McKinsey & Company

McKinsey Explainers

# What is 5G?

5G is the fifth generation of wireless technology. Its increased speed, lower latency, and improved reliability stand to revolutionize a wide variety of industries.

October 2022

**Fifth time's the charm:** 5G—or fifth-generation wireless technology—is powering the Fourth Industrial Revolution. Sure, 5G is faster than 4G. But 5G is more than just (a lot) faster: the connectivity made possible with 5G is significantly more secure and more stable than its predecessors. Plus, 5G enables data to travel from one place to another with a significantly shorter delay between data submission and arrival—this delay is known as latency.

Here are a few big numbers from the International Telecommunications Union. 5G networks aim to deliver:

— 1,000 times higher mobile data volume per area

— 100 times the number of connected devices

— 100 times higher user data rate

— ten times longer battery life for low-power massive-machine communications

— five times reduced end-to-end latency

Here's how it works: like all cellular networks, the service area of 5G networks is divided into geographic sub-areas called cells. Each cell has local antennae, through which all wireless devices in the cell are connected to the internet and telephone network via radio waves. To achieve its very high speeds, 5G utilizes low- and midbands on the radio spectrum (below six gigahertz), as well as whole new bands of the radio spectrum. These are so-called "millimeter waves," broadcast at frequencies between 30 and 300 gigahertz, which have previously been used only for communication between satellites and radar systems.

Cell phone companies began deploying 5G in 2019. In the United States, 5G coverage is already available in many areas. And, while previous generation 2G and 3G technology is still in use, 5G adoption is accelerating: according to various predictions, 5G networks will have billions of subscribers by 2025.

But 5G can do more than enable faster loading of cat videos. This new speed and responsiveness—and the connectivity solutions it makes possible—is poised to transform a wide variety of industries.

## How will 5G be used?

To date, 5G will enable four key use-case archetypes, which will require 5G to deliver on its promise of evolutionary change in network performance. They are:

1. *Enhanced mobile broadband.* The faster speed, lower latency, and greater capacity 5G makes possible could enable on-the-go, ultra-high-definition video, virtual reality, and other advanced applications.

2. *Internet of Things (IoT).* Existing cellular networks are not able to keep up with the explosive growth in the number of connected devices, from smart refrigerators to devices monitoring battery levels on manufacturing shop floors. 5G will unlock the potential of IoT by enabling exponentially more connections at very low power.

3. *Mission-critical control.* Connected devices are increasingly used in applications that require absolute reliability, such as vehicle safety systems or medical devices. 5G's lower latency and higher resiliency mean that these time-critical applications will be increasingly reliable.

4. *Fixed wireless access.* The speeds made possible by 5G make it a viable alternative to wired broadband in many markets, particularly those without fiber optics.

## How might 5G and other advanced technologies impact the world?

If 5G is deployed across just four commercial domains—mobility, healthcare, manufacturing, and retail—it could boost global GDP by up to $2 trillion by 2030. Most of this value will be captured with creative applications of advanced connectivity.

Here are the four commercial domains with some of the largest potential to capture higher revenues or cost efficiencies:

— Connectivity will be the foundation for increasingly intelligent *mobility* systems, including carsharing services, public transit, infrastructure, hardware and software, and more. Connectivity could create new revenue streams through preventive maintenance, improved navigation and carpooling services, and personalized "infotainment" offerings.

— Devices and advanced networks with improved connectivity could transform the *healthcare* industry. Seamless data flow and low-latency networks could mean better robotic surgery. AI-powered decision support tools can make faster and more accurate diagnoses, as well as automate tasks so that caregivers can spend more time with patients. McKinsey analysis estimates that these use cases together could generate up to $420 billion in global GDP impact by 2030.

— Low-latency and private 5G networks can power highly precise operations in *manufacturing and other advanced industries*. Smart factories powered by AI, analytics, and advanced robotics can run at maximum efficiency, optimizing and adjusting processes in real time. New features like automated guided vehicles and computer-vision-enhanced bin picking and quality control require the kind of speed and latency provided by high-band 5G. By 2030, the GDP impact in manufacturing could reach up to $650 billion.

— *Retailers* can use technology like sensors, trackers, and computer vision to manage inventories, improve warehouse operations, and coordinate along the supply chain. Use cases like connectivity-enhanced in-store experiences and real-time personalized recommendations could boost global GDP up to $700 billion by 2030.

The use cases identified in these commercial domains alone could boost global GDP by up to $2 trillion by 2030. The value at stake could ultimately run trillions of dollars higher across the entire global economy.

Beyond industry, 5G connectivity has important implications for society. Enabling more people to plug into global flows of information, communication, and services could add another $1.5 trillion to $2 trillion to GDP. This stands to unlock greater human potential and prosperity, particularly in developing nations.

## What are advanced connectivity and frontier connectivity?

Advanced connectivity is propelled by the continued evolution of existing connectivity technologies, as networks are built out and adoption grows. For instance, providers are upgrading existing 4G infrastructure with 5G network overlays, which generally offer improvements in speed and latency while supporting a greater density of connected devices. At the same time, land-based fiber optic networks continue to expand, enabling faster data connections all over the world.

On the other hand, frontier technologies like millimeter-wave 5G and low-earth-orbit satellite constellations offer a more radical leap forward. Millimeter-wave 5G is the ultra-fast mobile option, but comes with significant deployment challenges. Low-earth-orbit (LEO) satellites could deliver a breakthrough in breadth of coverage. LEO satellites work by beaming broadband down from space, bringing coverage to remote parts of the world where physical internet infrastructure doesn't make sense for a variety of reasons. Despite the promise of LEO technology, challenges do remain, and no commercial services are yet available.

## How are telecommunications players grappling with the transition to 5G?

5G promises better connectivity for consumers and organizations. Network providers, on the other hand, are resigned to higher costs to deploy 5G infrastructure before they can reap the benefits. This cycle has happened before: with the advent of

4G, telcos in Europe and Latin America reported decreased revenues.

Given these realities, telecommunications players are working to develop their 5G investment strategies. In order to achieve the speed, latency, and reliability required by most advanced applications, network providers will need to invest in all network domains, including spectrum, radio access network infrastructure, transmission, and core networks. More specifically, operators will increasingly share more parts of the network, including towers, backhaul, and even spectrum and radio access, through so-called MOCN (Multi-Operator Core Network) or MORAN (Multi-Operator Radio Access Network) deals. This is a 5G-specific way for operators to cope with higher investment burdens at flat revenues.

Some good news: 5G technology is largely built on 4G networks, which means that mobile operators can simply evolve their infrastructure investment rather than start from scratch. For instance, operators could begin by upgrading the capacity of their existing 4G network by refarming a portion of their 2G and 3G spectrum, thereby delaying investments in 5G. This would allow operators to minimize investments while the revenue potential of 5G remains uncertain.

## How will telecommunications players monetize 5G in the B2C market?

The rise of 5G also presents an opportunity for telecommunications players to shift their customer engagement. As they reckon with the costs of 5G, they also must reimagine how to charge customers for 5G. The B2B 5G revolution is already under way; in the B2C market, the value proposition of 5G is less clear. That's because there is no 5G use case compelling enough, at the present time, to transform the lives of people not heavily invested in gaming, for instance.

But despite the uncertainty, McKinsey has charted a clear path for telecommunications organizations to monetize 5G in the B2C sector. There are three models telcos might pursue, which could increase average revenue per user by up to 20 percent:

*Impulse purchases and "business class" plans.* 5G technology will allow telcos to move away from standard monthly subscriptions toward flexible plans that allow for customers to upgrade network performance when and where they feel the urge. Business class plans could feature premium network conditions at all times. According to McKinsey analysis, 7 percent of customers are already ready to use 5G boosters, and would use them an average of seven times per month if each boost cost $1.

*Selling 5G-enabled experiences*. The speeds and latency of 5G make possible streamlined and seamless experiences such as multiplayer cloud gaming, real-time translation, and augmented reality (AR) sports streaming. McKinsey research shows that customers are willing to pay for these 5G-enabled experiential use cases, and more.

*Using partnerships to deliver 5G-enabled experiences.* When assessing customer willingness to pay for 5G cloud gaming, McKinsey analysis showed that 74 percent of customers would prefer buying a 5G service straight from the game app rather than from their mobile provider. To create a seamless experience for customers, telcos could embed 5G connectivity directly into their partners' apps or devices. This could greatly expand telecommunications organizations' customer base.

## How has COVID-19 impacted connectivity IoT?

For one thing, the pandemic has created the need for applications with the advanced connectivity that only 5G can provide. Among other things, 5G enables the types of applications that help leaders understand whether their workforces are safe and which devices have been connected to the network and by whom.

Advanced connectivity technologies like 5G also stand to enable remote healthcare, although, ironically, the pandemic has also eaten up the

resources necessary to create the infrastructure to implement it.

During the pandemic, Industry 4.0 frontrunners have done very well. This illustrates the fact that digital first businesses are nimbler and better prepared to react to unforeseen challenges.

## How can advanced electronics companies and industrials benefit from 5G?

The 5G Internet of Things B2B market, and its development over the coming years, offer significant opportunities for advanced electronics organizations. 5G IoT refers to industrial use-case archetypes enabled by the faster, more stable, and more secure connectivity available with 5G. McKinsey analyzed the events surrounding the introduction of 4G and other technologies, looking for clues about how 5G might evolve in the industry.

We found that many companies will derive great value from 5G IoT, but it will come in waves. The first 5G IoT use-case archetypes to gain traction will be those related to enhanced mobile broadband, followed shortly thereafter by use cases for ultra-reliable, low-latency communication. Finally, use cases for massive machine-type communication will take several more years. The businesses best placed to benefit from the growth of 5G include mobile operators, network providers, manufacturing companies, and machinery and industrial automation companies.

The B2B sector is especially well placed to benefit from 5G IoT. The most relevant short-term opportunities for 5G IoT involve Industry 4.0, or the digitization of manufacturing and other production processes. The Industry 4.0 segment will account for sales of about 22 million 5G IoT units by 2030, with most applications related to manufacturing.

In order to take advantage of the opportunity, advanced electronics companies should look now to revamping their strategies. In the short-term, they should focus on B2B cases that are similar to those now being deployed in the B2C sector. Looking ahead, they should shift their focus toward developing hardware and software tailored to specific applications. But expanding the business field is always something that should be done with great care and consideration.

## How will 5G impact the manufacturing industry?

There are five potential applications that are particularly relevant for manufacturing organizations:

1. *Cloud control of machines.* In the past, automation of machines in factories has relied on controllers that were physically installed on or near machines, which would then send information to computer networks. With 5G, this monitoring can in theory be done in the cloud, although these remain edge cases for now.

2. *Augmented reality.* Seamless AR made possible by 5G connectivity will ultimately replace standard operating procedures currently on paper or video. These will help shop-floor workers undertake advanced tasks without waiting for specialists.

3. *Perceptive AI eyes on the factory floor.* 5G will allow for live video analytics based on real-time video data streaming to the cloud.

4. *High-speed decisioning.* The best-run factories rely on massive data lakes to make decisions. 5G accelerates the decision-cycle time, allowing massive amounts of data to be collected, cleaned, and analyzed in close to real time.

5. *Shop-floor IoTs.* The addition of sensors to machines on factory floors means more data than ever before. The speeds made possible by 5G will allow for the operationalization of these new data.

Find more content like this on the
McKinsey Insights App
Scan • Download • Personalize

Articles referenced:


— “Unlocking the value of 5G in the B2C marketplace,” November 5, 2021, Ferry Grijpink, Jesper Larsson, Alexandre Ménard, and Konstantin Pell

— “Connected world: An evolution in connectivity beyond the 5G revolution,” February 20, 2020, Ferry Grijpink, Eric Kutcher, Alexandre Ménard, Sree Ramaswamy, Davide Schiavotto, James Manyika, Michael Chui, Rob Hamill, and Emir Okan

— *The 5G era: New Horizons for advanced electronics in industrial companies*, February 21, 2020, Ondrej Burkacky, Stephanie Lingemann, Alexander Hoffmann, and Markus Simon

— “Five ways that 5G will revolutionize manufacturing,” October 18, 2019, Enno de Boer, Sid Khanna, Andy Luse, Rahul Shahani, and Stephen Creasy

— “Cutting through the 5G hype: Survey shows telcos’ nuanced views,” February 13, 2019, Ferry Grijpink, Tobias Härlin, Harrison Lung, and Alexandre Ménard

— “The road to 5G: The inevitable growth of infrastructure cost,” February 23, 2018, Ferry Grijpink, Alexandre Ménard, Halldor Sigurdsson, and Nemanja Vucevic

— “Are you ready for 5G?,” February 22, 2018, Mark Collins, Arnab Das, Alexandre Ménard, and Dev Patel


Designed by McKinsey Global Publishing
Copyright © 2023 McKinsey & Company. All rights reserved.