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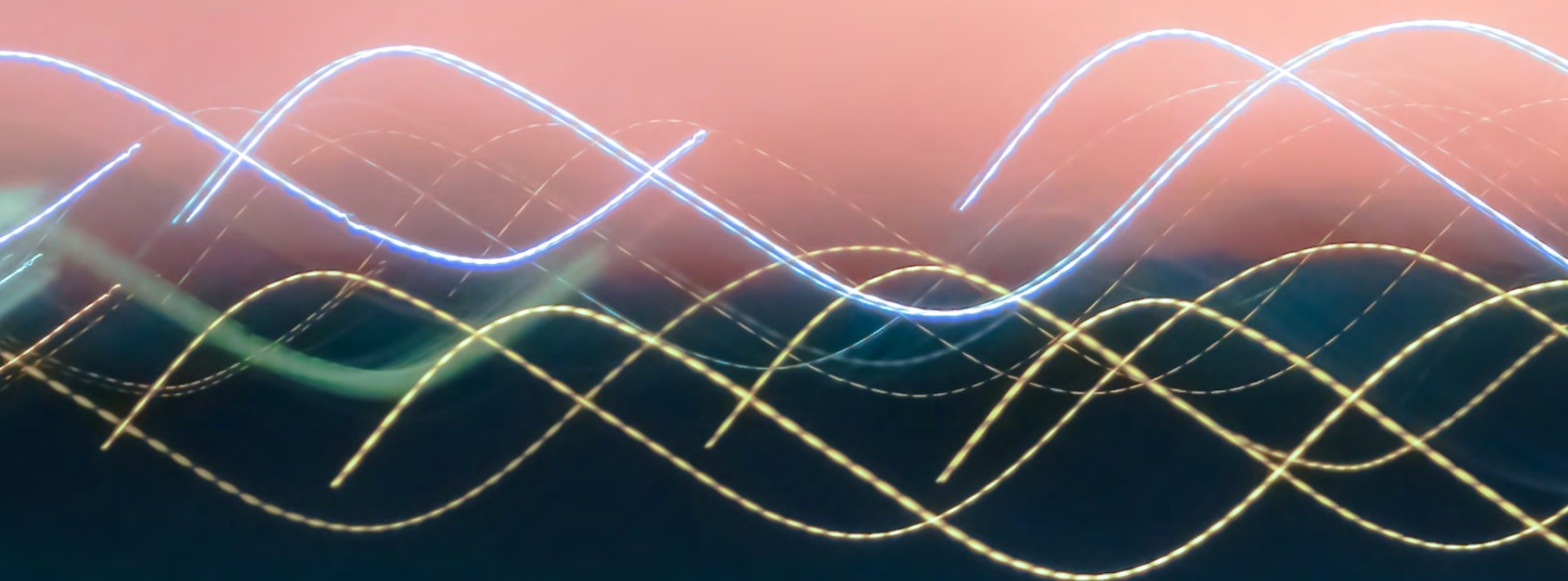
WORLD ECONOMIC FORUM

5G Outlook Series:
Enabling Inclusive Long-term Opportunities

JANUARY 2021



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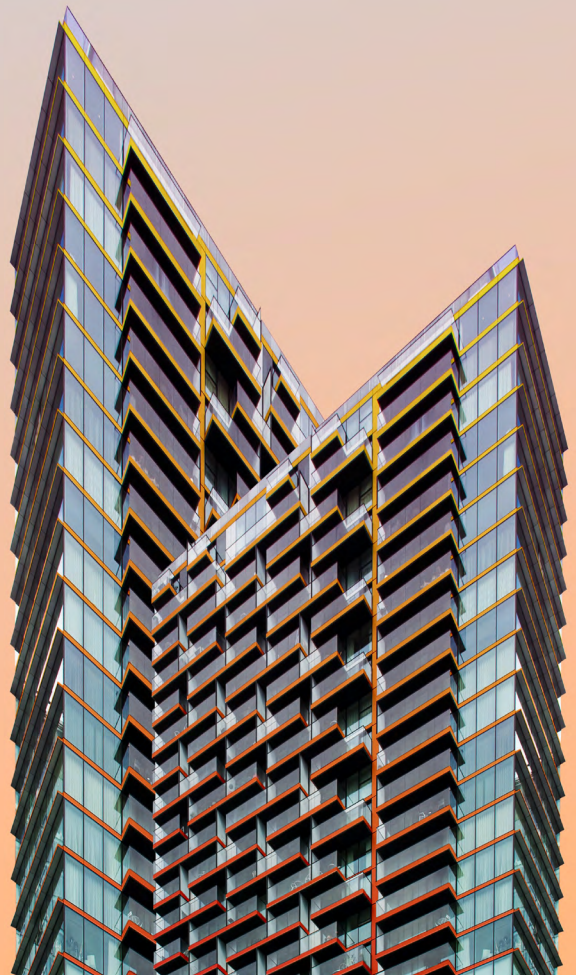
Contents



Foreword

In 2020, communications reinvented the way we team up, learn and work. With large proportions of the world's population confined to their homes, several years' worth of digital transformation has taken place over a matter of weeks. This rapid switch to digital technologies was noticed in even the most technologically resistant industries, among small and medium businesses and across all countries, developing and advanced.

This report concludes the 5G Outlook Series of publications in 2020 that have been analysing the role of 5G in the short, medium and long term in the context of the pandemic and the economic crisis. Five key takeaways have emerged from interviews and workshops:

1. In the 2020s and beyond a robust 5G infrastructure will be foundational to both inclusive economic growth and competitiveness
2. 5G has the potential to democratize computing, helping to close digital divides
3. Public-private partnerships are essential to success and broad-based gains
4. To benefit from 5G, countries urgently require a clear strategy for cross-industry investment and policy
5. 5G is a general-purpose technology enabler, unlocking the potential of cloud, artificial intelligence (AI) and edge computing

These insights will contribute to shaping public-private dialogues across sectors throughout 2021 as well as initiatives related to digital inclusion, digital transformation and the Fourth Industrial Revolution agenda.

Executive summary

The year 2020 brought global challenges that none of us could have ever expected or had experienced before. Businesses and governments adopted digital technologies in a matter of weeks which might otherwise have taken several years. Surviving the pandemic through the adoption of digital tools and skills has given us additional flexibility and resilience to deal with uncertainties in the future, whatever form they may take.

This switch to digital technologies has advanced consideration of 5G's role in a post-COVID world. Given that it is the first mobile network designed to connect a massive number of devices in addition to humans, 5G presents a central opportunity for digitization as the world emerges from the global pandemic.

Interviews with global chief executive officers, presidents and chairpersons of leading technology companies as well as senior government officials have curated the following nine specific opportunities:

5G on the move	1. **Remote operations** to manage workplaces, generating data-driven insights to ensure better productivity as well as safe and secure operations.
	2. **Connected transport** through real-time vehicle-to-vehicle communication enables a partly driverless future, making travel and transport safer and more efficient.
	3. **Mass adoption** brings a new wave of smart and personalized services to connect our increasingly integrated digital and physical lifestyles post pandemic.
5G on-site	4. **Smart monitoring** enables the automation of asset-management processes freeing up time for asset utilization and increasing workplace safety and security.
	5. **Environmental protection** will benefit from new management techniques, driven by the ability to monitor, assess and act in a sustainable manner as 5G scales up.
	6. **Autonomous robotics** allows real-time automation to improve efficiencies in carrying out complex and repeatable, sometimes hazardous, operational tasks.
5G in communities	7. **Democratizing 5G** enables a wider uptake of benefits across communities through public-private collaboration, which results in a more efficient use of scarce, available resources.
	8. **Regionalizing 5G** by encouraging earlier deployment through incentives, benefiting people and businesses based outside major urban centres.
	9. **Experiential living** – transforming our interactions socially, in classrooms, while gaming, with families, and in many other social and community settings.

1 Leadership perspective on 5G

5G will help catapult Colombia, promote its culture, boost the economy and stimulate talent for a new technological era. It will allow us to be at the forefront and enable the implementation and use of emerging technologies that will improve lives and opportunities for Colombians.

Karen Abudinen, Minister of Information and Communication Technologies of Colombia

Through its ability to connect everything to the cloud in a reliable manner, 100% of the time, 5G will help democratise computing by enabling access to powerful compute-intense applications in the cloud. And, as 5G-enabled devices quickly approach mass market, this will benefit consumers as well as the broader digital transformation of industries.

Cristiano Amon, President, Qualcomm

Governments need to prioritize getting enterprises on 5G now, not least through investment friendly policies. Enterprises can unleash 5Gs potential as a platform for innovation, taking forward uses that help us emerge strongly from Covid-19 and tackle other acute challenges, such as climate change.

Börje Ekholm, President and Chief Executive Officer, Ericsson

5G has the potential to revolutionize and transform entire industries but could also worsen the digital divide with irreversible consequences. If we fail to recognize the promise of 5G for developing countries and the need to make the technology safe, affordable and inclusive, we will fail in our mission to promote equitable growth across the world.

Boutheina Guermazi, Director, Digital Development Department, The World Bank

5G will have a far-reaching impact on people's quality of life and on Chile's productivity. With the opening of the offers of the interested operators, we are getting closer to having 5G in the country.

Gloria Hutt, Minister of Transport and Telecommunications of Chile

The world is changing. Physical industries, such as manufacturing, utilities and healthcare, must adopt Fourth Industrial Revolution technologies, including 5G, in order to keep up with customer expectations. The outcome will be more resilient supply chains, productivity growth, quicker go-to-market, and immense economic gain.

Pekka Lundmark, President and Chief Executive Officer, Nokia

Cellular and WiFi have enabled the interconnected lives we lead. 5G and WiFi6 together will power the next era, transforming businesses, economies and nations. It is my hope that we will become more connected, collaborative and ultimately more responsible global citizens as a result of the hyper-connectivity achieved from these technologies.

Antonio Neri, President and Chief Executive Officer, Hewlett Packard Enterprise

Applications with massive bandwidth requirement will first benefit from the availability of 5G. The massive roll-out of 5G will help to drive cost down significantly and open up application scenarios which are commercially not feasible today.

Peter Weckesser, Chief Digital Officer, Schneider Electric

5G will drive tremendous investment in Digital Infrastructure globally and its impact will be more fundamental and profound on how we live than we can anticipate today.

Sanjiv Ahuja, Chairman and Chief Executive Officer, Tillman Global Holdings

The new normal is a change in how we think about remote working. 5G presents us with an acceleration of how we serve customers, and it is the beginning of low touch operations with little human interaction.

Sigve Brekke, President and Chief Executive Officer, Telenor Group

While governments cannot predict what future consumer tastes across all industries will be, we do have a unique ability to mobilise and encourage key players within industry sectors to develop 5G solutions and use cases.

Paul Fletcher, Minister for Communications, Cyber Safety and the Arts of Australia

The greatest value of 5G lies in enabling the digital transformation of industries. For companies, it will cut costs and boost productivity. For people, it will make the workplace safer and less taxing. Every industry is unique so we need to identify real and practical needs.

Ken Hu, Deputy Chairman, Rotating Chairman, Huawei

The current COVID crisis should also be seen as an opportunity to accelerate digital transformation, a key differentiator for the post-COVID world. This includes security, which has to be addressed at an architectural level to ensure the robustness and reliability of critical network infrastructure.

André Kudelski, Chairman of the Board and Chief Executive Officer, Kudelski Group

At a time when countries need to decide on how to best respond to the pandemic, Governments should take the opportunity to set the right policies for the future and aim at implementing thoroughly planned measures that will benefit the population not only in the short-term, but above all in the long-term.

Mario Maniewicz, Director of the Radiocommunication Bureau, International Telecommunications Union

5G alone cannot be a solution for the pandemic crisis but in combination with other technologies it can help drive recovery. To support this, a huge amount of investment is needed to upgrade the telecom infrastructure.

Alain Rauscher, Founder, Managing Partner and Chief Executive Officer, Antin Infrastructure Partners

We live in an interesting intersection of time and technology. The pandemic crisis has shown that technology has a critical role to play and that the once hypothetical future world scenarios are now real.

Andrew Weinberg, Founder, Managing Partner and Chief Executive Officer, Brightstar Capital Partners

2 5G is set to play a key role in a post-COVID world

Despite many businesses feeling capital constraints under the pandemic, numerous markets have seen an acceleration in 5G network deployment in 2020, revealing new levels of confidence in the role of 5G as we recover.

In fact, industry analysts have suggested 5G will add $3.8 trillion, or 2%,[1] to expected gross output by 2035, supporting 22.8 million new jobs.[2] These benefits will be felt in many industries as 5G provides the technology to digitize business, enabling value chains to evolve and markets to grow. As we emerge from the pandemic, this paper finds that 5G is expected to have a profound impact in both emerging and advanced economies and across the themes depicted below.

Industrial growth	Social cohesion	National development
5G will play a role to sustain change haphazardly forced on industries during the pandemic. The pandemic forced adoption of digital tools and practices in weeks, for what would have taken years of incremental transformation. This sudden transition has challenged perceptions of the physical location of work, the organization of the supply chain and interactions with customers and partners. As we move beyond addressing pandemic-related emergencies, 5G's role in embedding impacts will emerge.	5G offers an opportunity to challenge the digital divide, since the pandemic has threatened to exacerbate inequality. But it is believed 5G deployment economics may support mass deployment in densely populated regions of developing countries, including many parts of South and South-East Asia, Africa, the Middle East and Latin America. Population density, flat topography and a lack of fibre combine to make the case for deploying 5G in developing markets more attractive than before the pandemic struck. With the benefit of shared deployment models, 5G is also poised to expand into regional areas outside cities in many countries.	The pandemic has underlined the importance of emerging technologies that will support societies in adopting digitization. 5G is thus poised to contribute to nationwide uplifts in GDP and employment in all countries, requiring the collaboration and cooperation of both the private and public sectors. Realizing these opportunities requires a favourable policy environment to remove obstacles that delay or prevent the rapid and wide uptake of 5G. Fast and fair 5G deployment needs enabling policies to accelerate site acquisition and promote the sharing of infrastructure. The public sector may also play a role in funding support to ensure inclusion of the disadvantaged.

Source: PwC | Strategy& analysis

3 Nine opportunities for 5G to enable transformation in the long term

While 5G is a mobile communications technology, its impact will be felt both in terms of mobility across geographies as well as in micro-locations such as factories, homes and sites designated for specific use. This includes imparting learning (e.g., a school or university) or providing healthcare (e.g., a clinic or hospital). Broadly, three themes for 5G to enable transformation in the long term have been identified:

1. **5G on the move**, representing the impact 5G will have in enabling and facilitating the movement of assets and people post-pandemic

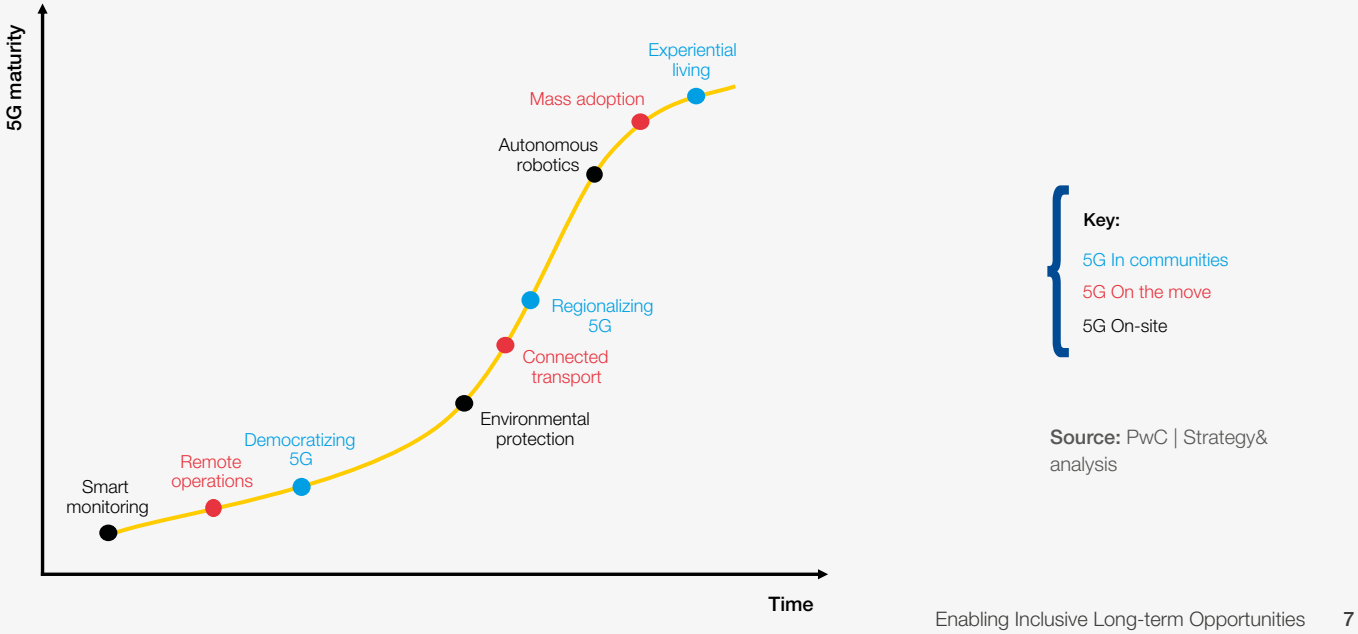
2. **5G on-site**, representing how 5G will help transform industrial processes and ways of working through enabling connectivity in factories, offices and other places of industrial activity

3. **5G in the community**, representing how 5G will transform how we live, work and play in our communities, families and in both urban and regional spaces.

5G is expected to emerge as a technology which has versatile uses both outdoors and indoors, recognizing that some 80% of mobile traffic today terminates or originates in a building.[3] Leveraging the momentum of 5G deployment in the re-emergence from COVID-19, scaled economic impact is expected to be driven by 5G from 2025 onwards.

The graphic below aims to convey how 5G may be expected to create impact in the long term on the move, on-site and in communities. Over time, it is likely that greater maturity will be achieved in all three impact themes, culminating in experiential living, mass adoption and autonomous robotics becoming mature throughout societies and economies. The sequence applied for maturity of each theme is drawn from senior leader consultations in preparing this document, as well as supporting industry analysis. The relative positioning of themes is not intended to be at scale.

FIGURE 1 **The nine opportunities for 5G on-site, on the move and in communities**



Source: PwC | Strategy& analysis

5G on the move

5G on the move consists of three sub-themes: remote operations, connected transport and mass adoption.

1 **Remote operations** provide an opportunity to remotely manage physical workplaces, generating data-driven insights to ensure better productivity as well as safe and secure operation.

5G enables AI-enabled, real-time remote diagnostics, a capability that leaders have told us is critical for sustaining many industrial and community-support functions in the post-COVID world, and especially in a world with risks of natural disasters and emergencies. This opens the opportunity to use smart machine vision combined with AI for efficient detection, reporting and insights. Some industries – for example, in disaster management, healthcare, manufacturing and utilities – are already trialling this technology. With the development of further use cases, other industries are not far behind. Remote operations will help remove geographical barriers and, especially when used in conjunction with other technologies, greatly reduce the potential for human error. The development of edge computing will enable necessary data processing to occur near-site or on-site, paving the way for a new wave of connected devices to be synchronized in real-time.

Establishing 5G's role:

Emerging from the COVID pandemic, initially, remote operations will be crucial to maintaining a safe distance between workers but over time will allow industry specialists to provide their expertise regardless of location. Establishing 5G's role requires undertaking trials and developing enabling industry-based protocols to drive standardization and manage common risks, for example, in performing remote healthcare procedures.

Case study: Telefonica O2 partnered with Samsung, Visionable and Launchcloud for the trial of a 5G smart ambulance use case. Smart ambulances were able to conduct on-the-spot diagnostics and communicate with doctors to reduce the need to either transfer patients to hospitals or to enable patients to be stabilized more effectively through mobile expert consultation before they reached the hospital.[4]

2 **Connected transport** through real-time vehicle-to-vehicle communication enables a partly driverless future, making travel and transportation safer and more efficient.

It is well known that connecting vehicles to move in an efficient and integrated system with minimal human interaction will eventually become possible with 5G. A combination of low latency connectivity, fast data transfer and massive bandwidth to support increased device density will deliver the reliable and real-time connection required. Key benefits will include improving safety by decreasing the number of incidents associated with human error and improving transport efficiency by calculating the most efficient pathways available to a vehicle. While trials are under way in some places, it is unlikely that end-to-end driverless transport will become a reality this decade. However, part-driverless routes will begin to be implemented sooner and will provide an important testing ground for longer-term evolution. Industry leaders have explained that connected transport could collectively transform and aid the diversification of supply chains, and in the post-COVID world this carries the potential to significantly reduce future risks of disruption. The operator addressable revenue related to 5G connected vehicles alone is estimated at $69 billion in 2026.[5]

Establishing 5G's role:

A complex set of regulatory standards will need to be developed, which ensure that quality and safety standards are met, complying with both transport and communications industry needs. Global harmonization, or at least significant cooperation in the sharing and creation of applicable rules is likely to minimize legal and regulatory hurdles for firms engaging in this area. Supportive future-of-work policies will be needed to counter potentially negative social impacts from the loss of transportation jobs, mitigated through reskilling activities in the short term, as well as empowering workers to take up the new roles to be created as a result of transformation within the transport industry.

Case study: In Sweden, an autonomous 5G-enabled minibus pilot has been conducted along a short route on the island of Djurgården. Further trials are expected as part of an initiative led by Urban ICT Arena in partnership with Keolis, Telia, Ericsson and Intel, which focuses on how 5G and control towers can help facilitate the safe introduction of self-driving vehicles and make 5G-enabled electric driverless public transport services a reality.[6]

3

Mass adoption brings a new wave of smart and personalized services to connect our increasingly integrated digital and physical lifestyles post-pandemic.

The way we consume, exercise, learn, work and do many other things has changed in 2020. In the post-COVID world this is expected to change even more as communities seek safer, more efficient and flexible ways to interact. Huawei's latest *Global Industry Vision* report projects that, by 2025, for every adult on earth there will be, on average, five smart devices. Eight billion smartphones aside, it is expected there will be more than 20 billion PCs, tablets, VR headsets, smart watches and screens and other smart devices.[7] Enhanced mobile broadband (eMBB) through 5G networks provides a first-of-a-kind capacity to connect such devices, 5G being the first network designed to connect millions of devices per site, rather than hundreds of humans. A new horizon of opportunities lies ahead in how we can reimagine many services whilst on the move, given how 5G networks will be able to connect data which can personalize and anticipate our needs better than ever before.

Establishing 5G's role:

Facilitating widespread deployment of 5G and affordability of device deployment, access and connectivity will be required. Affordability of devices for mass adoption poses new commercial challenges to communications operators and other firms which install this capability to find enticing new business models that encourage large-scale uptake. There are also critical risks that will need mitigation. Firstly, elevated energy demand for the production and connection of billions of devices globally will bring new environmental concerns. Secondly, greater reliance on connected devices heightens vulnerability to a loss of data privacy and security.

Case study: China Mobile and Huawei have jointly launched the world's first 5G shopping mall, L+ Mall, in Shanghai, using the 5G digital indoor system (DIS).[8] The mall is a testbed for trailing new, diverse, personalized and richer shopping experiences for customers.

5G on-site

5G on-site consists of three sub-themes: smart monitoring, environmental protection and autonomous robotics.

4

Smart monitoring enables the automation of asset management processes many of which may currently not be digitized, freeing up time for workers to focus on asset utilization as well as increasing workplace safety and security.

While remote asset tracking and monitoring applications have well-established use cases, industry leaders have observed that the widespread application of 5G in this space is being limited by the use of current business models for deploying devices and connectivity, which were designed for deploying dozens rather than thousands of connections on-site. With suitable commercial models in place, 5G is expected to overcome these barriers by reducing long-term operating costs in business, as well as offering benefits in terms of enhanced connection density, deeper coverage and reduced power consumption.

Through 5G's ultra-reliable, low latency connectivity, the widespread use of connected sensors feeding real-time information will enable businesses to develop the capability to sense, analyse and actuate data in the production environment. This will enable transformation in many different industrial and production environments, promoting efficiency, accuracy and safety. Once at scale, it is likely to become economically viable to track and constantly monitor a wider range of assets in real-time with predictive maintenance that will decrease unplanned downtime.

Establishing 5G's role:

Industrial and government stakeholders will be required to each encourage widespread adoption of monitoring solutions in their respective operating environments, meaning that current use cases must be positioned to demonstrate tangible benefits and for this to be done across multiple industry verticals. Role establishment will have to happen industry by industry, since the needs, for example, for smart monitoring in an airport will be significantly different from those of a privately owned factory site.

Case study: As an example of how smart monitoring can be used in industrial settings, Hewlett Packard Enterprise (HPE), Orange and Casa Systems jointly demonstrated how a 5G network can self-heal when suffering network degradation, caused, for example, by on-site latency or excess traffic. The demonstration used a kit robot fitted with a 5G radio over an open 5G core network and using a dedicated "slice" of the network to connect at high speeds. As part of the test, conducted in Paris, additional data traffic and latency were introduced to the network and, as expected, the robot's performance visibly deteriorated. However, in this case, the 5G core network recognized the connectivity degradations and self-corrected by creating a new dedicated network slice and restoring the robot to normal operation. The case illustrates how self-healing 5G core networks are set to play a role in ensuring consistent machine performance, something which many production environments will depend on.[9]

5

Environmental protection will benefit from the introduction of new management techniques, driven by the ability to monitor, assess and act in a sustainable manner as the uptake of 5G scales in the future.

The COVID-19 pandemic has brought the windfall benefit of a reduction in carbon emissions driven by reduced global transportation and production-related emissions and energy consumption. With 5G providing the capacity for some 500 times more connected sensors than previously, whole-of-organization monitoring of energy consumption and waste management has the potential to become a reality. With nations and organizations globally working towards net-zero carbon emissions, 5G at scale will provide opportunities to sustain this one-time benefit from the pandemic period. With real-time detection powered by 5G, organizations will now have a realistic capability to monitor, assess and act when it comes to energy and emissions efficiency. The use of smart sensors will also allow cities to emerge that are more productive, less wasteful and where citizens experience a higher quality of life with cleaner and healthier air.

Establishing 5G's role:

Organizations will need to deploy sensor technologies targeting environmental protection at scale, requiring organizations to forge commitment to green targets and lower emissions, as well as devising business and investment cases for sensor implementation which create meaningful environmental impacts and energy efficiencies.

Case study: There are several 5G agricultural use cases whereby the use of sensors and other connected devices allow farmers to produce more output while consuming less scarce natural resources, such as water. Agroscope, a centre for agricultural research in Switzerland, has deployed real-time sensors that measure soil moisture, crop growth, weather data and animal movements. These sensors have allowed farmers to decrease the amount of nitrogen fertilizer use by roughly 10%, without any corresponding loss in crop yield.[10]

6

Autonomous robotics allows real-time automation to improve efficiencies in carrying out complex and repeatable, sometimes hazardous, operational tasks.

5G technology will boost the next generation of autonomous robotics – allowing for more complex and sophisticated capabilities for robots in the workplace, be it in an office, a factory, or at a port or a mining site. While robots are already ubiquitous in manufacturing, 5G will enhance their ability to harness cloud analytics and edge computing and be reconfigured swiftly to changing factory environments as firms strive to meet frequent changes in demand. Robotics will continue to evolve the automation of complicated labour-intensive work, beyond just mere placement and movement of objects, to undertaking sophisticated and subtly varied precision tasks which require the robot to sense changes in context. With a growing range of applications, the global 5G-enabled autonomous robotics market is estimated to reach $74 billion by 2030, growing by over 10% annually between 2020-2030.[11]

Establishing 5G's role:

Significant training and development will be required for the safe operation of autonomous robotics to ensure that productivity gains are safe and controlled, and that workplace safety is itself enhanced as a result of automation. 5G deployment must target geographical regions with high demand from "physical" industries for real- time automated robotics to truly transform ways of working. This is also true for key transport hubs, whether they are serviced by sea, air, rail or road.

Case study: In the Netherlands, a collaboration between KPN and Wageningen University and Research (WUR) has developed an IoT proof of concept which combines the application of 5G connected robots, AI and cloud-based edge processing power to address large-scale outdoor crop management. The project used Robotti, an autonomous robot designed to identify and spray unwanted plants which appear in sugar beet plantations. Robotti achieved an accuracy of 95% and up to 20 times the productivity of a manual labourer.[12]

5G in communities

5G in communities consists of three sub-themes: democratizing 5G, regionalizing 5G and experiential living.

7

Democratizing 5G enables a wider uptake of the benefits of 5G in communities, through public and private sector collaboration, which results in a more efficient use of scarce, available resources.

Allocating scarce and critical resources for deploying 5G and reducing capital or roll-out costs will encourage network deployments that benefit a higher proportion of a nation's population. Where governments can work with the communications industry to defray network roll-out costs, nations are more likely to see widespread 5G benefits across the economy sooner. Democratizing 5G in this manner is a significant way of avoiding a 5G-driven digital divide.

Establishing 5G's role:

This requires the communications industry, national and local governments to coordinate in respect of easing up site allocation, standardizing deployment protocols and rules, harmonizing spectrum allocation and usage rules, and actively developing protocols for easier, more effective and ethical use of citizen and business data. Governments may also play a role in some jurisdictions to do more to encourage fiberization of 5G cell towers, which will mean that wireless connectivity of 5G networks is met by the speed of backhaul connectivity as well.

Case study: South Korea's Ministry of Science and ICT's 5G+ strategy positions 5G as an innovation growth engine, with plans to mobilize $25 billion in public and private funding to secure nationwide uptake 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 $50 billion to GDP and 600,000 new jobs by 2026.[13]

8

Regionalizing 5G by encouraging earlier deployment through incentives enables 5G to be enjoyed by people and businesses based outside major urban centres.

There is going to be pressure on governments worldwide to ensure that the recovery reaches all populations and not only those in urban areas. Encouraging 5G deployment in semi-urban and regional areas will enable communities and businesses in these areas to participate in the digital economy benefits which are expected to be enjoyed in cities and geographies that have a higher density in business activities. This will enable further growth in industries such as agriculture, greater resilience in managing natural disasters such as bushfires and greater control of the use of scarce resources such as water. Regionalizing 5G is another important way to avoid a 5G-driven digital divide.

Establishing 5G's role:

Policy measures will be required that address a role for 5G in rural areas and avoid a geographic digital divide. Since regional areas are typically less digitized than urban areas in most countries, policies to encourage 5G deployment in these regions are likely to have an important impact on citizens and businesses in these areas and will likely have a greater proportionate impact on GDP growth in these areas than it does in cities.

Case study: The Federal Communications Commission in the US recently approved a rural 5G connectivity scheme, which provides funding to private mobile telecommunications operators. The scheme enables them to bid for financial support specifically to deploy 5G networks in rural areas with lower than urban population densities, increasing the possibility that US citizens and businesses in rural areas benefit from 5G sooner.

9 **Experiential living** – transforming our interactions socially, in classrooms, while gaming, with families and in many other social and community settings post-COVID.

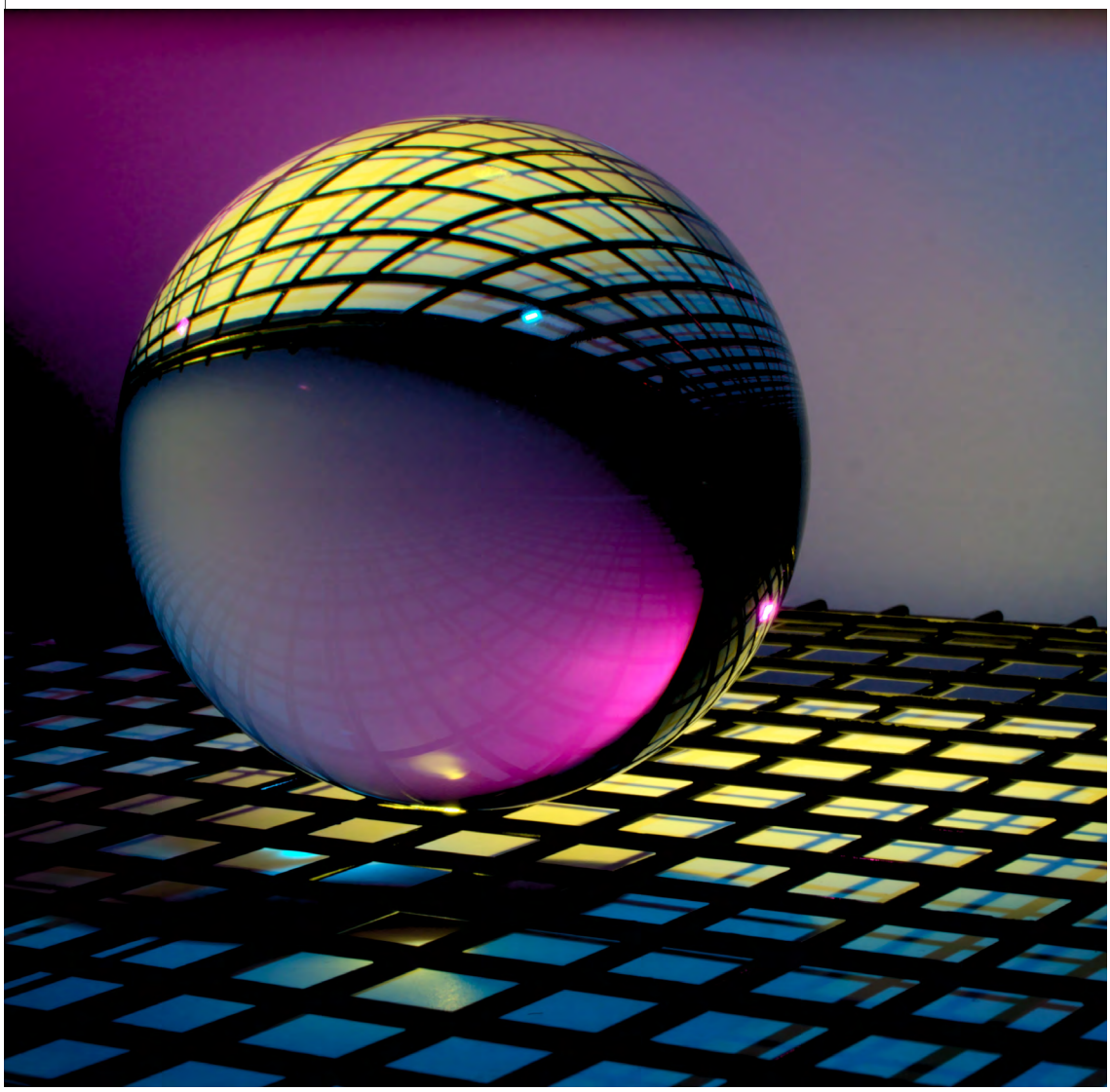
5G's high network capacity and ultra-reliable, low-latency connectivity enables real-time exchange of video and VR content through a 5G network. The enriched multimedia experience this enables will help close the gap between live and virtual settings; for example, in training and education provided in a classroom versus upskilling experiences provided remotely. With 5G, multi-player gaming or even children's museum visits, experienced through simulated scenarios, will become more lifelike than ever before. Micro-credentials gained through short, remotely experienced courses by workers through VR/AR equipped devices will help workforces adapt rapidly to shifting industry needs.

These developments will provide opportunities to diversify and create new revenue streams in the healthcare, education and tourism industries, as well as transforming interactions between colleagues and customers in commercial settings. VR and AR have the potential to deliver a $1.5 trillion boost to the global economy by 2030.[14]

Establishing 5G's role:

Establishing 5G's role in diverse aspects of experiential living requires policy measures that enable the development and trialling of such use cases so they can be scaled up commercially as well as ethically and responsibly. It is likely that, in the initial years, this will be done industry by industry and use case by use case, until governments and the private sector devise collaboration methods to define 5G's role at scale.

Case study: BT, Glasgow City Council, the University of Glasgow and the Scotland 5G Centre delivered a VR demo of the use of 5G technology in education and manufacturing. A real-time VR teaching scenario was delivered from the James Watt Nanofabrication Centre in Glasgow, Scotland, to demonstrate how faster speeds, reliability and responsiveness of 5G enable immersive content and real-time interaction to campuses across the world.[15]



Conclusion

5G has a crucial role to play post-COVID. At a time when we need a resurgence of economic growth, this third paper in the 5G Outlook Series outlines specific opportunities that we can grasp to ensure 5G fulfils its role as a premier-enabling technology to a prosperous future. Throughout the development of the three publications in the series in collaboration with PwC and under the strategic guidance of the Forum's 5G Global Accelerator community, have been identified five key insights that will contribute to shaping initiatives related to digital inclusion, digital transformation and the Fourth Industrial Revolution broadly in the coming months.

First, 5G will help to facilitate industry transformation and secure superior economic growth as we emerge from the pandemic. Second, through this emergence, characterized by increased digitization, 5G can democratize access to, and affordability of, computing which could help to close the digital divide across regions. Third, public-private partnerships will be key as governments seek to sustain the economic recovery following the COVID crisis. Fourth, countries urgently require a clear strategy for cross-industry investment and a supportive policy that removes barriers and facilitates private sector involvement. And fifth, over the course of the next decade the power of 5G will be realized in combination with other technologies that are evolving in parallel. These must be encouraged to scale through targeted intake ensuring widespread adoption and deployment.

In the aftermath of the COVID-19 global pandemic, these papers have sought to showcase how important a role this new communications technology is now poised to play as we seek to recover and reboot our economies. During 2021, these insights will inform the agendas of public-private dialogues across sectors to 1) address the imperatives required to realize business opportunities that generate value for industries and society, 2) provide a space for knowledge exchange and best practice sharing to scale successful collaboration models and 3) drive action by engaging decision makers willing to implement successful policies and business recommendations.

Contributors

This publication is the result of a collaborative effort coordinated by a project team under the strategic guidance of the 5G Global Accelerator community. The contribution of a multistakeholder working group was fundamental for the development and validation of the findings presented here and for the broader agenda of the World Economic Forum's Platform for Shaping the Future of Digital Economy and New Value Creation. Additionally, expert interviews and workshops provided invaluable insights. We would like to extend our thanks to the members of the Global 5G Coalitions Network representing associations and alliances globally across sectors. Special thanks to the following leaders who have been interviewed or shared their perspectives:

Karen Abudinen, Minister of Information and Communication Technologies of Colombia

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More details about this community and the activities of the 5G Global Accelerator programme can be found on https://www.weforum.org/projects/5g-global-accelerator.

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Endnotes

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