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The 5G Revolution: Connecting for Impact

Emerald Group

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1. Introduction

We live in an age where in most parts of the world connectivity is a given. Wireless and cellular network have been facilitators of globalization and economic growth over the years. Each generation of network has created value across value in chains in multiple sectors, increasing connectivity and helping build end to automated processes and systems.

Development of wireless network has progressed at a pace unimaginable during its inception in the 1980's. Today, after four generations of networks, we are standing at the cusp of the 5G revolution. End to end connectivity enabled by 5G technology is anticipated to revolutionize digital transformation and create nearly $3.6 trillion in economic output. This will result in creation of 22.3 million jobs in the 5G value chain alone by 2025. This report aims to understand what this technology entails, how it will impact various industries and understand the systematic challenges in its path to adoption.

With a top speed pf 2.4kbps for data transmission, the first generation of networks was launched in the 1980s. A few decades later, we are now witnessing the emergence of the fifth generation or 5G. It has taken just 40 years for us to exhaust five generations of wireless connectivity. This represents the world's pressing desire for wireless speed and full connectivity.

As is the case with every generation of successive mobile networks, features like efficiency, speed, voice and data experience, cost, among other aspects become better and more efficient. The evolution of network has been exponential, each generation taking a leap towards achieving end to end connectivity. Over the years, users have experienced the telephonic and digital world through various generations, starting from a voice only, analog service (1G) to SMS and MMS and encryption (2G), mobile internet with more data and video calling provisions (3G), 500 times faster and the current standard cellular network with HD support video experience (4G), to now 5G. With this, each generation of wireless connectivity also creates new value across sectors and society and furthers industrial growth. Each industrial revolution has been powered by the evolution of network infrastructure. Electricity and its reach were the drivers of the second and third Industrial Revolution as economies of scale were achieved, plants were connected, and grids were finally able to reach a wide base of households. Industry 4.0 will only be able to realize its full potential once 5G is adopted across the world. The driver of the fourth Industrial Revolution will be 5G.

This report aims to study the impact of emergence of 5G on various industries using particular use cases. We aim to analyze multiple scenarios and access the overall impact of the same across 3 industries – mainly, healthcare, manufacturing and automotive. Further, it will study the economic and social value added through its adoption by analyzing the overall benefits.

The Next Generation Network

Section 2

2. The Next Generation Network

2.1 What does 5G entail?

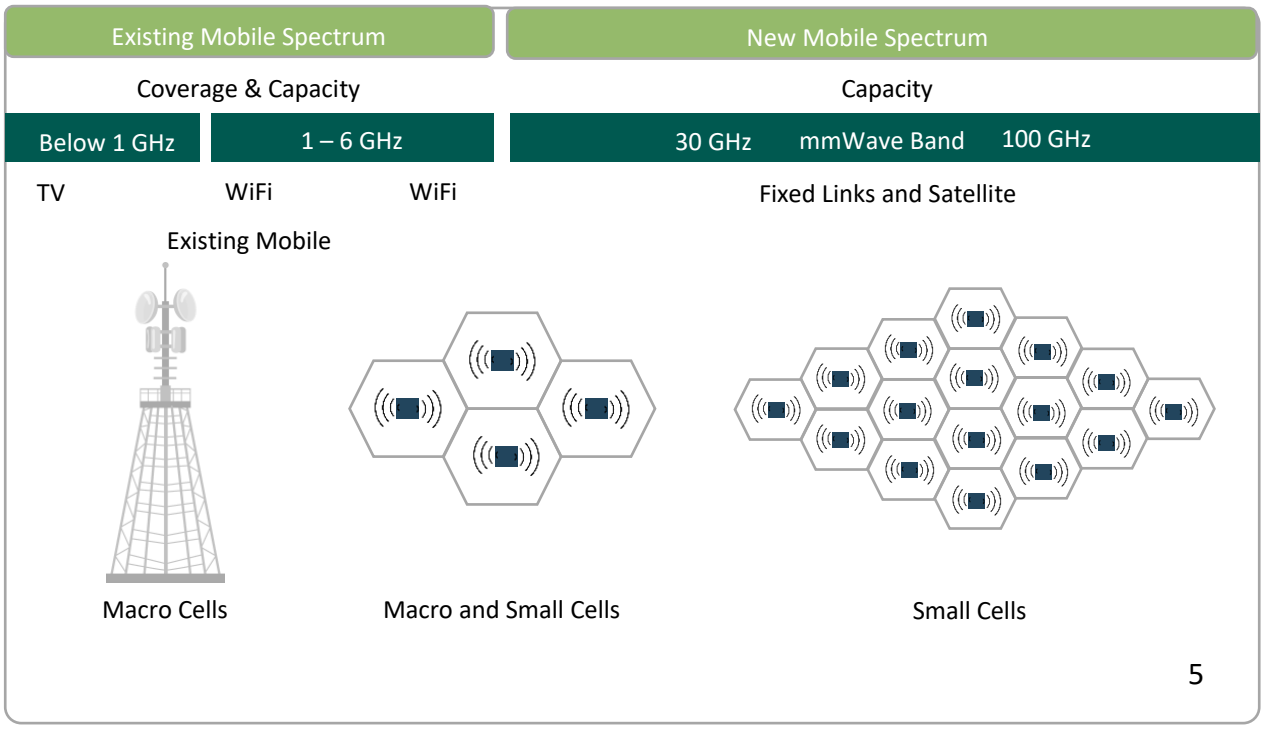
5G is the next major phase beyond the current 4G Long Term Evolution (LTE) Standards. As the smart phone consumer base and the IoT access and reach increases, more than 25 billion devices are expected to need cellular network by 2024-25. This is where the 5G experience begins.

It has been designed to not just provide energy efficient, larger network capacity, faster and cost-effective services to the users but also with a unique capability for forward compatibility. Even when users are moving around, data connectivity stays consistently high.

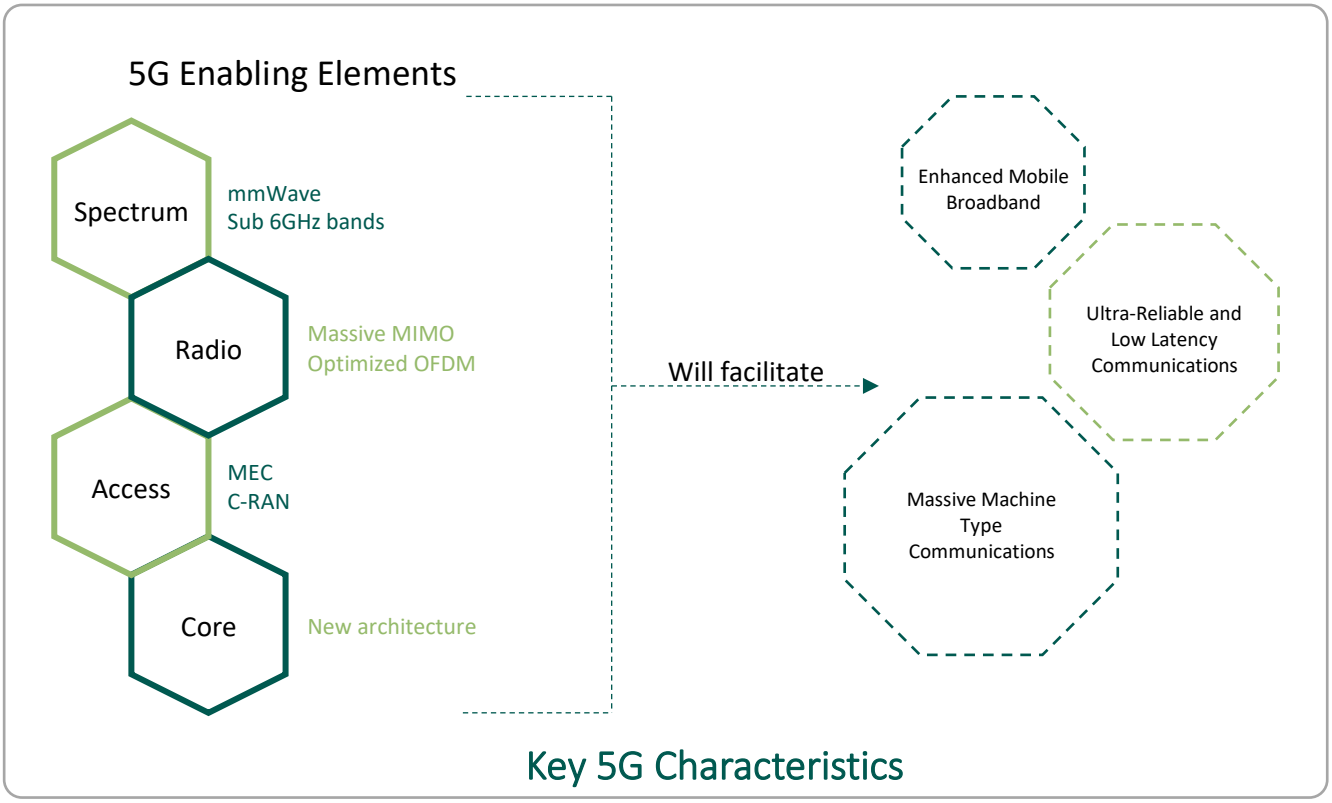
Apart from a capacity to expand into new spectrum, such as mmWave, 5G can deliver much lower latency and a uniform user experience.

5G will enable not only people to connect better, but also connected machines, infrastructure, automobiles and other facilities which will improve the quality of life. Further, it has the potential to flexibly support unknown services that would be needed in the future.

The standards for 5G have been set by the International Telecommunications Union (ITU). These have been tentatively used to compare the world as we know it – before and after 5G.
5G will not just enable mobile networks to operate more efficiently as eMBB addresses consumer centric needs, but also expand the current capabilities to various MIoT and MCS deployments.



2.2 Characteristics



Broadly, 5G comes into use in the following major categories and for the purpose of this report, the use cases in each industry are driven from the following characteristics of 5G:

1. eMBB (Enhanced Mobile Broadband)

5G mobile technology will provide improved and uniform smartphone network, delivering high throughput experience which will be better in building/ indoor access, and cater to dense/ crowded areas. In addition to this, the improved spectrum utilization is expected to usher in new immersive experiences with the deployment of data intensive use cases like Augmented and Virtual Reality (AR/VR), Cloud, 3-D Video/ 4K screens with enhanced features and lower rates.

2. uRLLC (Ultra-Reliable and Low Latency Communications)

Commonly known as Mission Critical Services (MCS), this 5G feature can help transform many industries. It can enable new services in critical infrastructure, vehicles, medical procedures, among other connected devices by providing a highly available and reliable network, ultra-low latency-based performance and highly secured network infrastructure.

In order to facilitate real time capabilities and performance and support services which require immediate or greater monitoring and control, 5G enabled improved reliability and ultra-low latency applications across industry verticals are being deployed. Critical and other devices which might prove to be good examples include intelligent transport, autonomous vehicles, drones and robotic applications, real time industry applications, health monitoring system / tele-health, smart grid.

3. mMTC (Massive Machine Type Communications)

Restricted network connectivity and lack of reliability in dense urban areas coupled with device power requirements limited the wide scale deployment of IoT with 4G/ LTE. 5G improves upon the low power operational capabilities for devices by using both, licensed and unlicensed spectrum bands through CAT–M1 and NB-IoT advancements. mMTC use cases have led to new sector verticals originating, such as smart cities and impacting several other industries including agriculture, energy/ utility management, industrial automation, smart logistics, grids and smart consumer wearables.

2.3 Adoption of 5G

5G had begun to be launched in early 2019. Global operators and major players like Verizon, AT&T, T-Mobile, and Sprint in the US as well as major phone manufacturers and network providers across the world, plan to foray into the segment and leverage the 5G technology for their user bases. It is expected to have a much higher rollout rate as compared to previously launched networks. It has been launched in 35+ countries and more and more countries are expected to build this momentum further and adopt even nationwide 5G networks. Realizing the massive potential of the technology, almost 3% of the network-based mobile service providers are expected to launch 5G network commercially by 2020. More than 20% of the total 681 LTE commercial networks globally, that is, almost 154 operators across 66 countries have started the process of conducting field trials and testing the technology in the respective regions.

For the purpose of this report, we have analysed the deployment of this technology across geographies understanding various scenarios for countries as per their economic standing and technological advancement as well as early adopters and future users.

2.3.1 Investment and R&D

The countries leading the 5G development are China, US, UK, South Korea, Australia, France, Germany and Japan, among others, at the forefront. The collected expected investment within these nations with respect to R&D, innovation and deployment is estimated at $235 billion annually, in the period from 2020 to 2035.

Among these nations, the major domination in terms of innovation and capex is expected by US and China with investment figures running between $1-1.5 trillion each as they would account for a total of 50% of the global investment in 5G. Building on the existing infrastructure and R&D investment created by 3G and 4G.

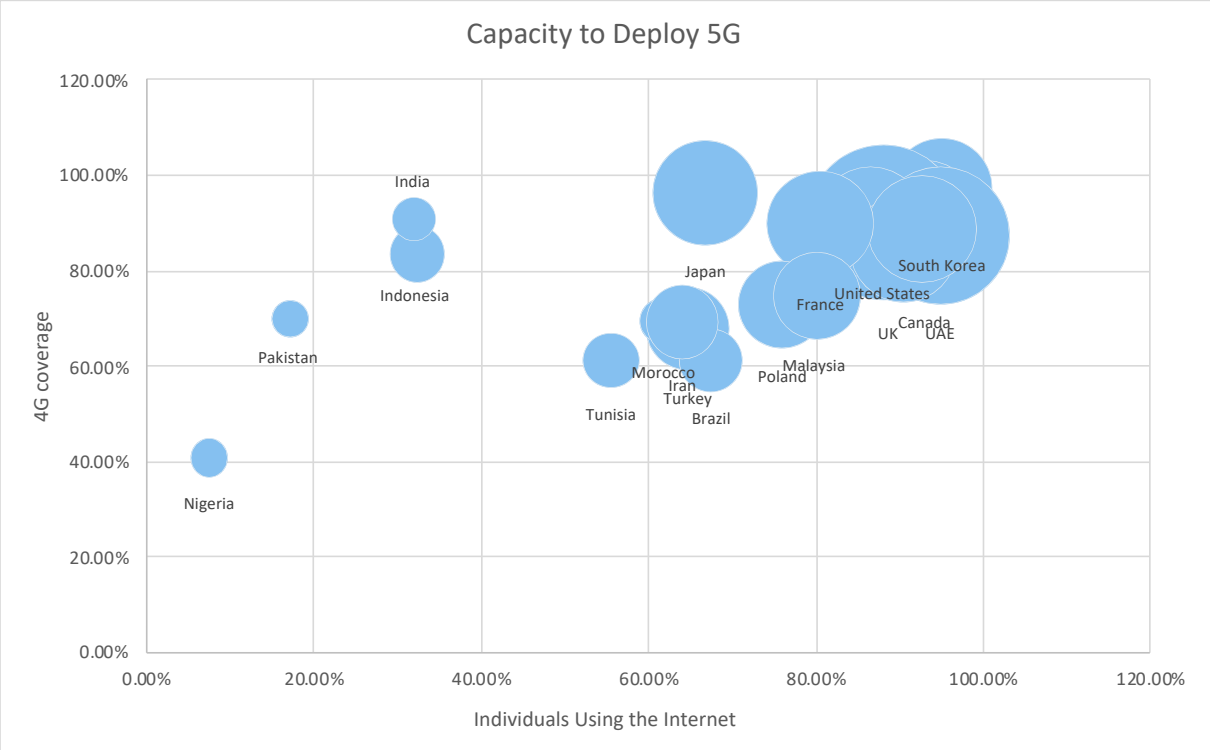
Technology advancement and spectrum licensing dynamics have driven R&D and investments from big players. A similar scenario will help 5G leverage on the existing infrastructure and extend the research and development for continual innovation. The investment for 5G will shift from building infrastructure and technology networks to innovation and development of existing resources.

2.3.2 Deployment

The deployment of 5G across countries and sectors is likely to take place in various phases. Due to the mass adoption of eMBB is most likely to expand the fastest. The maturity and timelines of the various use cases across countries over the years vary across geographies as deployment is influenced by each economy's revenue potential and market dynamics. These include the situation of current infrastructure and network connectivity as well as the investment capacity and regulations.

Demand dynamics play a key role in understanding the deployment trends across the regions as demographics change. The per user data usage, affordability and accessibility – are all key issues that need to be considered to assess the reach.

As classified above, there are some countries which are major players and key investors in the space. These include China, US, UK, Japan and parts of Europe. China, particularly with its huge population counts, stands to be the major contributor, numerically, in terms of deployment, investment and job creation. With major investments over the last few years, it aims to shift one-fourth of the population's digital needs to 5G. US is not far behind with huge firms like AT&T leading the technology development in the region and accounting to more than 25% of the global investment in the technology.



Even though there is potential and planning for broad global adoption and deployment of technology, a large section of the population still does not have access to a network or proper connectivity. This is particularly the case for developing nations like India, South East Asian countries, and parts of Africa and Europe. Even though the technology is being deployed with modernized methods and private and public sector support, the networks are restricted and limited to only a few major cities and rural areas particularly face the brunt of lack of access.

2.3.3 Policy Scenario

The policy and regulatory scenario as well as the availability of 5G appropriate hardware and chipsets will also affect the adoption process. Governments across the world are fueling the transition with initial investments in technology and network developments. Further, regulatory bodies are planning for upcoming commercial roll outs and support for innovation and deployment for 5G technology. Low latency and high reliability enabled through the technology is expected to help network operators and telcos meet user demand for high speed, AR/VR experience and high-quality data transmission. Particularly in developing countries with a relatively low broadband penetration, the opportunities are vast, especially when we consider an expected GDP rise of 1% for 10% increase in penetration.

A Connected Future: Reshaping Industries

Section 3

3. A Connected Future – Reshaping Industries

5G promises a truly connected future. It will not only foster innovation and economic growth, but also make new use cases possible, while increasing the performance for existing ones. It is certain that 5G enabled connected cities, systems and devices will create a revolution never seen before. 5G is upto 20 times faster than existing generations with peak data transfer rates of 20 Gbps, an extremely low latency of one millisecond and is almost as reliable as wired data transfer (high reliability of up to 99.99~%). The number of connected devices in the IoT world are already surpassing the number of humans on the internet and with 5G, this number is expected to grow exponentially. Here, we look at 2 different arguments regarding the deployment of this technology.

Firstly, many are believed to view this next generation of wireless connectivity as just an upgrade from the previous one, with faster, more reliable and low energy consuming features. While initial 5G deployments would leverage 4G capabilities and infrastructure and enhance the performance and capacity of the same, there will soon be completely new infrastructure built to support the technology. Stand-alone 5G towers and network systems with separate power capacities, cells, antennas that can support high bandwidth, low latency and more energy efficiency will be set up across transport lines, industrial areas and residential areas.

In addition to this, there have been concerns over the limits of the technology and whether it will truly be revolutionary or just make the existing networks better. Currently, maximum 5G deployments and innovations revolve around the B2C space due to ease of adoption and the network operators seeking to provide a better service. However, there are expected to be numerous opportunities in the B2B space across sectors. 5G will create significant impact and not just incremental performance enhancement when it comes to various industrial uses. Experts have estimated more than 70 billion connected devices across the world by 2025, with major use in industrial applications. 5G opens up new fields of application in various sectors, including 'critical communications' which require high reliability and secure transmission, where other networks can't sustain. This report aims to analyze the distinctive use cases for industries which have incorporated 5G technology to ensure enhanced performance, increase efficiency and prepare for a connected future.

It is inevitable to link the 5G revolution with the rise of the new digital industrial technology, called Industry 4.0. It is expected to transform production and change traditional methods of manufacturing to more efficient, flexible, faster, cost effective and data efficient processes to produce higher quality goods. Through the intervention of 5G, Industry 4.0 is expected to enable devices and humans to function in a connected manner in the Internet of Things (Iot), with decentralized decision making and assessment so that responses can be made

locally and in real time. Hence, it will not only accelerate the rapid Internet of. Things, but also boost the fourth industrial revolution.

Connected Health

3.1 Connected Health

5G will have a major impact on the healthcare sector with respect to the services within and related to the health industry. The technology, varying from telemedicine to robotic surgeries, entails key features and characteristics that will help generate a significant impact on the healthcare sector.

Rising automation has enabled medical devices equipped with the technology (Internet of Medical things, IoMT) to electronically communicate with sensors and other remote equipment in order to monitor activity. Due to the faster data transmission and interconnected services such as cloud computation and data servers, 5G can fuel ultra-reliable real time responses closer to the device, as per the need. It's ability to process large amounts of data in no time with smart and customized solutions for patients. This not just saves precious minutes in emergency situations but also creates an innovative and seamless experience for both the service providers, caregivers and patients.

Internet of Medical Things consists of devices such as medical devices, remote sensors and wireless patches that help monitor and transmit information. 5G acts as a catalyst for IoMT. Its reliability and capacity to support high bandwidth transmission at low latency enables faster flow of data and helps incorporate back end data centers and remote file servers into one entity.

Even though the ubiquity of 5G data assimilation, combined with cloud computing facilitates transmission and sharing of data, it provides a secure environment for harnessing this information by safeguarding the process of any risks and data leaks.

5G in healthcare also has the potential to spark new business models. One such example is of the opportunities attached to big data in healthcare. Assuming that privacy concerns are taken care of, this offers opportunities for data analytics vendors and healthcare providers to monetize information. This would particularly be of interest to pharmaceutical firms and medical device manufacturers exploring embedded analytics within their devices.

Hence, with the above features 5G is expected to significantly improve the quality of treatment made available to patients across regions as well as enable more efficient remote services for the sector.

We look at the various cases where 5G will prove crucial through the following examples:

3.1.1 5G enabling remote service:

With the characteristics of 5G enabled eMBB, which support virtual and augmented reality, it can massively increase the availability of remote diagnosis treatment. Using ultra reliability and low latency networks, an interactive environment between the patient and the health service providers can be created. This will help with both pre-examination of the patient's condition using HD images

and data, as well as real time interaction and examination of the patient by a doctor for immediate telemedicine diagnosis and effective treatment. Particularly in the case of strokes or heart attacks, the first few minutes are extremely critical for the patients and receiving immediate help or treatment during this time can prove to be priceless and sometimes a matter of life and death.

3.1.2 5G and Personalization of Healthcare:

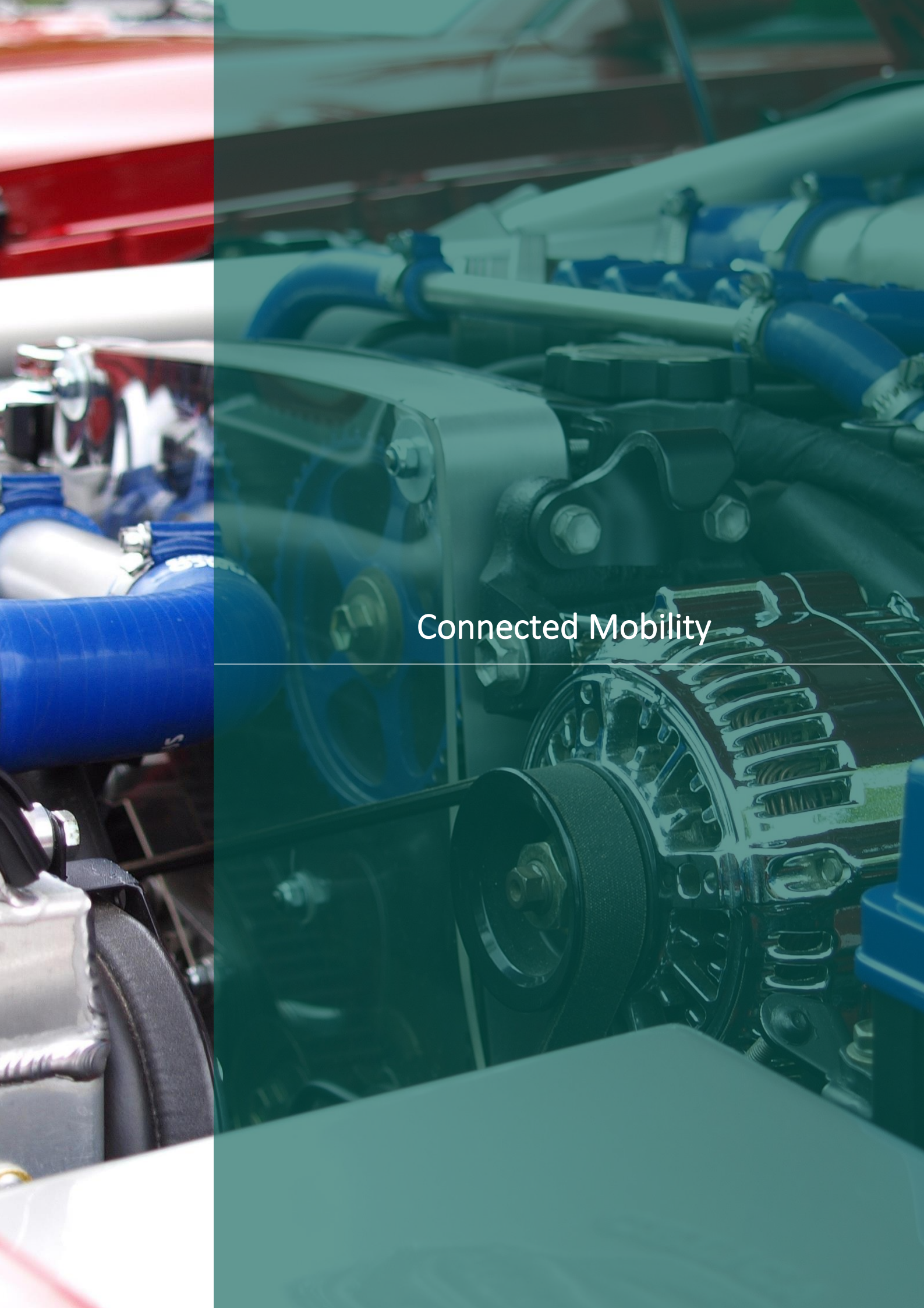
Personalization of healthcare entails improved services and better health and well-being for individuals. This majorly focuses on long term and cost-effective measures to increase the quality of life and on preventive care by adopting healthier lifestyle changes. Further, it would shift the locus of care from hospitals to homes by enhancing remote surveillance, diagnosis as well as treatment. Essentially, now care will be wherever the patient is. This can be achieved through a sustained and efficient communication between the individuals and the caregivers. Through the IoMT, an ecosystem of connected equipment and devices used for treatment and diagnosis as well as data inputs from patients can be generated. This information can be further used to create feedback loops and understand the needs of the individuals to develop tailor-made, personalized healthcare plans and regimes for each as well as empower more and more people to self-manage their health. IoMT brings together a rich set of information facilitating better monitoring and precise diagnosis.

In the long term, this will provide actionable insights from data collected over time through multiple sensors and intelligent devices. The data sets recorded will reduce the intervention of a physician or professional to be physically present to provide treatment or diagnosis and increase the flow of information and hence, personalized care to individuals. Even in the case of critical conditions, a home-care model would be accessible and efficient enough to reduce costs for both the patient, and indirect cost saving for the society as a whole by saving resources and practioners' time.

3.1.3 Key Takeaways

Along with other use cases such as disease management, wearables and drone enabled medical service delivery, the fifth generation of wireless networks will be facilitate building connected health while maximizing patient safety and convenience. Implementation areas such as M-Health (mobile health) and telemedicine will also increase access to quality healthcare and better prevention measures will result in lower long-term costs related to health services.

The reliability and ubiquity that accompanies 5G along with the personalization it allows in delivery will enable the healthcare sector to move closer to increased prevention and increased precision. The technology will facilitate big data and health informatics thus opening up new business opportunities in the space. The precision and reliability with the technology will also be one of the first steps towards building outcome driven health care where outcomes are defined and measured effectively.



Connected Mobility

3.2 Connected Mobility

The automotive industry has been growing exponentially, especially in terms of technology adaptation and innovation. With connected cars and advanced services for users, 5G can help impact the experience of both car owners as well related service providers.

The possibility of seeing autonomous cars driving on roads across the world is still years away. However, connected cars are here. Connected cars essentially mean when technology enables vehicles to use 5G to communicate with vehicles around it, infrastructure and pedestrians. With 5G, automobiles have the potential of becoming sensor laden mobile IoT devices. They can have on board computing power and communications systems for:

- Telematics - vehicle location, driver behavior, engine diagnostics and vehicle activity
- V2X communication - surrounding environment
- Infotainment – vehicle's occupants

For these systems to realize their full potential, 5G is essential. 5G will facilitate transformation in the sector.

In the B2C space, connected vehicle with data connectivity offer driving statistics to the entire ecosystem ranging from vehicle owners, parking services companies, operators and insurance firms. Innovative service offerings like insights on the vehicle maintenance and specifications, internet connectivity, parking assistance, alarms, fuel optimization updates are provided using these connected services.

In some countries, these features are being used to create a larger impact on the society and environment by reducing the accident rate as well as the carbon emissions.

We looked at the following key areas where 5G will make the overall industry more attractive and sustainable:

3.2.1 Enhanced Consumer Experience:

Right from the time of sales to the final driving experience, the use of 5G in the automotive industry provides enhanced value-added services. The use of AR and mobile app to derive 4K, 360-degree images of the vehicle could help increase sales as well as assist in the training of technicians who service the vehicles. Further, connected cars can provide intelligent tools to enable an easy driving and maintenance experience for the consumers by providing smart alerts and self-assist features. 5G, with its low latency and faster speed also has the capability to provide infotainment options to users as they ride along.

3.2.2 Data Collection and Analysis

Connected vehicles and infrastructure will develop a network of multiple data points from various sources. This network would be capable of transmitting information and alerts regarding traffic, accidents, consumer behavior and other region and vehicle specific from multiple players. All the data can be optimally utilized by government agencies, automotive firms and IT cells to enhance decision making and

create an industry wide impact for the betterment of society.

Betterment of road safety is an integral use case of 5G. C-V2X particularly helps deliver safer driving. C-2VX has two modes:

- Direct communication using PC5 interface over the unlicensed 5.9GHx band for cases with low latency needs like Vehicle to vehicle (V2V), vehicle to infrastructure (V2I) and vehicle to pedestrian (V2P) use
- Latency tolerant vehicle to network (V2N) communication using Uu interface on regular licensed band of cellular network for applications like infotainment

An ecosystem of C-V2X requires widespread roadside units and on-board units to support direct communication and strong cellular connectivity on the roads.

3.2.3 Key Takeaways

5G will change the way the mobility sector develops vehicles through applications in autonomous driving, shared mobility, connectivity and electrification. 5G technology has a part to play in each one of these. Currently, the supply chain ends with assembly lines of OEMs. The industry's value chain will transition from its current linear form to connected ecosystems with multiple stakeholders interacting with each other.

Auto makers, with the help of 5G, will make cars which are connected and be aided by roads and infrastructure capable of supporting this. Alongside the connected vehicle there is also a need for a plethora of connected devices like sensors to gauge driving conditions, cameras, etc. Many of these will rely on 5G technology.

From all the use cases it is evident that the factors of utmost importance in the adoption of 5G in the mobility sector are as listed below. These need to be achieved to deploy 5G effectively in the automotive sector.

- High mobile connectivity capabilities and maintenance of stable connections at very high speeds
- Low latency for essential road information
- High device density capacity
- High levels of reliability, especially for autonomous steering

Smart Manufacturing

3.3 Smart Manufacturing

The first three waves of the industrial revolution were backed by steam, electricity, people and software. The fourth will be driven by network.

With the rise of the new digital industrial technology, Industry 4.0, a manufacturing revolution is imminent. Smart factories, data driven processes, high quality goods, reduced costs and increased productivity and growth are what will drive this revolution. 5G will bring about a functionality boost in the communication system. This is key to the smart factories concept. 5G in smart manufacturing will bring mobile edge computing capabilities and aid in implementation of artificial intelligence which can be performed close to the origin of data and devices.

5G will help build futuristic factories where devices will be connected to work in tandem with each other and their environment. Smart factories will consist of sensors monitoring every aspect of the environment and collecting information. Tools will also be connected to collect data and guide workers. On the factory floor 5G has the capacity to provide connectivity for multiple uses. Machines and systems will be assembled into new lines according to the demand in a wireless manner.

Competitors would evolve with innovation in the space to increase efficiency and drive down costs. These innovations would primarily be enabled by IoT and 5G.

Characteristics like high reliability, low latency and high bandwidth are requirements for manufacturing applications and these features of the 5G technology will enable shorter lead times and lower costs of production. However, there are also certain crucial systems that require 5G. These include data analysis, automation and smart logistics and design systems,

3.3.1 Data Analysis, Automation and Industrial Control

In order to maximize data collection and distribution, it is essential to reduce the connection limitations and make it flow as freely as possible. Manufacturers would be able to collect, analyze and distribute large amounts of data – fast and in real time - using 5G enabled connected devices. This can be understood by visualizing the uses of the technology in various phases. In operations, machines and their respective operators can communicate in no time, sensors can access data and provide intelligent alerts

This will make logistics quick and safe through effective communication between tools, machines, robots and humans. 5G is secure for transactions and provides access to operators from flexible and remote locations. For a production unit, this feature massively increases productivity and efficiency on a daily basis.

Another element 5G will help better is reducing unplanned down time. Unplanned downtime of machines cost manufacturers heavily. Equipment breaking down without warning disrupts the value chain. Predictive maintenance combats this. Advanced predictive

maintenance is facilitated by 5G and involves collecting large amounts of data to predict machine failures to minimize unplanned downtime. 5G here impies increasing sensors on equipment to measure a multitude of parameters including temperature, humidity and pressure. It also includes ensuring reliable collection data in real time to facilitate accurate analysis for prediction.

3.3.2 Augmented Reality

Augmented reality and virtual reality systems have been deployed in a number of manufacturing operations. These help perform visual inspections, tests and troubleshooting, thus, reducing the reliance on manuals and instead making the experience real time and hands-free. AR-assisted factory inspection and stock maintenance can be carried out efficiently with the help of 5G's low latency which is required for sustained augmented high-resolution image quality.

3.3.3 Key Takeaways

It is evident from the cases above that with the arrival of 5G, tomorrow's factories and machines will become more sophisticated and grow. Smart factories will revolutionize the supply chain by connecting and unifying it.

5G technology will help manufacturers to increase data volume available on their production factories by increasing the number of devices that can be connected and the amount of data that can be supported through the network. It will drive data driven decision making in manufacturing and connect tools, machines and plants. Allowing large scale of data to be processed will also speed up the decision cycle time and eliminate vulnerabilities.

It is safe to say that 5G will empower a new era of manufacturing with smart factories and data driven decision making processes.

Impact

Section 4

4. Impact

4.1 Economic Impact

5G technology will generate long term and sustained returns on the global GDP. The economic impact of the will be realized over the years as will be successfully supporting more and more industries and devices. With Industry 4.0, 5G enabled socio-economic growth is estimated to be at $13.2 trillion of global economic output reached by 2035.

These use cases are enabled and enhanced in combination with an overall expected macroeconomic value. Driven primarily by manufacturing, communications and other industries are expected to grow with the 5G economy with $13.2 trillion worth of goods and services. The 5G value chain (manufacturers/OEMs, operators, industry professionals, app developers, and consumers) could alone support up to 22.3 million jobs created worldwide.

In terms of economic benefits through a 5G enabled healthcare system, apart from saving direct costs, such as above, a country's capital and workdays lost in sickness can be impacted using 5G. With continuous and guided healthcare and remote or mobile-health alternatives, patients with long term illness can self-manage their conditions. This type of superior management will massively bring down the burden of critical care and hospital stays and reducing the burden on taxpayers for critical healthcare services. With self-management, long term health and reduced illness days will further reduce the need for hospital and health insurance risks. Hence, the model poses a significant potential for cost containment for the entire healthcare ecosystem.

The coexistence of 4G and 5G is expected to carry on into the 2030s with a longer investment cycle for 5G as compared to 4G, reaching almost 1 trillion in value by 2025 (GSMA).

4.2 Social Impact

As mentioned earlier in the report, 5G has the potential to drive societal changes and significant social impact. Better healthcare, sustainable and environment friendly practices and long-term social value can be generated through 5G enables connected networks and communities.

Through continuous connectivity, consumers and service providers would become more aware and hence, more conscious and responsible. This would in turn reduce the risk factors, increase the standard of living and promote decent work in the communities.

5G's strong contribution and correlation with enhancing industries across the world will generate a wide impact towards developing a sustainable society. Environmental benefits through lower production time and resource requirements, fuel efficient and smart eco-friendly solutions would further make this a strong value proposition for societies.

Way Forward

Section 5

5. Way Forward

5.1 Challenges

Even though 5G and its use cases appear to be enabling a positive impact on industries and society in general, there are several challenges and barriers that come along with the adoption of this technology.

Firstly, deployment of 5G requires suitable digital infrastructure facilities enabled through competent wireless services and support. While this is not a challenge in most developed countries, there are many developing countries which still have a long way to go when it comes to adopting the technology efficiently.

Further, the lack of favorable regulatory policies and regimes to incorporate 5G into the economies with provisions for not just adopting and financing the technology but also ensuring the secure use of the data transmitted through it. Even though some central governments have managed to provide 5G enabled states with solid mechanisms to leverage the features, security and safety remain key concerns for economies.

The introduction of 5G in any economy will open up a realm of possibilities and opportunities for growth across industries. These need to be addressed through efficient strategies and long-term planning to collaborate across sectors and geographies, globally.

5.2 Future of 5G

It is essential at this stage that an economy leverages on the evolving eco-system around 5G by building support for a deeper and faster deployment.

Along with revising the regulatory scenario and generating infrastructure to support the technology, it is equally important to build awareness and education about the use of the same. Awareness programs and skill development trainings for the working force of the economy are critical to fully leverage the benefits of 5G. Further, promoting and fostering innovation in 5G use cases and empowering entrepreneurship at a localized level is key to bring faster and large-scale adoption.

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