5G
5G is the fifth generation mobile network and a global wireless standard. Since the first 5G mobile networks began launching in 2019, this new standard has rolled out slowly around the world. Eventually, 5G will offer higher speeds, low or even no latency in data transfer, and the ability for billions of devices to connect with one another.

Examples
5G advances today’s networks using a more responsive kind of radio technology that not only moves data faster but also requires less power to do so. It will shorten transmission latency from 30 milliseconds to just a single millisecond, allowing essentially instantaneous connectivity between devices on a network. This means big opportunities for telemedicine and robotic-assisted surgery, autonomous vehicles, gaming, and streaming. Unlike Wi-Fi, a 5G network can be built to prioritize certain data transmissions over others. For example, heavy manufacturing companies and utilities will be able to automate more of their core processes using advanced robotics systems, which will in turn create a new market for all the components, devices, and consulting services necessary for operating such a network.

Disruptive Impact
Monetizing 5G remains a challenge for mobile network operators (such as Verizon, Vodafone, and Telefónica), which must gradually make network improvements while continuing to provide service for previous 3G and 4G standards. This last mile of the telecom ecosystem is the most complex and costly to maintain, and earns revenue mainly through customer plans. South Korea launched high-value, premium 5G plans to increase revenue alongside new products and services to entice adoption. VR cloud gaming, augmented reality shopping, and live sports streaming are bundled in new premium plans. South Korea notwithstanding, most 5G launches still lack the use cases needed to convert users and justify the investment in network upgrades. In the U.S., the Federal Communications Commission created two Innovation Zones, city-scale test beds in Salt Lake City and in New York City’s West Harlem, for advanced wireless communications and network research, including 5G networks.

Emerging Players
- National Spectrum Consortium
- 5G Fund for Rural America
- Open Radio Access Network (O-RAN)
- Spectrum Forward Other Transaction Agreement
- U.S. Department of Defense’s Research and Engineering Division
There’s a geopolitical fight underway, pitting the U.S. against China in a race to deploy the telecom equipment and systems required to build 5G networks. The Trump administration tightened the screws on China when it banned Chinese companies ZTE and Huawei from supplying gear to American network operators in the U.S. Chipmaker Qualcomm, meanwhile, is one of a scant few U.S. companies making components necessary for a widespread 5G rollout. Trump revoked licenses to Huawei suppliers, which included Intel, and thereby weakened the Chinese tech giant’s position in the global market. American security experts are urging the Biden administration to build a 5G network with and for geopolitical allies and to exclude Chinese equipment. As of this writing, only Ericsson, Nokia, and Samsung are allowed to build 5G networks in the U.S. Meanwhile, Chinese President Xi Jinping has made it clear that he intends to wean China and its allies off of Western-made technology entirely.

New entrants are circumventing politics. Japanese e-commerce giant Rakuten launched a virtual network running on cloud native and open radio access network (O-RAN) technology. The network architecture costs far less to build and operate, and doesn’t rely as much on equipment from traditional suppliers. Elon Musk’s Starlink is developing a low-latency broadband internet system with speeds of 300Mbps—fast enough to manage Wi-Fi calling and just about anything else consumers might stream, play, operate, or build.

- Semiconductor Industry Association
- Open Radio Access Network (O-RAN)
- Rakuten Mobile
- Starlink
A little more than 25 years ago, AT&T debuted a bold advertising campaign predicting a future world enabled by emerging technologies. At the time, the ads mimicked science fiction—video calls from a payphone, sending a fax on the beach and talking to a friend on a watch. While the experiences look different than our predecessors imagined, they are now realities and even necessities, as 2020 pivoted the needs of our customers and forced transformation across all industries.

What can we accomplish in the next five, 10 or 25 years? Innovation is happening at the speed of 5G, and the next wave of bold predictions is well on its way.

5G will ultimately be a paradigm shift from prior networks. The increased speeds, lower latency and higher reliability will create the ideal foundation for transformational use cases. The ecosystem is developing capabilities never before imagined with LTE. There’s no better time than now to take a visionary approach to the possibilities. We’re collaborating with customers and allies to identify how technology can create a safer, more connected world.

Take the healthcare industry, for example. The combination of 5G,
There's no better time than now to take a visionary approach to the possibilities.

5G is also paving the way for the future of transportation. At the AT&T 5G Innovation Studio in Plano, Texas, we’re working with collaborators to showcase how 5G and edge computing can enable autonomous drones. And, as the edge expands, self-driving cars will eventually become ubiquitous, creating safer roadways. Flash forward even further, and you could be looking toward the sky for a flying taxi.

Today's technology will also transform the retail world, because 2020 shifted how we shop. There could be "magic mirrors," or connected displays, that use 4K sensors and digital displays to replicate the experience of standing in front of a mirror. Instead of having to physically try on clothes, consumers could swipe left and right to try on outfits and accessories. Then, using a connected tablet, an employee could place the order, and the clothes could be on a customer's doorstep in 48 hours. This will become a widespread reality that many retailers are expected to embrace.

Another exciting area of opportunity is the entertainment industry. 5G is already re-imagining how we create and consume media in this new world. Holographic communication proved useful during last year’s NBA playoffs when reporters were able to perform holographic interviews with players from hundreds of miles away, a necessity given restrictions around in-person interviews.

Now, imagine holographic communication for the masses. In the not-so-distant future, we could enjoy live, immersive concerts from the comfort of our couch. And, we’ve taken the initial steps toward this reality. AT&T recently used 5G, machine learning, and edge computing to deliver a live 3-D augmented reality interactive concert for a select group of fans. Entertainment will become more immersive with the advancement of AI and edge computing, and we’ll eventually blur the divide between the physical and digital world.

5G is triggering the next wave of business transformation and industrial revolution, and these use cases are only a glimpse of what’s on the horizon.

Igal Elbaz is senior vice president of Wireless and Access Technology. He is responsible for wireless and wireline access network architecture, design and technology roadmap, including radio access network, 5G and LTE mobility, voice core network functions, network AI and driving industry standards.
6G will be the sixth generation of wide-area wireless technology, following the transition to 5G. Planning for this new standard is already happening.

Project Hexa-X, the European Commission’s early 6G research initiative, kicked off in January 2021 in preparation for the global standard that comes after 5G. The current global transition from 4G to 5G is a tricky one: There are lots of variables over which no one entity has control. Core components—licensed and unlicensed spectrum bands, shared spectrum, antennas, and network architectures—aren’t necessarily uniform. Experts believe that what they learn building 5G networks will make the transition to 6G easier. Researchers at the University of California, Santa Barbara, are already working on component upgrades: They built a device that could push 6G’s terahertz frequency signals out of antennas using what’s known as an N-polar gallium nitride high-electron-mobility transistor (HEMT). Nokia is leading the 6G joint research initiative, and Nokia Bell Labs is already researching the fundamental technologies that will comprise 6G.

6G should support data rates of 1 terabyte per second, making latency and capacity balancing a thing of the past. This new standard will support technologies that demand real-time awareness—which are likely to include human-machine interfaces that intuitively understand our intentions. Combined with artificial intelligence, the new infrastructure of 6G will make networks capable of making decisions autonomously for things like data storage, processing, and sharing.

**Emerging Players**
- Hexa-X
- Nokia
- Next G Alliance
- University of Oulu
- University of Padova
- Beijing University of Posts and Telecommunications
- NTT DoCoMo
- Samsung
- Ericsson
- Huawei
- ZTE
Breaking the Millisecond Barrier

KEY INSIGHT
The amount of latency in mobile networks differs, based on how far a signal must travel, the number of routers it passes through, and a variety of other factors. A new standard for latency is in the works that could result in just 1 millisecond of lag.

EXAMPLES
Latency causes problems in gaming, videoconferencing, and VR. A typical 4G network incurs 50 milliseconds of lag, and with more devices and people connecting to networks, systems can quickly become glitchy. As people worked and learned from home during the pandemic, signals weakened, causing interruptions or crashes. The coming swarm of signal-hungry consumer devices will put added strain on networks, unless current latency barriers can be broken. Reducing latency from 4G’s 50 milliseconds to 5G’s 10 milliseconds and below will be crucial to support applications such as autonomous vehicles and multiplayer games.

DISRUPTIVE IMPACT
A new 1 millisecond standard is being developed at New York University’s NYU Wireless research center. It will require a new approach to encoding, transmitting, and routing data—but it also promises a wild new frontier in communications. If signals transmit fast enough that humans can’t perceive any lag at all, teleoperated surgical robots could go into widescale use. Haptic devices that map sight and sound could convince us that a digital environment is real, not virtual.

EMERGING PLAYERS
- NYU Wireless
- Internet Engineering Task Force’s L4S
- U.S. Department of Defense