5G

Fifth-generation wireless, or 5G, is the latest iteration of cellular technology, engineered to greatly increase the speed and responsiveness of wireless networks. With 5G, data transmitted over wireless broadband connections could travel at rates as high as 20 Gbps by some estimates -- exceeding wireline network speeds -- as well as offer latency of 1 ms or lower for uses that require real-time feedback. 5G will also enable a sharp increase in the amount of data transmitted over wireless systems due to more available bandwidth and advanced antenna technology.

In addition to improvements in speed, capacity and latency, 5G offers network management features, among them network slicing, which allows mobile operators to create multiple virtual networks within a single physical 5G network. This capability will enable wireless network connections to support specific uses or business cases and could be sold on an as-a-service basis. A self-driving car, for example, would require a network slice that offers extremely fast, low-latency connections so a vehicle could navigate in real time. A home appliance, however, could be connected via a lower-power, slower connection because high performance isn't crucial. The internet of things (IoT) could use secure, data-only connections.

5G networks and services will be deployed in stages over the next several years to accommodate the increasing reliance on mobile and internet-enabled devices. Overall, 5G is expected to generate a variety of new applications, uses and business cases as the technology is rolled out.

1G, 2G, 3G, 4G, 5G

The G in 5G means it's a generation of wireless technology. While most generations have technically been defined by their data transmission speeds, each has also been marked by a break in encoding methods, or "air interfaces," which make it incompatible with the previous generation.

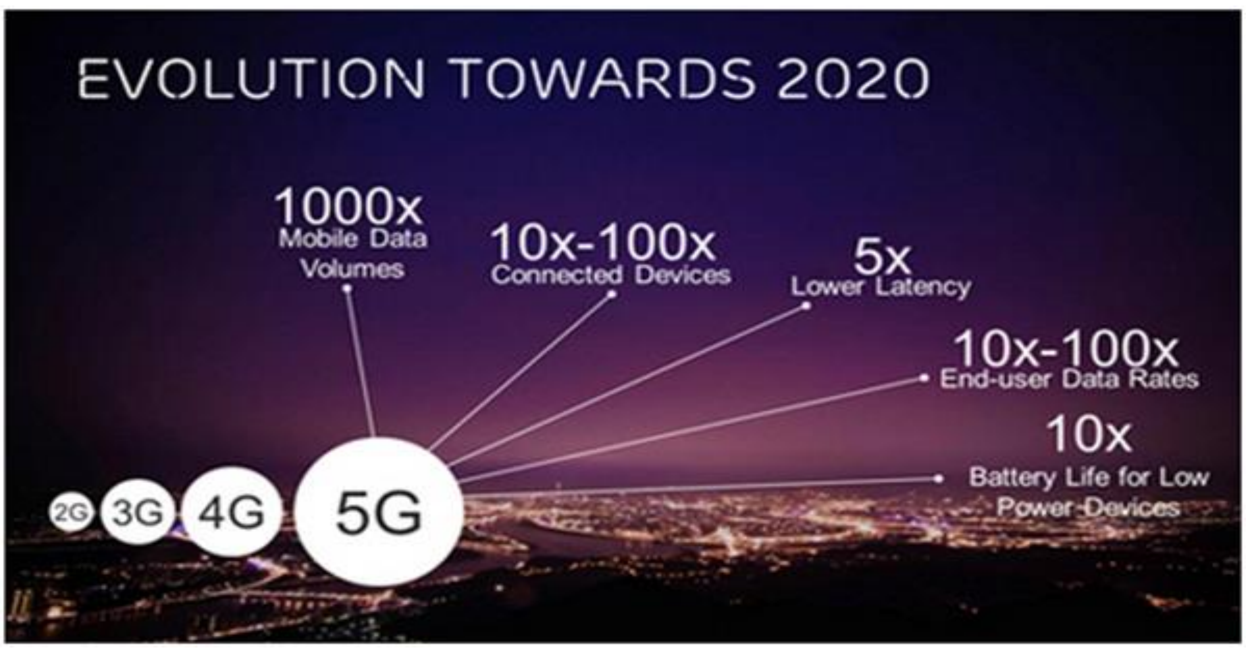
1G was analog cellular. 2G technologies, such as CDMA, GSM, and TDMA, were the first generation of digital cellular technologies. 3G technologies, such as EVDO, HSPA, and UMTS, brought speeds from 200kbps to a few megabits per second. 4G technologies, such as WiMAX and LTE, were the next incompatible leap forward, and they are now scaling up to hundreds of megabits and even gigabit-level speeds.

5G brings three new aspects to the table: greater speed (to move more data), lower latency (to be more responsive), and the ability to connect a lot more devices at once (for sensors and smart devices).

The actual 5G radio system, known as 5G-NR, won't be compatible with 4G. But all 5G devices, initially, will need 4G because they'll lean on it to make initial connections before trading up to 5G where it's available.

4G will continue to improve with time, as well. The upcoming Qualcomm X24 modem will support 4G speeds up to 2Gbps. The real advantages of 5G will come in massive capacity and low latency, beyond the levels 4G technologies can achieve.

That symbiosis between 4G and 5G has caused AT&T to get a little overenthusiastic about its 4G network. The carrier has started to call its 4G network "5G Evolution," because it sees improving 4G as a major step to 5G. It's right, of course. But the phrasing is designed to confuse less-informed consumers into thinking 5G Evolution is 5G, when it isn't.



How 5G works

Like other cellular networks, 5G networks use a system of cell sites that divide their territory into sectors and send encoded data through radio waves. Each cell site must be connected to a network backbone, whether through a wired or wireless backhaul connection.

5G networks will use a type of encoding called OFDM, which is similar to the encoding that 4G LTE uses. The air interface will be designed for much lower latency and greater flexibility than LTE, though.

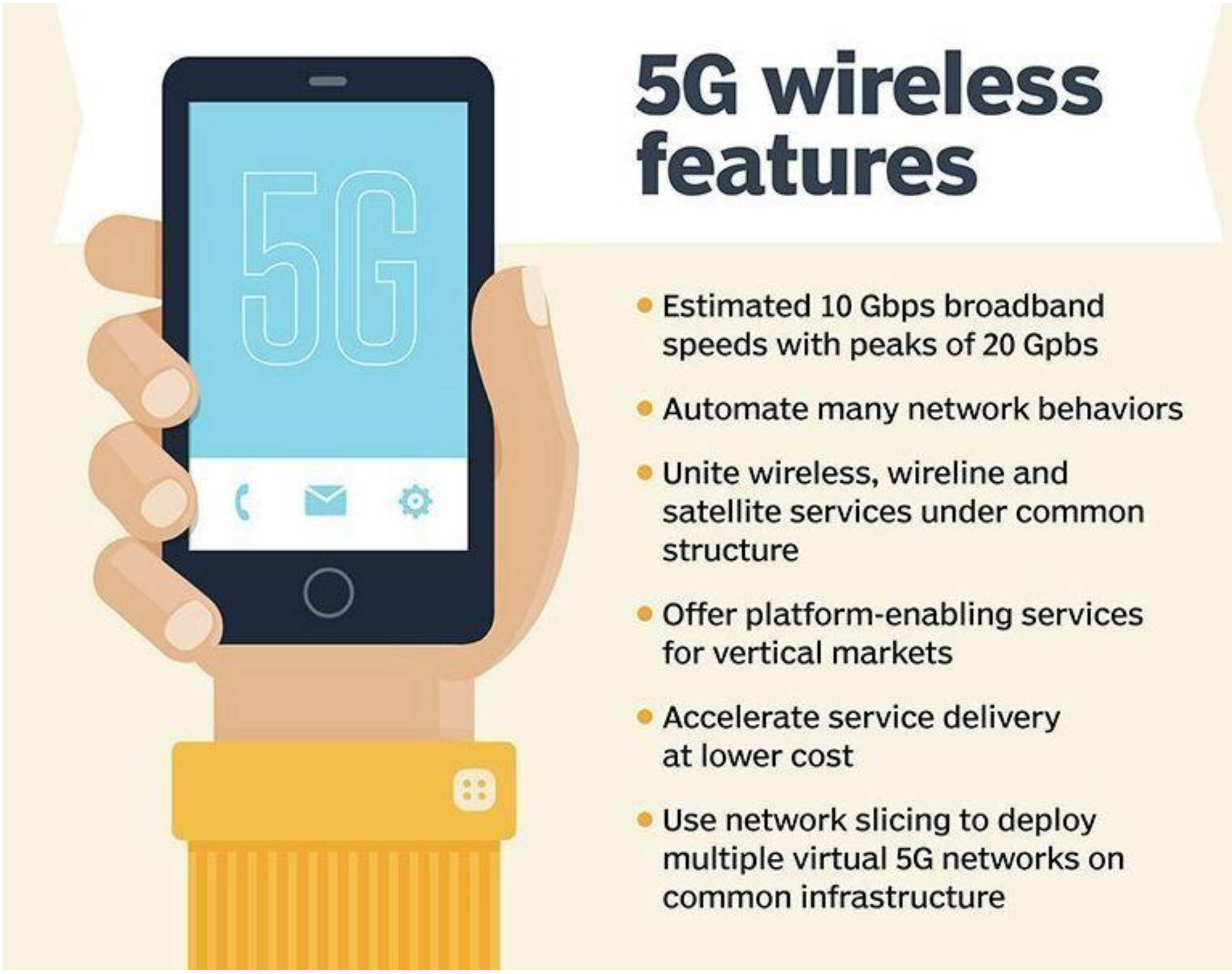
5G networks need to be much smarter than previous systems, as they're juggling many more, smaller cells that can change size and shape. But even with existing macro cells, Qualcomm says 5G will be able to boost capacity by four times over current systems by leveraging wider bandwidths and advanced antenna technologies.

The goal is to have far higher speeds available, and far higher capacity per sector, at far lower latency than 4G. The standards bodies involved are aiming at 20Gbps speeds and 1ms latency, at which point very interesting things begin to happen.

Key capabilities of 5G

Capability	Description	5G target	Usage scenario
Peak data rate	Maximum achievable data rate	20 Gbit/s	eMBB
User experienced data rate	Achievable data rate across coverage area	1 Gbit/s	eMBB
Latency	Radio network contribution to packet travel time	1 ms	URLLC
Mobility	Maximum speed for handoff and QoS requirements	500 km/h	eMBB/URLLC
Connection density	Total number of devices per unit area	10^6/km^2	MMTC
Energy efficiency	Data sent/received per unit energy consumption (by device or network)	Equal to 4G	eMBB
Spectrum efficiency	Throughput per unit wireless bandwidth and per network cell	3-4x 4G	eMBB
Area traffic capacity	Total traffic across coverage area	10 (Mbit/s)/m^2	eMBB

Features


5G
5G wireless features
Estimated 10 Gbps broadband speeds with peaks of 20 Gpbs
Automate many network behaviors
Unite wireless, wireline and satellite services under common structure
Offer platform-enabling services for vertical markets
Accelerate service delivery at lower cost
Use network slicing to deploy multiple virtual 5G networks on common infrastructure