

What are the differences between 2G, 3G, 4G LTE, and 5G networks?

Simply, the "G" stands for "GENERATION". While connected to the internet, the speed of the connection depends upon the signal strength that is shown in abbreviations like 2G, 3G, 4G, 5G, etc. on any mobile device. Each generation of wireless broadband is defined as a set of telephone network standards that describe the technological implementation of the system.

The aim of wireless communication is to provide high quality, reliable communication just like wired communication and each new generation represents a big leap in that direction. Mobile communication has become more popular in the last few years due to fast reform in mobile technology. For the comparison of 2G, 3G, 4G, and 5G we first need to understand the key features of all these technologies.



SECOND GENERATION (2G)

- 2G refers to the second generation of mobile networks based on GSM. The radio signals used by the 1G network were analog, while 2G networks were digital. 2G capabilities were achieved by allowing multiple users on a single channel via multiplexing. During 2G, cellular phones were used for data along with voice. Some of the key features of 2G were:
 - Data speeds of up to 64 kbps
 - Use of digital signals instead of analog
 - Enabled services such as SMS and MMS (Multimedia Message)

- Provided better quality voice calls
- It used a bandwidth of 30 to 200 KHz

THIRD GENERATION (3G)

- The 3G standard utilizes Universal Mobile Telecommunications System (UMTS) as its core network architecture. 3G network combines aspects of the 2G network with new technologies and protocols to deliver a significantly faster data rate. By using packet switching, the original technology was improved to allow speeds up to 14 Mbps. It used Wide Band Wireless Network that increased clarity. It operates at a range of 2100 MHz and has a bandwidth of 15-20 MHz. Some of the main features of 3G are:
 - Speed of up to 2 Mbps
 - Increased bandwidth and data transfer rates
 - Send/ receive large email messages
 - Large capacities and broadband capabilities

International Mobile Telecommunications-2000 (IMT-2000) were the specifications by the International Telecommunication Union for the 3G network; theoretically, 21.6 Mbps is the max speed of HSPA+.

FOURTH GENERATION (4G)

- The main difference between 3G and 4G is the data rate. There is also a huge difference between 3G and 4G technology. The key technologies that have made 4G possible are MIMO (Multiple Input Multiple Output) and OFDM (Orthogonal Frequency Division Multiplexing). The most important 4G standards are WiMAX and LTE. While 4G LTE is a major improvement over 3G speeds, it is technically not 4G. What is the difference between 4G and LTE?

- Even after it was widely available, many networks were not up to the required speed of 4G. 4G LTE is a “fourth generation long term evolution”, capable of delivering a very fast and secure internet connection. Basically, 4G is the predetermined standard for mobile network connections. 4G LTE is the term given to the path which has to be followed to achieve those predefined standards. Some of the features of 4G LTE are:
 - Support interactive multimedia, voice, video.
 - High speed, high capacity and low cost per bit (Speeds of up to 20 Mbps or more.)
 - Global and scalable mobile networks.
 - Ad hoc and multi-hop networks.

Following is the comparison between 4G and 5G speeds:

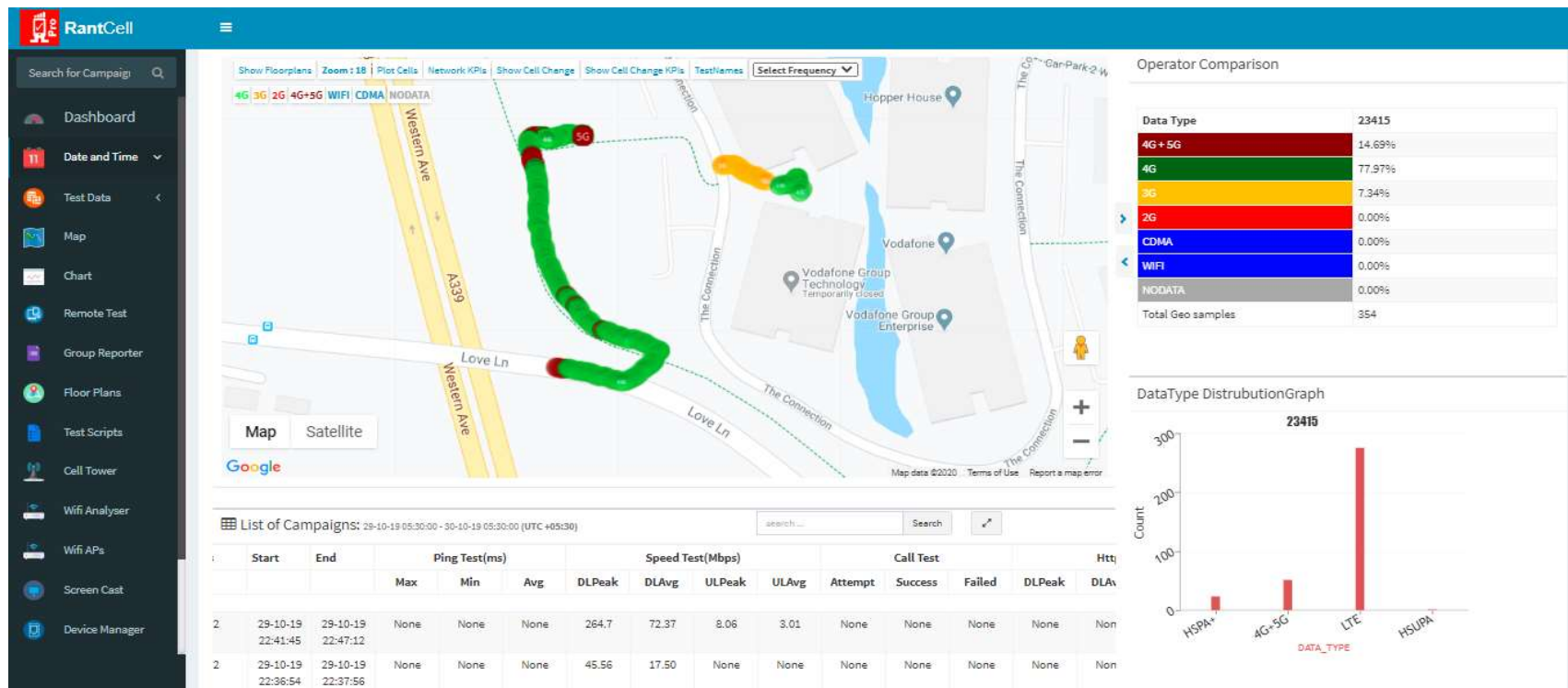
Theoretical 5G vs 4G speed

Network	Peak speed	Average speed
5G	10 Gbps	400 Mbps
4G	1 Gbps	50 Mbps

Live 5G vs 4G speed test performed via RantCell App

Network	Peak speed	Average speed
5G	264.7 Mbps	72.37 Mbps
4G	45.56 Mbps	17.50 Mbps

We conducted a comparison test campaign of 4G and 5G with our RantCell app. The result displays 4G and 5G data points with peak throughput in a particular location for '23415' mobile network operator i.e. Mobile network code for Vodafone as shown in the image below:



FIFTH GENERATION (5G)

- 5G networks operate on rarely used radio millimeter bands in the 30 GHz to 300 GHz range. Testing of 5G range in mmWave has produced results approximately 500 meters from the tower. Using small cells, the deployment of 5G with millimetre wave based carriers can improve overall coverage area. Combined with beamforming, small cells can deliver extremely fast coverage with low latency.
- Low latency is one of 5G's most important features. 5G uses a scalable orthogonal frequency-division multiplexing (OFDM) framework. 5G benefits greatly from this and can have latency as low as one millisecond

with realistic estimates to be around 1 – 10 seconds. 5G is estimated to be 60 to 120 times faster than the average 4G latency.

- Active antenna 5G encapsulated with 5G massive MIMO is used for providing better connections and enhanced user experience. Big 5G array antennas are deployed to gain additional beamforming information and knock out propagation challenges that are experienced at mmWave frequency ranges.
- Further, 5G networks clubbed with network slicing architecture enables telecom operators to offer on-demand tailored connectivity to their users that is adhered to Service Level Agreement (SLA). Such customised network capabilities comprise latency, data speed, latency, reliability, quality, services, and security.

With speeds of up to 10 Gbps, 5G is set to be as much as 10 times faster than 4G. Following is a brief comparison of 2G, 3G, 4G, and 5G.

2G vs 3G vs 4G vs 5G

- Each generation in some way has improved over its predecessor. There is a lot of ground to compare the cell networks over. Following is the comparison between 2G, 3G, 4G, 5G.
- The comparison of 2G, 3G, 4G, and 5G clearly shows the differences in the technologies. The comparison of 2G, 3G, 4G, and 5G also makes it evident that 5G is going to be one of the most ambitious leaps in the history of cell network technologies.

Comparison	2G	3G	4G	5G
Introduced in year	1993	2001	2009	2018
Technology	GSM	WCDMA	LTE, WiMAX	MIMO, mm Waves
Access system	TDMA, CDMA	CDMA	CDMA	OFDM, BDMA
Switching type	Circuit switching for voice and packet switching for data	Packet switching except for air interference	Packet switching	Packet switching
Internet service	Narrowband	Broadband	Ultra broadband	Wireless World Wide Web
Bandwidth	25 MHz	25 MHz	100 MHz	30 GHz to 300 GHz
Advantage	Multimedia features (SMS, MMS), internet access and SIM introduced	High security, international roaming	Speed, high speed handoffs, global mobility	Extremely high speeds, low latency
Applications	Voice calls, short messages	Video conferencing, mobile TV, GPS	High speed applications, mobile TV, wearable devices	High resolution video streaming, remote control of vehicles, robots, and medical procedures

<https://rantcell.com/comparison-of-2g-3g-4g-5g.html>