Electro Rent

The Wide-ranging Impact of 5G

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The future is here. Are you ready?

The impact of the fifth-generation of mobile network (5G) technology cannot be underestimated. With 5G technologies and applications, we are on the verge of some of the most significant scientific and industrial developments the world has ever seen. Consumer adoption of the Internet of Things (IoT), business acceptance of the Industrial Internet of Things (IIoT), and the ubiquity of the Internet of Everything (IoE) will enable billions of people, machines, and devices to share massive amounts of data, high-resolution images, and HD video streams in real time.

5G technology will be the catalyst that accelerates the pace of change in many industries, including automotive, transportation, manufacturing, and healthcare, all across society. This paradigm shift, combined with ongoing developments in artificial intelligence and machine learning, augmented and virtual reality, 3D printing, quantum computing, biotechnology, nanotechnology, and genomics will lead to new scientific discoveries and advancements in business innovation, efficiency, and productivity.

In what some have termed the Fourth Industrial Revolution, (Source: World Economic Forum, what it means, how to respond.) the Internet of Everything will combine connected devices, machine-to-machine (M2M) communications, automation, and robotics with virtually unlimited processing power, bandwidth, and storage capacity, leading to disruptive innovation, new business models, innovative products and services, novel manufacturing techniques and new transportation solutions.
While we cannot know what might be possible when 5G applications are fully deployed, some practical applications include self-driving cars; automated delivery drones and commercial fleets; automated manufacturing and supply-chain management; remote surgery, as well as smart homes, buildings, factories and cities.

In the coming decades, the world is likely to see some of the most important advancements it has ever seen in manufacturing, technology, consumer convenience, resource management, energy conservation, healthcare, agriculture, telecommunications, and transportation — all of which have

the potential to increase living standards and quality of life for millions of people around the world.

The impact of the fifth-generation of mobile network (5G) technology cannot be underestimated.

Get Ahead with 5G

Who Will Gain First-Mover Advantage?

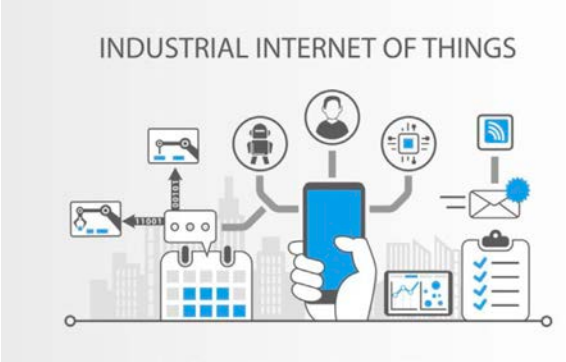
Transformative developments such as semiconductors, personal computers, the internet, smartphones and the cloud have led to significant improvements in education, literacy, and the quality of life for millions of people around the world. Similarly, 5G will fundamentally transform our society by improving how we communicate, share information, enjoy free time, and manufacture and distribute products. By enabling real-time connections among billions of people, machines, and devices, 5G will lead to widespread advancements in innovation, convenience, automation, efficiency, productivity and safety.

Why 5G?

To accommodate the expected explosion in internet-connected devices via the Internet of Things (IoT), a massive increase in bandwidth will be required. When Industrial IoT (IIoT) and the Internet of Everything (IoE) become widely accepted, the result will be a threefold increase in cellular and non-cellular connections to 25 billion by 2025. (Source: The Mobile Economy 2018, GSMA Intelligence.)

5G Latency

5G offers many compelling advantages, including the ability to serve as a single global standard, the ability to accommodate capacity increases without the need for successive network iterations, virtually unlimited bandwidth, and low latency. 5G latency — the delay between data request and transfer — is expected to be in the range of 1 ms to 2 ms, which compares to 50 ms on a 4G network.



5G will fundamentally transform our society

This imperceptible lag enables a host of mission-critical applications where delay would be unacceptable, such as self-driving vehicles, remote-controlled commercial delivery vehicles, autonomous public-transportation fleets, industrial automation, remote robotic surgery, and aviation/military/defence applications. On the lighter side, 5G will support powerful virtual and augmented reality applications, as well as real-time HD video sharing and cloud gaming.

Get Ahead with 5G

5G Speed

While the speed of 5G will undoubtedly make even the best 4G seem slow, it is likely to be measured in terms of the User Experience in ways that aren't restricted to the handset. Performance will be measured in data rates experienced by the user, which will include machine-type communication (MTC) and human-type communication (HTC). The aim is that the most appropriate data rate will be available for 95% of the time in 95% of locations.

The data rate experienced will depend on the use case; for example, indoor ultra-high broadband access should deliver a download speed of 1 Gbps and an upload speed of 500 Mbps, with a latency of 10 ms at pedestrian speeds. Conversely, users on an airplane could typically expect a download speed of 15 Mbps per user with 10 ms latency, while travelling at up to 1000 km/h.

Because 5G is expected to play a significant role in MTC, a use case will exist to support massively low-cost, long-range, low-power connectivity and here the speeds will typically be around 100 kbps with a latency that could be measured in hours while travelling at up to 500 km/h. This use case is clearly appropriate for package tracking, for example.

For applications that require ultra-low latency in the range of 1 ms or less, the use case would support a download speed of 50 Mbps and upload speed of 25 Mbps, traveling at pedestrian speeds. Adding ultra-high reliability to this use case would dictate a download speed of up to 10 Mbps while travelling at speeds of up to 500 km/h.

It is anticipated that speeds of tens of Mbps should be available to tens of thousands of users in the same large area, such as a stadium, and up to 1 Gbps for tens of HTCs in a relatively smaller area, such as the floor of an office building.

The Race is On

Many European countries have committed to having some form of 5G network in operation by 2020, including Norway, Germany, UK and Switzerland. Others have indicated they intend to start 5G rollout before then, perhaps even in 2018. Speaking at Mobile World Congress in February 2018, the CEO of Nokia, Rajeev Suri, observed that '5G is happening fast, even faster than we or anyone expected'. He sees it as a neck-and-neck race between the US and China to deploy first in a big way.

Initially, both 4G and 5G networks will exist simultaneously, with a full transition to 5G occurring in time and bringing opportunities for innovation, economic growth, and disruptive change. 5G networks will be used for mission-critical applications that require high reliability and low latency, while 4G networks will support non-critical roles until 5G networks are fully implemented.

5G is so important to global technology leadership that the US government blocked a takeover of San Diego-based Qualcomm on the basis that its lead in 5G development is a critical national asset. Reuters estimates that Qualcomm owns 15% of 5G-essential patents, which is more than Nokia (11%) or all telecoms in China (10%).

IoT

According to the McKinsey Global Institute, IoT has the potential to deliver more than four trillion dollars in global economic impact a year by 2025. Leading contributors are factories and cities; consumer, retail, and logistics; connected autos and autonomous driving; workplace operations and maintenance; and connected homes and offices. Although consumer IoT will deliver many benefits and gain much of the attention initially, B2B and industrial applications are expected to account for nearly 70% of the value.

Industrial and Commercial IoT Applications

Robotic Manufacturing and Smart Factories

Industrial IoT (IIoT) refers to IoT applications that are not consumer related. It includes smart factories that use machine learning, artificial intelligence, robots, connected sensors, and real-time data and analysis to improve the manufacturing process.

M2M communication will enable factory systems to "talk" to each other, share massive real-time data streams, and make decisions and adjustments largely on their own. Subsequently, data can be analysed by humans to gain additional insight and discern how to further improve operations, increase quality, reduce production time, or lower costs.

In a smart factory, cameras and sensors will be used to monitor and adjust manufacturing in real time. Costs can be reduced via lower error rates and less rework. Efficiency can be increased with improved throughput and less human intervention, leading to increased consistency and higher quality. (Source: Developers Alliance, Internet of Things, Manufacturing IoT From the Factory Floor.)

As IIoT evolves, multiple systems, factories, and logistics providers will be connected to a centralized IT system that provides total visibility to all manufacturing and supply chain events. Radio Frequency Identification (RFID) tags can track products as they move, improving accuracy and quality, and informing managers about issues that need adjustment or resolution.

Today, companies use IIoT largely for predictive maintenance and to improve safety. For example, sensors are used to deactivate a machine if humans inadvertently cross a predetermined safety zone. Although IIoT is in its infancy today, it is expected to be the largest growth category by 2023, when it will overtake consumer IoT. (Source: The Mobile Economy

2018, GSMA Intelligence.)

Smart Cities

Have our city centres become too large, complex, and fast-paced for humans to manage effectively? The smart cities of tomorrow will use a variety of IoT-connected devices and sensors to better match resources with demand, monitor fleet reliability, improve infrastructure and operations, reduce human intervention and increase safety, service, quality, and efficiency.

Some examples include smart traffic management systems; smart parking, lighting, water, and public transportation systems; and automated waste management systems. By leveraging sensor data — as well as real-time information from vehicles, pedestrians, and infrastructure — city managers will be better able to reduce congestion, improve resource, and increase energy conservation.

Industrial and Commercial IoT Applications

Smart City Experimentation

Leading cities are already experimenting with smart systems. Tokyo is testing autonomous robot taxis that are expected to debut during the 2020 Tokyo Olympic Games, to demonstrate that Japan remains a world leader in technology.

Robot Taxi (www.dena-automotive.com) is a joint venture between mobile internet provider DeNA and robotics firm ZMP. According to Robot Taxi CEO Hiroshi Nakajima (via translator), "When you look at manned taxis, 70% of the cost is actually related to labour costs. If we can replace that with [artificial intelligence], I think we'll be able to provide a very attractive price point." (Source: Quartz.com, Japan is building a "Robot Taxi" service, with thousands planned for the 2020 Olympics.)

Separately, Nissan and DeNa are collaborating to pilot a self-driving taxi service in 2018 and commercialise it in 2020. Initially, autonomous Nissan Leafs will be available within a geofenced 4.5 km route around Nissan global headquarters and a local shopping centre. A safety driver will be behind the wheel in the event of an unusual situation or emergency. (Source: The Verge, Nissan plans to launch its own self-driving taxi service in Japan.)

Tokyo is also testing Panasonic autonomous wheelchairs at Haneda Airport that use sensors to navigate around pedestrians, luggage, and other obstacles. Disabled visitors use a smartphone to arrange for pickup and drop-off, and after the journey is completed the wheelchair automatically returns to its docking station or continues to its next destination. The fleet will debut at the 2020 Olympics, possibly to transport Paralympians. (Source: Smithsonian.com, What Will the Automated City of the Future Look Like?)

In Singapore, self-driving cars and buses have been testing since 2013. More recently, autonomous taxis have also been tested. By using a variety of sensors to track bus fleets, Singapore has been able to identify problem areas where more buses are needed to reduce congestion and wait times. As the island is only 30 miles across, it is an ideal testbed for IoT technologies. Its Smart Nation initiative aims to propel it to a leadership position among smart cities. (Source: bbc.com, Tomorrow's Cities: Singapore's plans for a smart nation.)

Due in 2020, a government-mandated satellite-navigation system will be required on all vehicles in Singapore to enable optimisation of traffic flow, assess road taxes, and inform better road design. With sensor data from around the city — from buildings, roads, buses, taxis, personal vehicles, and the infrastructure — a highly accurate computer model can be built to enable virtual simulation and modelling. Singaporeans can already access traffic and parking data, security cameras and other public data online. (Source: engadget.com, Singapore is striving to be the world's first 'smart city'.)

In September 2017, testing of an unmanned, aerial two-seat drone or flying air taxi, began in Dubai. With the goal of becoming the world's first autonomous flying taxi service, the 18-rotor Volocopter can fly for 30 minutes with a range of 17 miles. (Source: Newatlas.com, Volocopter flying taxis takes unmanned flight over Dubai.) Called "autonomous air taxi" (AAT) by the Dubai government, the aspirational goal is to have 25% of passenger journeys served by AATs by 2030.

Industrial and Commercial IoT Applications

Smart Traffic Management

The RAC cites unnecessary and excessive braking as one of the major causes for motorway traffic congestion, something that technologies enabled by 5G, including platooning and autonomy, will certainly address. The continued erosion of the cost of motoring has seen more cars on the road year on year, making road space a valuable commodity. When they do become congested it leads to increased fuel consumption and vehicle emissions, higher fuel and labour costs, and lower productivity and efficiency. To address this, real-time smart traffic management systems are being developed, enabled by 5G connectivity, to optimise signal timing and traffic flow in cities around the world.

A report commissioned by Vodafone (Creating a Gigabit Society – The Role of 5G) identifies several ways that 5G can tackle traffic congestion. This includes the autonomous vehicle and driver assistance systems, as well as platooning and intelligent navigation. It also suggests that data gathering, remote monitoring with predictive maintenance, and tele-operated driving modes could also play a significant role.

In the future, smart parking systems will be used to save fuel and reduce emissions by alerting users to space availability in real time. Smart public transportation will offer real-time tracking and traffic projections for metro lines, buses, and train systems.

Smart Resource Management

Smart grid management will improve operations, maintenance, planning, and resource allocation within cities. For example, internet-connected refuse containers for both recyclable and non-recyclable refuse could signal when waste collection and removal is required. This could be carried out using an automated collection fleet, thereby improving sanitation and reducing costs. Similarly, oil and gas delivery or utility service and repair could also be automated. Smart water sensors can monitor and adjust the quality of drinking water, while smart lighting sensors can dim street lights when no pedestrians or traffic are present.

As city systems evolve, real-time connections among vehicles, people, and infrastructure could decrease congestion, improve traffic flow and reduce emissions. Connecting vehicles to each other (V2V), to the infrastructure (V2I), and eventually to everything (V2X) would enable further advances in safety, convenience and efficiency. In a V2X scenario, vehicles could share information about road conditions with other devices — including traffic signals, sensors, emergency roadside warnings, and hazard systems — and with pedestrians and sensors embedded in road systems.

Industrial and Commercial IoT Applications

Smart Buildings

Smart buildings use IoT-connected devices to optimize energy use by matching resource allocation to occupancy patterns. Such systems can increase occupant comfort and convenience, predict equipment problems before they occur, and monitor building security.

Consumer IoT – The Smart Home

Smart homes use IoT-connected devices and a gateway/router to monitor and access home-control devices remotely, over the internet or through a mobile device such as a smartphone. The number of smart home connections is expected to increase threefold to more than 5 billion by 2025 (Source: GSMA Mobile Economy 2018.) Globally, this market grew 95% (Q2 2016 to Q2 2017) to $3.3 billion. (Source: IoT Analytics GmbH.)

The largest smart home categories include gateways, speakers, security systems, and appliances. Others include thermostats, lighting, switches, and detectors. For example, temperature sensors that continually adjust between efficiency and comfort, sensors that can turn off lights in unoccupied rooms, and window sensors that can sense when windows or doors are open to reduce HVAC usage. Other applications include appliance control (i.e., washers, dryers, refrigerators/freezers, ovens/microwaves), security systems (i.e., motion sensors, cameras, lock control), and entertainment devices (i.e., Bluetooth enabled speakers for music, smart speakers/voice controlled assistants).

In home entertainment, the increased bandwidth of 5G will enable widespread sharing of 4K, 8K, 3D video, and 360-degree video, all of which combined are expected to account for 75% of mobile data traffic worldwide by 2023 — up from 55% in 2017 (Source: Ericsson Mobility Report, November 2017.) 5G will also bring improvements in cloud gaming as well as augmented and virtual reality applications for training, education, marketing, sales, and entertainment.

Automotive IoT Applications

The Connected Car

A connected car is a vehicle with internet access, and many are already on the road today. Connectivity enables numerous safety, convenience, and entertainment features. Safety and security options include automatic crash notification, road hazard warning, emergency breakdown notification, and vehicle recovery services. Real-time traffic and navigation, remote vehicle diagnostics, service reminders, and remote lock and unlock functions add convenience. In the realm of in-car work and entertainment, connectivity brings streaming music and video, in-car hotspots, and mobile office functionality.

Self-Driving Vehicles

Trials of self-driving cars are being conducted around the globe, with a number of manufacturers aiming to release their first autonomous production cars in 2020. The first European trials took place in London last year, conducted by Nissan using a Leaf that had been modified for autonomy. The UK has stated it wants to have driverless cars on its roads by 2021 and the HumanDrive Project will be a major milestone in reaching this goal; a 200-mile journey across the UK taking in country roads, A roads and motorways, as well as roundabouts. The HumanDrive Project is led by a consortium that includes Nissan and the UK's Highways Agency.

Waymo (formerly the Google self-driving car project) is testing a fleet of self-driving cars with Level 4 autonomy, in a geofenced area in Arizona, USA. Waymo's cars are interacting with other real-world vehicles, pedestrians and road users, and it reported 635,868 miles in self-driving vehicles in 2016 (up from 424,331 in 2015).

In addition to self-driving miles logged, another key metric is the number of times the system disengages from autonomous mode, which indicates how often human intervention was required. Disengagement can occur for a variety of reasons. Some are related to software, such as camera or sensory perception issues, inability to properly predict traffic patterns, or unwanted vehicle manoeuvres. Others include external conditions, such as weather, improper driving from other vehicles, road construction, or roadway debris.

Waymo has shown that driverless cars can work in ideal conditions on real roads. They have also conducted hot weather testing in Death Valley, California and plan additional winter testing in Michigan to gain experience in snow, sleet, and ice. They are working to show that their vehicles can perform in all environments under any conditions and reach Level 5 autonomy.

Automotive IoT Applications

The Future of Automated Driving

Today, several automakers offer vehicles with Level 2 autonomy, where partial assistance is provided under certain conditions (Cadillac, Tesla, Volvo, Mercedes-Benz). One (Audi) has announced its intention to offer Level 3 autonomy on a 2019 model — pending regulatory approval in several states.

However, only experimental vehicles such as Waymo (Google self-driving car project) have achieved Level 4 autonomy. Although the technology is available to support fully autonomous vehicles today, it is expensive. Over time and with scale, however, the full cost of hardware, software, and associated systems and sensors will decline. Even so, market acceptance and introduction may be at least a decade away. (Source: plasticstoday.com, Here's Why Level 5 Autonomous Cars May Still be a Decade Away.)

Consumer acceptance is just one issue. Liability and regulations are others. In March 2017, AAA indicated that 75% of US drivers feel "afraid to ride in a self-driving car". The Kantar TNS Connected Car Report published recently indicated that, amongst Europeans, the Spanish are most interested in owning an autonomous car; 66% compared to 53% for the rest of Europe. An Accenture online survey revealed that 54% of online consumers are willing to be a passenger in a self-driving vehicle. (Source: Accenture.com.) So, while it appears that consumers are comfortable with some aspects of self-driving technology, they don't appear ready for full autonomy.

Legal liability issues also remain. The good news is that although regulations tend to lag the pace of technology development, state and local governments have generally welcomed technologies they believe will bring overall economic benefit, including autonomous vehicles.

With 5G, automakers will be able to gather over-the-air data from experimental fleets to create more powerful simulations, which then, in turn, can become part of the vehicle reference database. Because Level 5 autonomy must cover all situations all the time without driver assistance, automakers will likely focus on Level 4 autonomy for now, where routes are restricted to certain geographic areas. Several automakers intend to have Level 4 vehicles available by 2020/2021.

Conclusion

From automated manufacturing and self-driving vehicles to smart homes, buildings, and factories, the interconnectedness of society is set to increase exponentially with the introduction of 5G technology. Virtually unlimited bandwidth, superfast speeds, and near-real-time connections will become commonplace.

A multitude of connections — via IoT devices, vehicles, cities, infrastructure, and industrial entities — will enable new innovations, new technologies, and new business models. Some will offer more efficient and more productive ways of doing business for legacy industries; others are completely unknown and have yet to be discovered. One thing is certain, though. Disruption and change will be key components to the future fabric of our society, leading to new discoveries, transformation and improvement.

About Elecro Rent

Elecro Rent is the market leader in electronic test equipment, offering a range of solutions to help organisations globally use test equipment efficiently. Its services help minimise the costs of acquiring test equipment, optimise its use and maximise return at end of life without stretching capital expenditure, and include rental, leasing, sale of new and used equipment and buy-back as well as full asset management. As part of the Electro Rent Corporation we support our customers with test equipment assets worth over $1.1 billion. A team of 350 specialists serves Elecro Rent customers in over 150 countries from offices across Europe, the US and Asia. Elecro Rent currently provides equipment from leading manufacturers, including Anritsu, Keithley, Keysight Technologies, Rohde & Schwarz, Tektronix and Viavi.

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