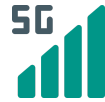


TELCOMA Global Whitepaper
Comparison of 5G and 4G technology



5G technology

5G is the fifth generation of wireless networks which is a new global standard after 4G. This technology is designed in such a way that it can connect everything and everyone virtually into one frame. It will offer data rates in multi-Gbps data speeds, more reliability than the previous generation, and is able to connect massive devices together, increased availability, and can give a good user experience. 5G will have an impact on every business and industry because it will offer more data rates, high reliability, and low latency which will be beneficial for various industries like logistics, remote healthcare, precision agriculture, and many more. 5G is designed to have the ability so that it can have the flexibility to support future services which are yet to be discovered. 5G will provide enhanced mobile broadband access, mission-critical communications, and massive IoT (Internet of things). 5G can also deliver much lower latency for uniform user experience so that the data rates stay constantly high even when the users are moving.

4G technology

It is the fourth generation of wireless communications technology. 4G can provide data throughput of 1 Gbps for stationary users and 100 Mbps for high mobility users, it can provide low latency and high reliability in the network with the benefit of clear HD voice calls as well. 4G is based on OFDM (Orthogonal Frequency division multiple Access) technologies instead of the WCDMA concept which was used by 3G systems. In OFDM technology, the digital signal is split into different narrow-band frequencies which are modulated by data streams and then re-multiplexed to create the OFDM carrier. 4G technology can provide a broadband experience to users with good upload and download speed on their mobile devices. It can provide applications like mobile web access, IP telephony, HD video calls, video surveillance, video calling, interactive services, 3D television, etc. The first release of 4G was LTE (Long term evolution) followed by LTE-Advanced and LTE-Advanced Pro. various releases were there to meet all IMT specific requirements like 4G core network should be all IP based packet, it should be able to share the network resources so that there will be more users per cell, it has scalable bandwidth concept rather than fixed bandwidth which was there in 2G and 3G technologies, scalable bandwidth as 5 - 20 MHz which could be expanded up to 40 MHz optionally with carrier aggregation. It has a hard handover which means it should provide smooth handovers across heterogeneous networks.

Comparison between 4G and 5G

Item	4G	5G
Peak Data Rate	1 Gbps (DL)	20 Gbps (DL)
User Experienced Data Rate	10 Mbps	100 Mbps
Spectrum Efficiency	-	X3
Areal Traffic Capacity	0.1 Mbps/m ²	10 Mbps/m ²
Latency	10ms	1ms
Connection Density	100,000/km ²	1,000,000/km ²
Network Energy Efficiency	-	X100
Mobility	350km/h	500km/h
Bandwidth	Up to 20 MHz	Up to 1 GHz

- Using the separate bands to communicate, 5G is smarter, more energy-efficient, and faster than 4G technology.
- 5G is up to 100 times faster than the 4G technology.
- 5G can connect more devices than 4G.
- 5G is designed for more than phones.
- 5G offers a speed greater than 1 Gbps whereas 4G offers around 200 Mbps.
- Latency is 5G is less than 10 milliseconds whereas 4G offers 20-30 milliseconds.
- 5G should be able to support many devices in addition to network demands of connected vehicles and other devices in the Internet of things.
- 5G also means more security and regulations than 4G.

- There is an improvement of 100x data rate compared to 4G.
- 5G will support 1 million devices per sq. km as compared to 4,000 devices per sq. km in 4G.
- 5G will be able to provide good IoT performance as compared to 4G.
- 5G will have enhanced capacity compared to 4G.

Level comparison

Parameters	4G (LTE)	5G (NR)
3GPP Releases	From Rel-8 to Rel-14	Rel-15 onwards
Maximum Carrier bandwidth	20 MHz	Below 6 GHz - 100 MHz Above 6 GHz - 400 MHz
Frequency range	< 6GHz	Upto 52.6 GHz
Services provided	Voice, Mobile broadband, Internet of things	Voice, enhanced Mobile Broadband, low latency applications and massive Internet of things
Waveforms	DL : CP-OFDM UL : DFT-S-OFDM	DL : CP-OFDM] UL : CP-OFDM, DFT-S-OFDM
Maximum number of subcarriers per carrier	1200	3300
Frame duration	10msec	10 msec
Slot size	2/7/14 OFDM symbols	1-14 OFDM symbols
RACH	4 step RACH	4 step RACH
Cyclic Prefix	Normal CP, Extended CP	Normal CP for all SCSs Extended CP for 60 kHz SCSs only
Beamforming	Digital	Hybrid

Channel coding	Turbo Code	Polar code
Synchronization Signals periodicity	5 msec	20 msec
SS block sweeping	1	4 for <3 GHz 8 for 3-6 GHz 64 for 6-52.6 GHz