imagination Potential"

Through the global language of 5G as defined by the standards, near instantaneous communications – from sensors, devices, critical infrastructure or humans – with decentralized, powerful computing and massive storage resources becomes a game changer. Recently, the industry has been swept by a wave of interest and early deployments of edge computing. For service providers, one natural location for edge-computing resources is at the network edge within the access network close to the radio towers.[5] The premise is simple: bring compute closer to the users and Internet of Things (IoT) devices to reduce latency and support data processing near the data sources. Combining network edge computing with the powerful capabilities of the 5G New Radio creates the potential to solve problems that could not be previously addressed. Together, these form the new toolsets to power the Fourth Industrial Revolution.[6]

5G New Radio provides a mechanism to capture or deliver data streams efficiently, at scale and within very tight latencies.[7] It has been designed with sensors and distributed devices in mind. Since sensors have varying degrees of sensitivity in both data transfer rates and expected response times, 5G specifications incorporated these requirements to meet expected demands for device density (for example, utility sensors in one square block of a smart city), throughput (in speed equivalent terms such as Mbps) and latency. As noted above, the ability to slice 5G networks means that any single slice can be configured for the actual needs of that use case by assigning resources to meet the service level objectives. This combination of 5G with distributed edge computing upon which analytics, machine learning, or AI-based technologies reside brings a new set of resources ready to transform industry and society.[8]

One unique aspect of 5G has been its definition through an "industry-first" lens. Requirements for 5G networks continue to be aggregated across various industries and associations to define future deployment and operating models. This industry-first focus has produced an opportunity where the industry, government and other organizations can thrive through the deployment of new use cases that 5G is designed to deliver.

Previous generations of technological advances have had clear business models structured around patents and licenses, with a relatively small number of players. By contrast, 5G holds the potential to enable a rapid expansion of the traditional system with new entrants and verticals driving further developments. In turn, these verticals must consider the complexity of how to license and patent connected products to best capitalize on their invested R&D.

Today, there is an explosive set of hundreds of envisioned use cases ready to be explored with 5G, edge computing, IoT and AI. These new use cases range from basic services on enhanced mobile broadband (eMBB) such as AR/VR, to the exotic, immersive and futuristic scenarios that rely upon ultra-reliable low-latency communication (URLLC) network slices. Recently, a compendium of 40 use cases was published across several primary industries.[9] In addition, further analysis of these use cases,[10] as well as case studies and economic impacts, reveal direct industrial advances and societal impacts.

This comprehensive collection of current use cases illustrates the creative means to apply 5G and related solutions. As we have seen from prior disruptive technologies such as the internet, big data, and social media, major strides have been made in all facets of society and industry to the benefit of many. It is with this proven track record that many are excited to finally pursue formidable challenges knowing that the underlying communications, compute and storage advances will maintain pace.

New Designs Call for New Methods

As noted in the introduction, earlier mobile generations were and have been constructed from monolithic systems using domain knowledge entirely from the communications industry. Blending cloud and IT functionality into a radically new 5G design will dramatically reconfigure supply chains, vendors, operations, workforce skills and business models. The implications are far reaching and at this stage perhaps not entirely understood.

Historically, very specific value chains included telecommunications carriers defining requirements with the network equipment providers and device manufacturers standardizing those requirements. Once the networks were built by carriers, subscribers purchased connectivity from the carriers with often long-term contractual relationships. Back-office systems such as OSS and BSS were deployed along service lines with a more pronounced focus on the network than the customer. Each participant knew their role; the "system" maintained a level of stability. But long-lasting impacts surfaced and became embodied in a risk averse industry culture combined with inflexible, silo-based systems.

This highly structured, and to some, comfortable value chain is rapidly changing, propelled by strong market forces and external pressures. The telecom carrier may no longer be the sole provider of the connectivity value chain. Instead, a new value chain will put users, both consumer and enterprise, and, more shockingly, devices at the centre. Personalization, self-service, dynamic, cloud native, trust, open source, monetization, and so on are new taxonomies that have entered the industry lexicon. The level and scope of change is pervasive and is clear to industry leaders that yesterday's tactics are not today's strategies. This is driving an entirely new set of business models with a broadening of the overall ecosystem.

What these ecosystems seek to capture is value-based innovation that can be delivered rapidly and monetized in a collaborative manner. This demands an increased depth of knowledge about the users' pain points and how to solve big problems. Each of the use case examples outlined earlier reflects some basic guiding features: they are complex, they must demonstrate a recognized return quickly, they involve many participants. In short, easy problems have been solved and more challenging ones remain ahead. Hence, the importance of 5G, distributed computing and machine-driven data analysis at scale all packaged and swiftly delivered for local consumption, provisioned against specific use case KPIs. The sheer scope of solving big problems supports the rising trend and importance of well thought out partners and go-to market motions.

In part, one thing is clear. Delivering and consuming these services requires a new operational model built around automation at scale and led by a reinvigorated digital workforce. New skills and job roles are clear requirements. However, transitioning and forming a modern workforce becomes a daunting task. Many early adopter organizations are currently being reconfigured to better align to these new technologies and ecosystem-driven solutions.

Leadership teams within businesses, service providers and governments must embrace and embody new models of interacting with and adopting innovation from anywhere – externally or internally. Investing in workforce skills, instilling project-driven collaboration and adopting agile practices will pay dividends. If approached with a "fail fast" mentality and a new outlook on embracing innovation, innumerable challenges big and small can be overcome. On aggregate, as the use case examples have demonstrated, society can benefit significantly at large by addressing and solving specific problems locally.

Realizing the Full Potential of 5G as a Platform for Open Innovation

As witnessed throughout the dramatic events imposed by the COVID-19 crisis, it has become increasingly obvious that communications networks are essential and critical infrastructure as entire workforces and government services organizations re-orient their models to work at home. Naturally, this has sharply increased the network load as collaboration tools, video conferencing applications and other remote services saturate both internet and wireless connections. A clear example of this increased use of telecommunications networks can be found in the BEREC report on the status of internet capacity:

"…the overall traffic on fixed and on mobile networks has increased during the COVID-19 crisis, but no major congestion issues have occurred. According to the information available, network operators have been able to cope well with this additional traffic load. Some local and temporary difficulties with the internet access have been observed and mitigated but has not been considered to be out of the ordinary."[11]

In other words, communications providers have responded to these elevated network traffic loads through sound engineering and traditional traffic management practices. Nonetheless, these events – as manifested with the rapid rise of work-from-home, remote education and related activities – provide a glimpse into the forthcoming deluge of data demand that 5G will unlock.

Prior to COVID-19, there was already clear evidence of dramatic increases from mobile data traffic with newly introduced 5G services in advanced markets such as South Korea. Should the "new normal" for some jurisdictions involve continued home-based scenarios, network operators will still be faced with providing improved service quality for existing offers.

Not only that, but service providers will also be expected to introduce innovative new services. For example, consider new high bandwidth formats such as 4K/8K video or AR/VR technologies that will be an integral part of the near-term service mix for home-based businesses, remote workers and students seeking productivity or user experience enhancements. Thus, disruptions to user demographics combined with the expected pipeline of services provide compelling arguments for accelerating 5G deployments to meet these new challenges.

This is precisely what 5G is designed to deliver: efficiently provision and supply network resources rapidly to new and changing traffic conditions; shift and balance resources in a more automated fashion; and become a de facto mobile platform for service creation and innovation. The lesson to be drawn from this unusual set of circumstances is to ensure that adequate resources and polices are pursued to ensure sustainability, resiliency and innovation for future wireless deployments as a societal necessity.

Industry and governments must partner to address key economic and societal challenges while also advancing progress across the UN's Sustainable Development Goals. The 5G open innovation platform will help meet these challenges by powering inclusive digital transformation and sustainable carbon-neutral growth.

Governments and regulators can play their part by advancing policies that incentivize investment in the 5G platform, enable scalable and sustainable innovation on it, and build trust in the adoption and use of the new services. Optimizing spectrum policy and tackling infrastructure deployment obstacles are key priorities towards driving investment and realizing the platform´s full potential.

Optimizing spectrum policy

Uncertainty around spectrum availability and the timing of its release, high spectrum prices, short license durations, inflexible license conditions and unclear renewal terms all act as disincentives for 5G investment. Governments and regulators should maximize spectrum availability and develop a clear and reliable timetable for its assignment, designing auctions that spur high quality infrastructure deployments rather than maximize up-front fees. The table below highlights recent examples of governmental best practices that exemplify this trend.

Country	Policy action best practice
South Korea	The accelerated release of 280 MHz of mid-band and 2400 MHz of high-band spectrum for 5G enabled Korea to deploy the world's first 5G commercial services in April 2019. Through its December 2019 5G+ Spectrum Plan, the government aims to double spectrum availability for 5G services by 2026.
United States	The US Federal Communications Commission put the release of more spectrum, including 5GHz of mmWave and over 600 MHz of mid-band spectrum, at the heart of its 5G Fast Plan.[12] It is committed to an affordable spectrum supply policy that improves operational efficiency and customer experience.
France	In a landmark New Deal for Mobile,[13] the French government waived renewal fees in exchange for legally binding commitments to extend network coverage. The initiative applies to licenses in the 900, 1800 and 2100 MHz bands that are expiring between 2021 and 2024. To deliver ubiquitous 4G, each of the four operators will build 5,000five thousand new cell sites, some of which will be shared, at an estimated cost of 3 billion euros.
Saudi Arabia	As part of the National Transformation Program 2020 initiatives, the Communications and Information Technology Commission accelerated the clearance, re-farming and award of 870 MHz in the bands below 6 GHz between Q2 2017 and Q1 2019 using 5G empowering band and channel plans. Auctions were designed to maximize spectrum utilization rather than proceeds and license fees for 5G spectrum were delayed by three years to support network infrastructure investments.
Austria	The 5G spectrum auction objective aimed to incentivize deployment rather than maximize revenue. The regulator designed an investment-friendly auction where each bidder was able to acquire enough spectrum at a relatively low price. The price per megahertz per population in the C-band auction was €cents 5.77, considerably lower the same spectrum auctioned in Germany for €cents 16.77 and Italy for €cents 35.93.
Japan	Japan allocated the 5G spectrum licenses at no cost to MNOs (including mid-range spectrum in 3.7 GHz) via a competitive tender. Instead of auctioning the spectrum, the tender process awarded the spectrum licenses to the best 5G investment proposals.
Colombia	In the recent 700 MHz spectrum auction the Colombian government successfully introduced an innovative auction model to allow successful bidders to pay for spectrum fees with CAPEX investments; 60% of the $1.5 billion raised will be used to expand mobile coverage to 3,628 unconnected rural towns.

Tackling infrastructure deployment obstacles

Obstacles to 5G infrastructure deployment include slow and complex approval and permit processes for base station sites, expensive site rentals, and the challenges and costs of providing backhaul and power. Locally imposed, overly restrictive EMF limits create further barriers. Governments and regulators should promote site availability and affordability, accelerate approval processes, and ensure consistent application of internationally recognized EMF limits.

An overall policy commitment that focuses efforts on effectively addressing deployment obstacles will ultimately support expanded 5G deployments and accelerated adoption. Recent benchmarks and best practices are shown in the following table.

Country	Policy action best practice
South Korea	The Ministry of Science and ICT's 5G+ Strategy positions 5G as an innovation growth engine and plans to mobilize $25 billion in public and private funding to secure nation-wide coverage by 2022. The strategy targets use cases covering immersive content, smart factories, autonomous vehicles, smart cities and digital healthcare with the overall ambition of contributing $150 billion to GDP and 600,000 new jobs by 2026.
United States	As part of its 5G Fast initiative, the US has reduced impediments to deploying small cell infrastructure and given states and localities a deadline to approve or disapprove siting applications. The Federal Communications Commission is also trying to ensure that states and municipalities levy site access fee on a cost recovery basis.[14]
European Union	The Broadband Cost Reduction Directive sets out a centralized process for making information available on infrastructure deployment and dispute resolution. It sets a four-month deadline for decisions on planning permits. In its recent Digital Strategy for Europe Communication, the European Commission has committed to updating and upgrading the measures set out in the Directive.
Poland	The Ministry of Health adopted a new regulation setting internationally accepted limits for electromagnetic radiation, consistent with the recommendations set by the International Commission on Non-Ionizing Radiation Protection (ICNIRP). By adopting the limits aligned with the ICNIRP values, Poland will be able to facilitate the launch of 5G networks, which would have been operationally and commercially difficult under the former strict limits.
Saudi Arabia	The Communications and Information Technology Commission facilitated the modernization of mobile network infrastructure deployment regulations, in collaboration with the Ministry of Municipal and Rural Affairs, to enable the large-scale deployment of base stations of all sizes and types (from lamp sites to macro sites) in residential and non-residential areas and is developing an automated system to provide instant approvals for base station permits by the end of 2020.
Peru	The Ministry of Transport and Communications in Peru established an automatic permit approval if the operator or passive infrastructure provider presents the tower installation work plan with all legal requirements met – a measure termed "positive administrative silence".

Conclusion

5G is a paradigm shift in network architecture that has the potential to fundamentally change what, and how, services are delivered. This shift in network structure brings with it its own set of challenges, ranging from intellectual property and licensing, to orchestration and security that will need to be overcome in order to enable successful growth of communication services.

From a larger vantage point, this critical evolution in the long arc of mobile systems will prove to be an influential industry milestone that opens an entirely new set of possibilities that stretch far beyond traditional operators for individuals, industry, governments and other organizations.

No matter how this paradigm is looked at – from an industry, architecture, or value chain view – the result and opportunity look the same: 5G is a keystone solution enabling and supporting a vast set of use cases both known and yet to be considered.

The Global Future Council on New Network Technologies has served as a platform to address the paradigm shift and the societal impact of 5G and and its members will continue to align with the World Economic Forum's mission to improve the state of the world as part of the 5G Global Accelerator Community.

Acknowledgements

Global Future Council on New Network Technologies

Council Members

Name	Last name	Position	Organization	Country
Laxmi	Akkaraju	Chief Strategy Officer	GSMA	United Kingdom
Bocar	Ba	Chief Executive Officer	Samena Telecommunications Council	United Arab Emirates
Aileen	Chia	Deputy Chief Executive, Policy, Regulation and Competition Development; Director-General, Telecoms and Post	Info-communications Media Development Authority of Singapore (IMDA)	Singapore
Sylvia	Constaín	Minister of Information and Communications Technologies (2018-2020)	Ministry of Information and Communications Technologies of Colombia	Colombia
Erik	Ekudden	Chief Technology Officer	Telefonaktiebolaget LM Ericsson	Sweden
Maxime	Flament	Chief Technology Officer	5G Automotive Association	Germany
Jeon	Hong-Beom	Senior Executive Vice-President	KT Corporation (Korea Telecom)	Republic of Korea
Elizabeth Hyman	Hyman	Chief Executive Officer	XR Association	USA
Vishal	Lall	Chief Operating Officer	Hewlett Packard Enterprise	USA
Manish	Mangal	Chief Technology Officer, Network Services	Tech Mahindra Limited	USA
Muriel	Medard	Cecil H. Green Professor of Electrical Engineering and Computer Science	Massachusetts Institute of Technology (MIT)	USA
Atul	Mehta	Investor, Technology, Venture Capital and Funds	Digital Opportunity Fund	USA
Andreas	Mueller	Chairman	5G Alliance for Connected Industries and Automation (5G-ACIA)	Germany
Akihiro Nakao	Nakao	Professor, Interfaculty Initiative in Information Studies	The University of Tokyo	Japan
Robert	Pepper	Head, Global Connectivity Policy and Planning	Facebook Inc.	USA
Rima	Qureshi	Executive Vice-President and Chief Strategy Officer	Verizon Communications	USA
Thomas	Reichert	Chairman, Global Practices; Global Leader, DigitalBCG	Boston Consulting Group	USA
Paul Michael	Scanlan	Chief Technology Officer, Carrier Network Business Group	Huawei Technologies Co. Ltd	Hong Kong SAR, China
Kevin Shatzkamer	Shatzkamer	Vice-President, Enterprise and Service Provider Strategy and Solutions (2019-2020)	Dell EMC	USA
Surina	Shukri	Chief Executive Officer	Malaysia Digital Economy Corporation (MDEC)	Malaysia
Martha	Suarez	President	Dynamic Spectrum Alliance	USA
Renata	Zanuto	Co-Head, Cubo	Itaú BBA	Brazil

Council Fellow

Bo Wei,
Assistant Professor, Faculty of Science and Engineering, Waseda University, Japan

Council Manager

Rodrigo Arias,
Lead, 5G and Digital Transformation, World Economic Forum

Special thanks to Kevin Shatzkamer and Robert Gojmerac at Dell Technologies for consolidating all input provided by the Council and giving shape to it in this paper.

The World Economic Forum would like to extend its gratitude to Council Co-Chairs, Laxmi Akkaraju, Chief Strategy Officer, GSMA, and Atul Mehta, Investor, Technology, Venture Capital and Funds, Digital Opportunity Fund, for their leadership. The Forum would also like to acknowledge the teams supporting the Council Members, who have contributed to this work, and thank the Forum's Editing, Publications and Media teams for their support for the launch of this paper.

Endnotes

1. Gurnani, CP, “5G isn’t just a buzzword. It will change the world”, *Forum Agenda*, 21January 2019, https://www.weforum.org/agenda/2019/01/here-s-how-5g-will-revolutionize-the-digital-world.
2. Shatzkamer, Kevin, “Transforming Network Infrastructure for Cloud-Optimized 5G Services”, *Dell EMC*, 5 September 2017, https://blog.dellemc.com/en-us/transforming-network-infrastructure-for-cloud-optimized-5g-services.
3. Guckenheimer, Sam, “What is Infrastructure as Code?”, *Microsoft Build*, 4 April 2017, https://docs.microsoft.com/en-us/azure/devops/learn/what-is-infrastructure-as-code.
4. Author’s note, “What is Infrastructure as Code?”, *Microsoft*, 2017, https://docs.microsoft.com/en-us/azure/devops/learn/what-is-infrastructure-as-code.
5. Pugh, Ron, “Telecoms at the Edge Offers Huge Opportunity”, *Dell EMC*, December, 2019, https://blog.dellemc.com/en-us/telecoms-at-the-edge-offers-huge-opportunity.
6. Schwab, Klaus, “The Fourth Industrial Revolution”, World Economic Forum, https://www.weforum.org/about/the-fourth-industrial-revolution-by-klaus-schwab.
7. Desjardins, Jeff, “What is the future of 5G?”, *Forum Agenda*, 31 August 2019, https://www.weforum.org/agenda/2018/08/5g-the-next-generation-of-mobile-connectivity.
8. Suri, Rajeev, “5G will redefine entire business models. Here’s how”, *Forum Agenda,* 23 January 23 2019, https://www.weforum.org/agenda/2019/01/5g-will-redefine-entire-business-models-here-s-how.
9. World Economic Forum, *Repository of use cases. The Impact of 5G: Creating New Value across Industries and Society*, November 2019, http://www3.weforum.org/docs/WEF_The_Impact_of_5G.pdf.
10. World Economic Forum, *The Impact of 5G: Creating New Value across Industries and Society*, January 2020, https://www.weforum.org/whitepapers/the-impact-of-5g-creating-new-value-across-industries-and-society-9b6e9d073d.
11. BEREC, *Report on the status of internet capacity*, 30 March 2020, https://berec.europa.eu/eng/document_register/subject_matter/berec/press_releases/9238-press-release-berec-report-on-the-status-of-internet-capacity.
12. See https://www.fcc.gov/5G.
13. See https://en.arcep.fr/news/press-releases/p/n/new-deal-for-mobile-1.html.
14. This decision was currently under review at the time of publication.

WORLD ECONOMIC FORUM

COMMITTED TO IMPROVING THE STATE OF THE WORLD

The World Economic Forum, committed to improving the state of the world, is the International Organization for Public-Private Cooperation.

The Forum engages the foremost political, business and other leaders of society to shape global, regional and industry agendas.

World Economic Forum
91–93 route de la Capite
CH-1223 Cologny/Geneva
Switzerland

Tel.: +41 (0) 22 869 1212
Fax: +41 (0) 22 786 2744

contact@weforum.org
www.weforum.org