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5G & Future Business Use Cases

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5G, the next iteration of wireless cellular technologies, is currently reaching its final stages of development and commercialization by MNOs and industry stakeholders. Previous iterations of technologies (3G and 4G) were developed with a consumer-oriented focus. However, 5G will have further-reaching impacts, enabling a large number of use cases in IoT (Internet of Things) sectors such as healthcare, automotive industries, smart cities and mobile broadband. 5G networks will deliver high bandwidth and low latency that support services such as UHD (Ultra High Definition) video streaming, among many others.

Juniper Research anticipates that the first commercial network launches will occur in 2019; the first networks to provide 5G services will be located in the Far East and China and North America. Meanwhile, network operators in Europe have mostly adopted a 'wait-and-see' approach, closely following the progress of operators in these two regions.

Over the past two years, operators and network vendors have been actively trialing their 5G solutions, including antennae, core networks and beamforming. Since 3GPP standards have been finalized for 5G NRs (New Radios), many of these trials have focused on interoperability between devices and 5G networks. As a result, leading operators are now aiming for a 2019 launch date. Indeed, many operators have begun rolling out antennae and backhaul infrastructure to provide a 5G service. Initial 5G coverage will be in urban areas.

The 5G Standard – Key Requisites

To fully support these new types of devices and services, 5G needs to have some revolutionary innovations along with evolutionary improvements to existing technologies.

Factor	Requisite Deliverables	Anticipated Deliverables
Peak Data Rate	1-20 Gbps	500Mbps-1Gbps
Latency	Sub-1ms	5-20ms
Average Data Rate	10-100 Mbits/s	250-500Mbps
Connection Density	10,000-1,000,000 connections per km^2	10,000-1,000,000 connections per km2
Spectral Efficiency	15-20bits/s/Hz	75-85bits/s/Hz
Network Energy Efficiency	90% more efficient over LTE	90% more efficient over LTE
Connection Mobility	Up to 500km/hour	250km/hour

Table 1: Initial 5G Requisites & Anticipated Network Conditions
Source: Juniper Research
(Click to Enlarge)

The idea of 5G coverage is not as clearly defined as other wireless technologies, as the network will have changeable characteristics at any given location. Network slicing enables operators to manipulate network features to suit the needs at locations at various times. For example, densely populated areas will be provided with high data rates during peak usage times, or ultra-low latency will be introduced to accommodate edge computing use cases.

High Data Rates

Peak data rate for 5G or IMT-2020 will need to be above 10Gbps. This will be critical to support services such as UHD video streaming, large file downloads and VR applications. While this rate could be the maximum, average data rates between 1 and 10Gbps are expected and required and need to be achievable both indoors and outdoors.

Given the correct network conditions, however, these speeds are achievable on 4G infrastructure. While many operators and network vendors have announced they have achieved above 1Gbps in test conditions, these results must not be considered applicable in real-world environments. Many of these trials involve a single device per antenna, within a small range, and in direct LOS (Line of Sight).

Latency Requirements

5G also needs to be ultra-low latency, in the sub-1ms rate, which is the delay in end-to-end data transmission. Currently, 4G networks have a latency of 40-60ms, so this will entail a significant improvement in delay rates. As with 5G trials speeds, Juniper Research believes that results for network conditions should be considered a marketing exercise or PoC (Proof of Concept) for 5G rather than an applicable scenario for real-world usage. Compared with 3G and 4G, 5G will emphasize lower latencies in support of low-speed and high-speed services with high reliability and flexibility.

Spectral Efficiency

This refers to the use of available data bandwidth to transmit maximum information data (bits per second per Hz). Significant improvement in spectral efficiency is required and antenna technologies, such as MIMO (Massive Input, Massive Output), are expected to help 5G.

Energy Consumption and Battery Life

5G is expected to enable low-cost sensor device networks with up to 10 years' battery life. A reduction in power consumption by the networks is also a fundamental requirement. In the future, 5G radios will provide the necessary connectivity for backhaul infrastructure.

Roaming Requirements

Similar to 4G networks, with a wide range of spectrum that could potentially be used, fragmentation becomes the issue. Not only will this have implications for devices, 5G will also require a globally harmonized band for roaming services.

5G Business Models and Ensuring ROI

Once the total cost of securing spectrum and implementing the necessary tools for a 5G services has been estimated, operators must focus on securing ROI as soon as possible. In order to ensure this, setting correct pricing levels is essential, taking into consideration the specific challenges that each vertical market presents.

Opportunities in the IoT (Internet of Things)

The data-centric mobile world will become increasingly interconnected, leading to a range of opportunities at the infrastructure, device and component levels.

5G will be harnessed by many traditionally 'dumb' devices so they are connected. This will power connected devices, appliances, vehicles and critical developments in smart homes and cities. The impact of the IoT will be far-reaching, built through the widespread deployment of sensors in everyday items. The 'Internet of Things' is the concept of providing a connected digital identity to physical objects and networking those identities and their data together. Analysis of the data that these objects produce aims to improve quality of life, efficiency, create value or reduce costs.

5G-enabled New Vertical Market Applications

The Juniper Strategy Quadrant below illustrates the existing and new applications against the different enabling sectors in the IoT world that 5G will enable.

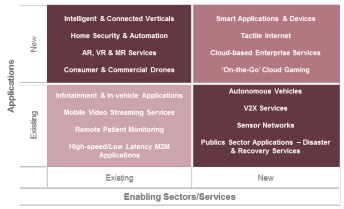

Figure 2: Strategy Quadrant: 5G and the IoT
Source: Juniper Research
(Click to Enlarge)

Operator Monetization Strategies

As noted in our previous edition, ARPU (Average Revenue per User) has been considered the benchmark metric for measuring operator success in terms of billed revenue. The new services discussed in the previous sections are expected to be heavily dependent on a favorable operator service model.

There is both a need and a desire to solve the ARPU problem that network operators are facing; carriers are considering different service scenarios that they could deploy to garner payback from their network license investments.

The challenge here, however, is that as 5G expected to drive a number of connected devices, systems and sensor networks, is ARPU going to be the right factor for measuring 5G? For example, consider M2M verticals:

Sector Usage Analysis

5G IoT Sector Data Traffic Analysis

As shown in figure 3, automotive 5G connections will generate 68 percent of all data generated by 5G IoT connections. This in turn is driven by the high data generated by future AV (Autonomous Vehicle) systems. Juniper anticipates that a full AV could generate more than 1TB of data per day. Additionally, smart city technologies are anticipated to generate 30 percent of all data by 2025. In

these instances, data will be driven by the public Internet gateways that connect city residents to the Internet and infrastructure management.

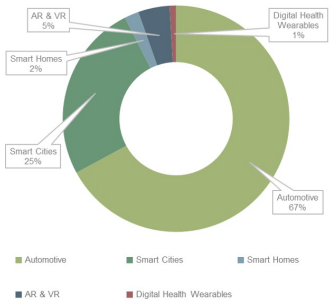

Figure 3: Proportional Sector Split of IoT Mobile Data Traffic Carried Over 5G Networks (PB), Split by 5 IoT Sectors in 2025 – 543 PB
Source: Juniper Research
(Click to Enlarge)

A significant proportion of these data-intensive connections will be in urban areas; in turn, this will place increased pressure on operators to solve the 'densification' challenge.

Other IoT sectors will generate minimum amounts of data, owing to a small addressable installed base of devices. For example, the desire to have an over-reliance on residential broadband connections will lead to development of 5G smart home security connections. While these connections are forecast to remain under 8 million by 2025, they will generate data that needs to be transmitted as HD video data.

Future Outlook

Juniper Research anticipates that the first 5G networks will launch in 2019 and that total connections will scale rapidly to 1.5 billion by 2025, with initial growth driven by fixed wireless access to replace or complement current broadband connectivity.

Operators in Japan and South Korea have established themselves as clear leaders in the development of 5G. Juniper Research forecasts that 43 percent of global 5G connections will be located in these two countries in 2019.

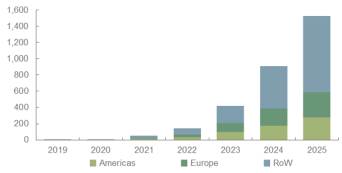

Figure 4: Global Mobile 5G Active Connections (m) 2019-2025
Source: Juniper Research
(Click to Enlarge)

Juniper also forecasts that 5G broadband will be among the first services to launch over 5G. Its suitability as a last-mile solution will drive adoption to over 220 million connections by 2025. However, the challenge for operators will be to demonstrate tangible benefits to enterprises and consumers over existing fiber-based solutions.

Juniper cautions, however, that operators face significant challenges both to deploy and most effectively configure 5G networks. We argue that with the need to deploy dense small cell networks, operators would need far greater access to sites to upgrade and share equipment. Furthermore, we would urge operators to invest in virtualized networks to enable both more efficient traffic management and to improve security in the network perimeter.