# How 5G can spark an electronics revolution

## The technology enabling next-gen manufacturing and self-driving cars

IBM Institute for Business Value

# 5G: More than just speed

The coming of 5G is a game-changer, but not in the way people expect. Smartphone users worldwide have long-awaited the arrival of fewer dead spots and download speeds up to 20 times faster.[1] Potentially far more significant is the capacity for 5G to unlock the full power of the 30 billion Internet of Things (IoT) devices expected to be connected by 2030.[2] Analysts estimate that by 2035, the 5G value chain will drive upwards of USD 3.5 trillion of new economic output, supporting 22 million jobs.[3] To make this projection a reality and justify the necessary investment, the electronics industry must tap into the full potential of 5G beyond the handset business.

# Heavy 5G investments must find strong returns

One fact about 5G most everyone agrees on is that it won't come cheap. Successful implementation requires major investments. Between 2020 and 2035, analysts estimate the collective annual investment in research, development and capital expenditures by network equipment firms, telecommunications companies and governments within the US, China, Japan, Germany, South Korea, the United Kingdom and France will average over USD 200 billion.[4] Estimated investment sums are enormous compared to the size of the industry. In contrast, the global revenue for mobile network operators (MNOs) was USD 1.4 trillion in 2017.[5] Although investing in 5G will happen over many years, shared across MNOs, electronics sector companies and government entities, the investment needed is huge. Smartphone revenues alone aren't enough to justify it.[6] However, the expanded value net will benefit and contribute to the investment.

The telecommunications industry, alongside network equipment providers (NEPs), must look for growth using software as the differentiator in a broader set of use cases across industries. This includes apps, analytics and bespoke software designs that address specific user needs; for example, artificial intelligence (AI)-enabled manufacturing, edge-specific decision making for transportation-as-a-service, and augmented reality that can assist with everything from utilities repair to construction trade work. In many cases, AI-capable chips will enable edge applications.

Chipset providers will likely address both hardware and software for IoT devices, enabling decisions to be made closer to the device instead of sending it to the cloud. It doesn't mean that the cloud will disappear, but more processing will be done locally, at the device level. Just as the Apple iPhone X face recognition happens on the phone itself, not the cloud, edge will require adjudication rapidly at the point of impact.[7]

### Edge computing and 5G

Edge computing solutions can run analytics and share information between IoT devices and clouds for speedier replies. Meeting 5G use case requirements will force an increase in edge-driven solutions: 5G specifications call for less than 1-millisecond roundtrip transaction latency.[8] A millisecond is about 120 miles of fiber round trip, or 60 miles one way, even assuming zero radio and switch latency.

If a vehicle is traveling through an intersection or a robotic surgery arm is performing an open-heart operation, low latency edge computing represents a faster decision and action. By being distributed, edge computing can avoid unwanted outcomes, such as catastrophic failures in parts, plant machinery and mobile applications.

# Bringing new use cases to life

5G is inherently more flexible and scalable than its predecessors. The way 5G networks are built allows them to be configured in virtual slices of network capabilities that can be used as needed for more speed, dedicated capacity and throughput. This enables lower latency. Each virtual network can operate independently, controlled and configured for user-specific needs, without creating a new physical network. Software defined networking (SDN) architecture makes network controls programmable, while virtualization allows the underlying infrastructure to be abstracted for applications. Orchestration instructs which protocols and processes to invoke, and in what order.

5G technology has to deliver in three vital modes: Enhanced Mobile Broadband (EMBB), Massive IoT (MIoT) and Ultra-Reliable Low Latency Connectivity (URLLC).

### Enhanced Mobile Broadband (EMBB)

One aspect of 5G that will impact the most consumers, EMBB provides faster wireless connections and extends cellular coverage, including previously underserved areas. EMBB also supports more devices and more data in dense locales and enables high-bandwidth applications such as augmented and virtual reality.

Use cases for EMBB focus on content and speed. They enhance dynamic network configuration and management, placing reception and speed where it's needed. It will enable more functions in digital signage displays, from restaurants to stadiums or lobbies with richer imaging and faster updates. Businesses can benefit from improvement in cross-enterprise collaboration, and training and education. It is expected to improve connectivity and apps on mobile devices or tablets on shop floors as they refresh faster and connect more broadly across networks.

Hundreds of factories worldwide take up enormous amounts of space, often millions of square feet. Operators and machines at one end need to communicate with those at the other, despite the challenges of a noisy environment and poor cell reception. EMBB alerts operators and machines to product switches, slowdowns, challenges, new configurations and potential repairs. If a piece of equipment is taken down for repair, a technician can use EMBB to share status and communicate with a remote command center. The command center responds by sending augmented reality repair instructions to quickly return the machine to productivity.

In the electronics industry, device manufacturers — alongside telecommunications providers — will likely focus on EMBB with new forms of home-based network extenders and other signal enhancements. In many cases, 5G EMBB capabilities will be embedded directly in end devices, such as video cameras, and will support more sophisticated media applications like ultra HD mobile streaming for uninterrupted video experiences, immersive and on-the-go gaming, and mixed reality services.

### Massive IoT (MIoT)

Society is becoming more connected and people need more energy to power it. Connected cities, energy and utilities, agriculture and transportation are obvious 5G applications for MIoT, which increases the scale and speed that edge computing and machine-to-machine applications can deliver while using less power. MIoT use cases increase machine intelligence across areas ranging from the tractors harvesting smart agriculture to trains delivering connected transport to smart cities. Energy and utility monitoring with MIoT will operate across broader physical infrastructure and smart grid technology, reporting on and responding to changing conditions in real time.

MIoT also supports expansion of energy marketplaces integrating smart charging stations for electronic vehicles. Increased use of beacons supported by MIoT will help connect shoppers and retailers, creating context-aware offers, signage and pricing. Emergency and disaster response will be improved by MIoT by expanding, for example, the use of drone-carrying cameras. Better resource tracking and coordination could improve damage assessment leading to more highly coordinated action.

### Ultra-Reliable Low Latency Connectivity (URLLC)

URLLC addresses the most time-sensitive and secure messaging delivery. It is crucial to further advancements in autonomous vehicles and remote equipment operations, such as hydropower plants or deep-water oil rigs. Factories might use cloud computing and network slicing with low-power cellular base stations called femtocells to establish private plant-centered networks, especially in IP-intensive situations or military applications.

URLCC also enables surgeons to operate remote robotic surgery appliances and conduct secure remote video-enabled patient conversations. URLCC application to smart grids streamlines processes to protect, detect and mitigate problems. URLLC helps autonomous vehicles to communicate with each other to make smart decisions when approaching intersections or potential hazards.

### Piloting 5G ahead of the curve

Ericsson, with China Mobile and Intel, piloted IoT equipment with attached sensors that transmitted real-time data to replace manual maintenance and usage tracking, and extend the lifespan of factory machines. Payback return on the investment came in less than 6 months.[9] Nokia and Verizon completed the first transmission of a 5G signal to a moving vehicle in a major step forward for mobile broadband and connected car applications.[10] South Korea showed off 5G at the 2018 Pyeong-Chang Winter Olympics, including immersive broadcasting on 5G-powered gadgets and an “Interactive Time Slice” with 100 ice arena cameras providing 360-degree instant replay, pause, angle adjustment and zooming.[11]

## New partnerships and joint ventures

5G is creating a new set of partnerships. MNOs will bring capacity and network operations, while other electronics players deliver technology and expertise. As such, 5G initiatives have led to a spate of joint ventures, including:

- Intel, Ericsson, Toyota, Denso, and NTT DoCoMo are working on 5G pilots in Japan, attaining speeds of 1Gbps down and 600Mbps up while streaming 4K video from a connected vehicle.[12]
- Nokia has partnered with T-Mobile to build a "nationwide" 5G network and provide products including radio platforms, core network technology and management systems.[13]
- Ericsson and IBM Research have collaborated on a radio front-end solution that supports 3GPP 5G Standards. It offers an upgrade path from 4G by reusing existing indoor network infrastructure.[14]
- British Telecom and Huawei have embarked on a 5G research partnership to consider the technical and commercial feasibility of deploying faster mobile communications globally.[15]

Partnerships deliver more value to the company, market or industry served. Consider the potential for better machine-to-machine communication. Supervisory control and data acquisition (SCADA) systems can provide more scalability and interoperability across the networks they operate and monitor. They can also embed greater security to identify intrusion more rapidly.

Because 5G represents the potential for multiple simultaneous IoT sensor connections and edge decisions across networks, this type of porous network requires extra protection. Organizations that pursue 5G applications will need to address shared responsibilities and governance to determine who does what.

Due diligence will be required for both government entities and private sector solutions. With traffic controls and medical devices as potential solution areas for 5G, security preparations can't be considered after the fact. Lives might truly be on the line without adequate protections.

### Network slicing

Increased bandwidth, massive IoT data and lower latency are all incremental improvements over previous generation wireless networking. But their impact will be muted without so-called network slicing. This unique form of virtualization allows for multiple logical networks to share a common physical infrastructure. Each logical network, or slice, is dynamically reconfigurable, and can be optimized for speed, bandwidth, latency, security and more.

By extending slices from the access network into the core network, end-to-end networks can be created that encompass virtual computing, storage and network control. A single 5G infrastructure can accommodate wireless consumer services plus virtually separated and secure first responder networks, Quality of Service (QoS)-optimized content distribution, real-time automated factory communications and more in a dynamically reconfigurable, software upgradeable network.

## Real or lofty expectations

Powerful 5G use cases are present across every industry, from autonomous vehicles to connected manufacturing facilities. 5G is real and investments are being made now, especially by NEPs and MNOs. For those in the electronics industry, two core paths are available.

The first involves applications that harness existing IoT data, combined with AI chipsets and subassemblies that can generate business value and insight. The second relates to embedding capabilities right into SCADA systems, handsets, IoT sensors, network controllers and industrial machinery. The easier it is to bring machinery into a 5G network securely, the faster solutions can be delivered. NEPs, MNOs and governments are doing their parts. Now is the time for the rest of the industry to get on board to deliver market potential more quickly.

As you investigate how 5G will affect your organization, consider these questions:

- Where do you have unique opportunities to pilot 5G applications?
- Where does 5G fit into your current strategies or portfolio to increase enterprise value?
- Which partners are best-suited to deliver both use case value and needed security?

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**Notes and sources**

1 Jonnalagadda, Harish. "Qualcomm's simulated 5G tests show a 20x increase in download speeds over 4G." androidcentral. February 2018. https://www.androidcentral.com/qualcomms-simulated-5g-tests-show-20x-increase-download-speeds-over-4g

2 "Internet of Things (IoT) connected devices installed base worldwide from 2015 to 2025 (in billions)." Statista. https://www.statista.com/statistics/471264/iot-number-of-connected-devices-worldwide/

3 "The 5G economy: How 5G technology will contribute to the global economy." IHS Economics. January 2017. https://cdn.ihs.com/www/pdf/IHS-Technology-5G-Economic-Impact-Study.pdf

4 Ibid.

5 "Revenue forecast mobile operators worldwide from 2012 to 2020 (in billion U.S. dollars)." Statista. https://www.statista.com/statistics/371899/mobile-operator-total-revenue-forecasts/

6 Kharif, Olga and Scott Moritz. "Upgrade to 5G costs $200 billion a year, may not be worth it." Bloomberg. December 2017. https://www.bloomberg.com/news/articles/2017-12-18/upgrade-to-5g-costs-200-billion-a-year-and-may-not-be-worth-it

7 deAgonia, Michael. "Apple's Face ID [The iPhone X's facial recognition tech] explained." ComputerWorld. November 2017. https://www.computerworld.com/article/3235140/apple-ios/apples-face-id-the-iphone-xs-facial-recognition-tech-explained.html

8 "The Mobile Broadband Standard: Release 15." 3gpp.com. July 2018. http://www.3gpp.org/release-15

9 Ekholm, Börje. "How 5G could speed up global growth." World Economic Forum. January 2018. https://www.weforum.org/agenda/2018/01/5g-mobile-speed-global-gdp-growth/

10 McCaskill, Steve. "Verizon and Nokia test 5G with a moving vehicle." TechRadar. August 2018. https://www.techradar.com/news/verizon-and-nokia-test-5g-with-a-moving-vehicle

11 Ramirez, Elaine. "In the race for 5G, South Korea shows off its tech prowess at the Winter Olympics." Forbes. February 2018. https://www.forbes.com/sites/elaineramirez/2018/02/23/in-the-race-for-5g-south-korea-shows-off-its-tech-prowess-at-the-winter-olympics/#1aa83c682853

12 Reichert, Corinne. "Intel and Ericsson 5G connected cars trial attains 1Gbps speeds." ZDNet. November 2017. https://www.zdnet.com/article/intel-and-ericsson-5g-connected-cars-trial-attains-1gbps-speeds/

13 Morris, Iain. "Nokia reels in $3.5B 5G deal with T-Mobile US." Lightreading.com. July 2018. https://www.lightreading.com/mobile/5g/nokia-reels-in-$35b-5g-deal-with-t-mobile-us/d/d-id/744997

14 "Ericsson wins awards for innovations in 5G technology." Ericsson. February 2018. https://www.ericsson.com/en/news/2018/2/ericsson-wins-awards-for-innovations-in-5g-technology

15 "BT and Huawei embark on pioneering 5G research partnership." BT.com. June 2018. http://home.bt.com/tech-gadgets/internet/broadband/bt-huawei-5g-mobile-technology-partnership-11364119667641