How 5G will rewire the world

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5G Begins

You cannot ignore 5G in 2019. The next generation of mobile technology is already creating new use cases and allowing businesses and mobile network operators (MNOs) to find new revenue streams and applications.

But it is still early days. 5G can change industry landscapes and introduce new challenges and issues that many have not thought through.

A wide-reaching technology like 5G also has the potential to unearth concerns about vendor-user relationships, and how industry players will align with each other to create specific use cases.

However, 5G is here to stay. Pockets of new deployments already show promise. More importantly, it sees radio technology becoming ready for mission-critical and industrywide deployments. And many new applications, from artificial intelligence and intelligent building to autonomous vehicles and telemedicine, are about to benefit from its availability.

This report looks at the immediate potential of 5G. It aims to unearth the various trends that 5G will bring about, from market and technological perspectives.

While 5G's introduction and its far-reaching impacts are for certain, the outcomes are not. As with any new technology, challenges exist. The difference is that with game-changing technology like 5G that can create and reinvent markets, those challenges can be profound.

This report ends with a look at the foremost challenges that the industry needs to address together. It also gives you a glimpse on the task that still lies ahead for all stakeholders, from the governments to the technology developers, to switch on 5G.

Market landscape and trends

5G initial rollouts will be limited to hotspot areas within urban environments. Population density and the potential for quick uptake will initially drive the strong revenue case for many MNOs and mobile device manufacturers.

For the most part, 5G will begin as an upgrade to 4G – not as a separate network. Current 5G technologies are designed using 4G networks and will allow MNOs to expand their 4G macro networks by refarming their 2G and 3G spectrum, or by adding additional spectrum if available. Such an evolutionary approach will enable them to minimize investments.

Most reports[1] indicate that national-scale 5G rollouts will not occur until we are well into the 2020s. It is when network upgrades will no longer support traffic increases and will require the build-out of new macro sites or small cells on a large scale. It is when the real potential of 5G will be unleashed.

Asia will be unique in that developing markets like China due to the vast potential subscriber base, will take the lead. They will also have their unique flavors that may or may not be replicated around the world.

As such, we see Asia setting the global benchmark in 5G. Already, there are several pilots within the region with large commercial launches expected in South Korea in 2019, and more massive rollouts in Japan and China by 2020.

There is also a difference in how MNOs view 5G rollout. While 5G is seen as a fixed wireless and mobile play across the globe, in Korea, China and Japan, it will be predominantly mobile.

How fixed wireless will eventually compete with existing fixed broadband networks remains uncertain. While the potential is there for 5G, like in Australia, the use cases are underdeveloped and fixed wireless will likely catch up and compete[2].

Japan: A solution for shifting demographics

Japan is one of the first nations to commercialize 5G. Along with South Korea, it is looking capitalize the Olympic Games fever, using 5G for content delivery at the 2020 summer games in Tokyo.

Japan also witnessed one of the earliest 5G trials, with Japanese (MNOs) are looking to spend a reported US$46 billion on 5G commercial rollouts by 2020. Many of these rollouts aim to create new revenue streams as 5G offers the potential to drive new applications such as autonomous vehicles and industrial internet of things (IIoT).

With the government promoting faster fiber-optic cable development to improve the backhaul for the 5G rollout, Japan will look to drive automation with 5G as it faces the challenges of an aging population[3].

South Korea: Solving rising unemployment

The South Korean government is setting aside for 5G funding support. The South Korea Ministry of Science and ICT is also looking to accelerate 5G network commercialization.

The 2018 Winter Olympics in PyeongChang saw a limited use case but highlighted the potential of 5G in shaping user engagement in sports. It included real-time viewership from an athlete's perspective, holographic displays, and real-time 360-degree virtual reality capture of the various sports.

Together with conglomerates like Samsung and LG, the country, like Japan, is looking to use 5G to create new jobs and encourage entrepreneurship. In turn, this has spurred interest 5G-based IIoT and other connected applications.

China: Being globally competitive

One country that has the potential to leapfrog its global rivals across diverse industries, from smart manufacturing to autonomous cars, is China. With a population that is ready for innovative applications, as noted in a McKinsey's survey that found 60 percent of Chinese respondents willing to switch to connected cars as opposed to 20 percent in Europe, the market uptake potential is high.[4]

It is one of the reasons why 5G figures prominently as a strategic priority in the China government's 13th Five-year Plan. It also explains the government's strong support for incumbent technology companies to drive the 5G rollout.

Besides consumer uptake of 5G, smart factories, autonomous vehicles, and IIoT will also feature highly in China. These will support the country's interest in using 5G as a foundation for its Made in China 2025 (MIC 2025) initiative, a strategy for the country to maintain its competitiveness amidst rising labor costs.

One key area that is seeing keen interest is robotic automation in warehouses, led by online retail giants. This is important as while China leads on ecommerce, it is facing a monumental task in keeping up with express delivery expectations. Other industries where 5G will make a significant impact are healthcare and logistics, especially road transportation.[5]

Buoyed by strong government support, 5G will shape the entire value chain, from MNOs to technology vendors, and chipset and handset manufacturers. Huawei's recent Balong 5000 chipset and 5G CPE Pro commercial device announcements offer a start to this journey. The chipset supports a range of 5G products, from smartphones to home broadband devices, while the commercial device supports both 4G and 5G fixed wireless connections[6].

Australia: Relieving 4G Congestion

Initial reports show that 5G will be primarily seen to be relieving 4G congestion, especially in high usage urban areas such as central business districts (CBDs), shopping malls, transport hubs, and sporting venues.

5G national deployment, however, will is only just beginning. Optus fired the first salvo at the end of January 2019 with the official launch of its 5G home broadband offering at three sites, with more sites planned in the coming months at residential and other hotspot locations. Other operators will undoubtedly follow. However, analysts noted that the 5G deployments will initially exclude many fiber to the node (FTTN) customers in the suburbs and urban edges[7].

We cannot discount the use of fixed broadband technology to meet the demand for data. It will continue to compete with 5G

[1] The road to 5G: The inevitable growth of infrastructure cost – McKinsey&Company

[2] 5G in Australia: Evolution not Revolution – Ovum

[3] Asia: Leading the race to 5G – Frost & Sullivan and Principal

[4] China gears up for the leap into digtisation of industry – Financial Times, Dec. 20, 2017, Jonathan Woetzel, MGI director and senior partner, Shanghai

[5] China gears up for leap into digtisation of industry – Financial Times, Dec. 20, 2017, Jonathan Woetzel, MGI director and senior partner, Shanghai

[6] Huawei announces 5G chipset and CPE device – Telcom Asia, Jan. 28, 2019, Dylan Bushell-Embling

[7] 5G in Australia: Evolution not Revolution – Ovum

mobile alternatives, especially when there is a lack of government push. In the end, the adoption of 5G mobile broadband will depend on strong use cases, and the industry seems to be currently focused on creating these.

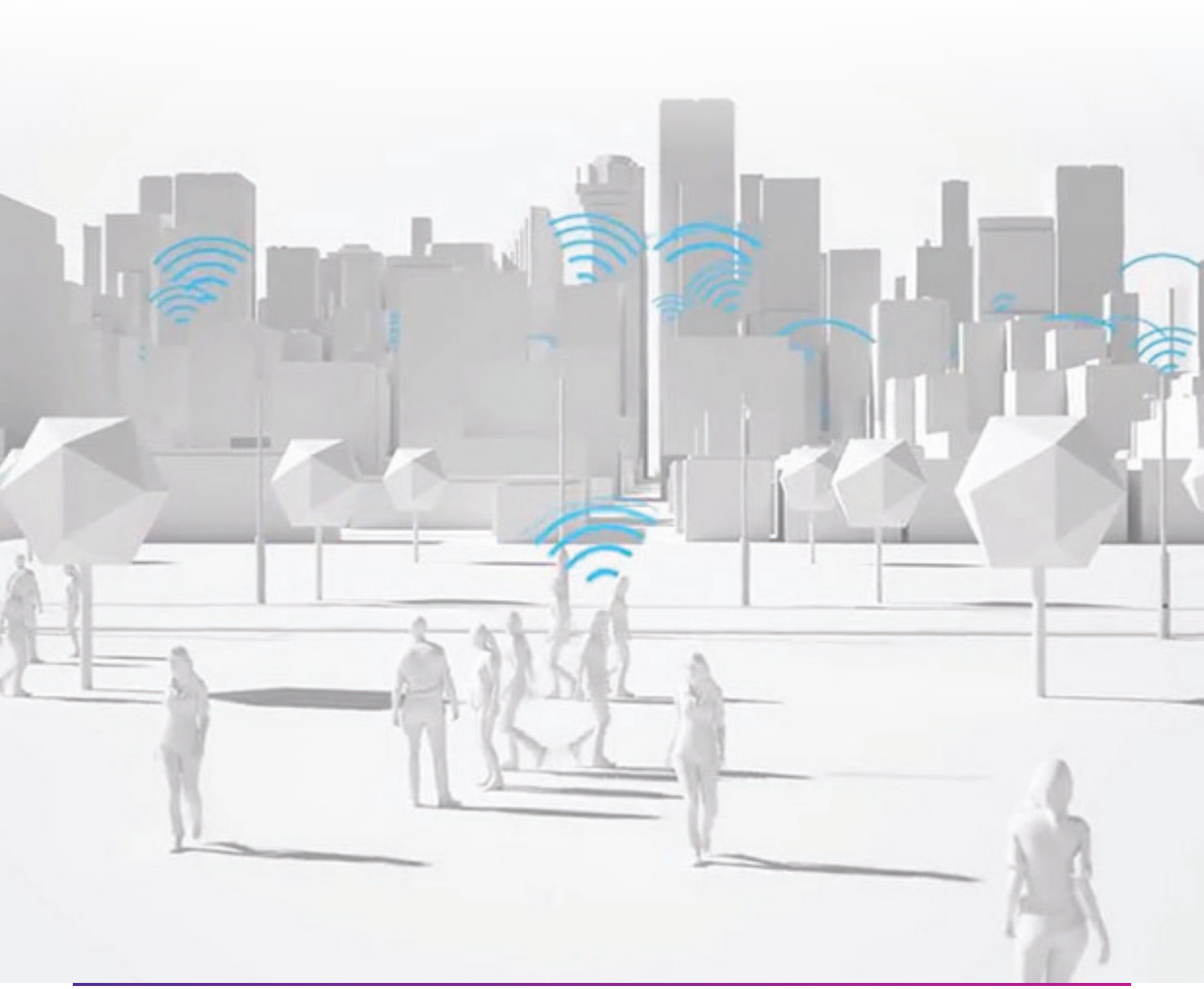
Rest of Asia: India's hidden potential

Hong Kong and Singapore are already rolling out limited trials, while their governments are encouraging MNOs to drive industrial applications around smart cities and IIoT. Thailand and Philippines are also looking at doing industry trials.

However, one country that has a high potential but remains in the shadow is India. The country is already experiencing rapid urbanization and looking for ways to tackle poverty through mobile technology. The government's Smart Cities Mission and Digital India place 5G in the center of all initiatives.

What is unclear is the role of IIoT in India, which is a strong use case for 5G. The government is working hard to drive Make in India initiative by spurring 5G development in the commercial arena, creating a 5G forum and setting aside budget for 5G research and development. Initial joint programs between OEMs and key Indian telcos also show promise.

However, India faces significant challenges. Fiber to sites is less than 30 percent. Many mobile subscriptions are still 2G with about 500 million feature phones in use. Indian MNOs are looking to leapfrog from 2G and 3G to 5G, but this will require significant investment in acquiring 5G spectrum assets, rolling out new 5G Base stations and upgrading their entire network to be able to provide 5G experience adequately.



Technology Trends

5G has use cases and trends. Of these, three have emerged to have the greatest potential: enhanced mobile broadband (eMBB), ultra-reliable low latency communication (URLLC) and massive machine-type communications (mMTC).

Essentially, eMBB delivers better mobile data connectivity. This includes using fixed wireless access to compete with traditional fixed broadband (as noted in the market trends).

URLLC will become critical for industrial and medical applications where high performance is potential revenue-saving and life-saving. Meanwhile, mMTC, which will enable applications such as smart grids and smart cities, where coverage and large numbers of connections are essential, can transform the way we live.

Of the three, the first holds the biggest promise in 2019. In turn, eMBB will deliver a number of technological trends that will shape the Asian mobile landscape.

NSA vs. SA Debate

Most 5G rollouts will fall under Non-Standalone (NSA) standards. Essentially, it means that existing 4G ones will support the 5G networks. From the MNO perspective, it makes sense as they have poured billions into developing the 4G network platforms, many of them virtualized to make them extensible to 5G.

China is slated to follow a different route with 5G Standalone (SA) networks and device standards. While the disadvantage is that it requires an upgrade across the entire value chain, the advantages are numerous. SA improves data throughput performance and will also be a driver for broader 5G coverage right up to the network edge. It is predicted that SA will enable the development of use cases for URLLC.

Antenna Development

Antennas and their form factors will become key concerns for 5G. For example, when using millimeter wave spectrum (mmWave), which operates frequencies usually higher than 26 GHz, MNOs will need to deploy dense small cell networks at street levels; when using frequencies lower than 6GHz, they will need to add new cells on crowded towers and rooftops.

These factors will drive the adoption of Active-Passive Antennas (APAs) as a solution. It aims to simplify MNOs' evolution significantly toward 5G. Integrating mMIMO systems with passive multi-band antennas, without altering the antenna shape or performance solves multiple issues. It can also tackle issues concerning thermal dissipation, while its size which is similar to a typical passive antenna allows it to be optimally placed in crowded areas.

RAN in the Cloud

5G will bring about a data explosion across the mobile network. One of the ways network operators are looking to cope with is by placing radio access network (RAN) in the cloud. The C-RAN (or Cloud RAN), also known as the Centralized RAN, aims to simplify operating costs.

A C-RAN architecture has three primary components — a centralized baseband unit (BBU) pool, remote radio unit (RRU) networks, and fronthaul:

- **BBU pool** — The BBU pool, located at a centralized site, such as a data center. The BBU nodes will dynamically allocate resources to RRUs based on network demand.
- **RRU network** — The RRU network connects wireless devices similarly to access points or towers in traditional cellular networks.
- **Fronthaul** — The fronthaul connects the BBU pool with the RRU network, providing high-bandwidth links to handle the requirements of multiple RRUs. Currently, there are many candidates for fronthaul technologies, with mmWave, sub 6GHz licensed spectrum, free-space optical based spectrum, and fiber technologies being the leading ones.

C-RANs essentially lower the total cost of ownership (TCO) and can improve network performance. These factors alone will drive its development and deployment. More importantly, C-RANs ensure that the MNOs do not have to rebuild of the entire data transportation network, while promoting reuse and lower energy consumption.

A C-RAN architecture also lets MNOs co-execute RAN functionalities along with other network functions in a data center environment. This offers a unique use case to allow operators to offer mobile broadband network services in these environments, especially with the rising deployment of micro data centers and edge clouds.

Operability is key for C-RANs to work. CommScope has joined the Open RAN partner ecosystem to address this. It will see the company joining interoperability trials with other ecosystem players. The full ORAN specifications have been officially released that include the management plane (M-plane).

The company is also developing solutions for mMIMO. The company collaborated with Nokia to develop an integrated antenna solution for network densification for 5G that includes its dual-band, FDD-LTE antenna.

Indoor 5G Coverage

One of the most exciting developments of 5G is indoor coverage. In most cases, indoor connectivity was served through a combination of Wi-Fi and fixed broadband networks. In-building 5G will allow service providers to drive new use cases for entertainment and industrial use.

A prime example is the 2018 Winter Olympics in PyeongChang, Korea, where 360-degree panoramic cameras were placed at different locations within the stadium. 5G helped to transmit high-frequency video signals in real time to the VR area of the audience seats, creating unique immersive experiences.

In 2019, you will see new use cases emerging, such as telemedicine, smart manufacturing, and emergency rescue. These have strict demands in terms of network reliability and latency that 5G can meet.

For example, the Second People's Hospital of Zhejiang, Beijing Genomics Institute, and China Mobile Zhejiang are already jointly working towards further innovation in 5G telemedicine.

CommScope is already enabling these use cases with new development. For example, CommScope Era offers an all-digital C-RAN antenna system that can create a centralized headend to serve multiple buildings, or even to tap capacity from the operator's existing centralized radio access network (C-RAN) hubs.

Meanwhile, the company's OneCell, which uses a distributed C-RAN baseband architecture, creates a single "super cell" across multiple access points throughout the building, thereby eliminating handovers and border interference. It allows multiple users to dynamically share the same frequencies, multiplying system capacity.

Densification

If 5G is to deliver on speeds that are ten or more times faster than 4G, you need to increase density of the network itself. MNOs understood this when they rolled out their 3G and 4G networks, with increased sectorization and the addition of small cells.

This trend will continue with 5G, which will require even more densification across macro sites, in-building and within small cells.

The problem with densification is that it increases complexity to the network because the number of cell borders increases. This means there is a higher chance where interference becomes a problem and the risk of dropped connections elevates. Intelligent, automatic spectrum allocation will be key to maintain quality and speed, while wireline infrastructure will need to be overhauled to provide adequate fronthaul, backhaul and power.

CommScope's Metro Cell family of outdoor small cell solutions enable RF equipment to be housed in the top, middle, or bottom of the pole, and are designed to meet the strictest zoning requirements. Meanwhile, the company continues to innovate in power over fiber solutions and remote power supply solutions to deliver power to remote cells through a common wireline infrastructure, while featuring a broad range of fiber to the antenna (FTTA) solutions, such as the HELIAX FiberFeed FTTA, and Outside Plant Fibre Optic cables.

5G Challenges

5G is not without its challenges. In fact, many of the use cases are constrained by them. For 5G to take off, MNOs and technology vendors need to find solution to address them. Below are some of the main ones:

MIMO Complexity

Today, the MIMO antenna array can be complex to deploy and optimize. These antennas require significant upgrade to tower infrastructure in terms of space, loading and power. The beamforming capability of these antennas may initially require significant efforts to control interference between cells and have a well optimized network.

Backhaul Costs

Justifying the TCO as MNOs build out their backhauls will be a considerable challenge. The cost of installing, leasing and maintaining fiber can be prohibitive. At the same time, the cost and investments related to 2G, 3G and 4G networks will also increase, although this will differ over time and locations.

MNOs have two choices, according to analysts like McKinsey[8]. They can opt for a lean in approach where they prioritize 5G investments or delay 5G investments while upgrading current network infrastructure. There is no clear answer to which option is best but what is certain is that as operators add additional macro sites and small cells, 5G will become a more significant component of the TCO.

MNOs must also decide whether they should rewire mobile backhaul from wireless systems, such as point-to-point (P2P) microwave, to fiber-based systems. The issue is not cost of the equipment but the cost of installing or leasing the fiber. However, studies show that there is a lot of capacity still left in PTP microwave and will meet the demands of most 5G macro cell sites. Essentially, MNOs need to address this question individually based on their business requirements while balancing it out with user experience and expectations.

Use Case Development

A key challenge for 5G has to do with use cases. The technology has the potential to shape and rewire existing industries, and even create new ones. This will mean that justifying these use cases will take time.

Five major use cases that were cited earlier include fixed wireless using millimeter wave (mmWave) spectrum and beamforming, enhanced mobile broadband, mMTC, URLCC and enhanced event experiences. These require more than MNOs to deliver; other stakeholders such as regulators, industry solution providers and hardware players need to collaborate to create strong use cases. Driving cross-industry collaboration and co-creating a strong value proposition that benefits all stakeholders will be a considerable challenge. Government incentives and push might be required.

Once these use cases are developed, however, they will be able to spur and shape 5G adoption and its impact across industries.

Eco-system Development

As for any new technology, eco-system development determines the mass adoption. Certain unique challenges for 5G eco-system like support for multiple new spectrum bands, wider bandwidths and dual support of 4G and 5G layers for NSA type deployments will add to the complexity and may limit exploitation of 5G benefits initially.

[8] The road to 5G: The inevitable growth of infrastructure cost – McKinsey&Company

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