

5G Technology

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Abstract

5G is almost around the corner. 5G as a buzzword has been knocking on our doors for some time now sans a lot of action on the ground. However, that's about to change as the Department of Telecom (DOT) recently approved applications from Telecom Service Providers (TSPs) to conduct trials for the use and application of 5G technology. While field trials begin here in India, 5G as a technology has been commercially available in just over 50 countries such as France, South Korea, the US, etc. for a few years and there are valuable lessons that we can take from launches, successes, and failures in these markets. Indian operators could learn from their counterparts' experience and avoid or rather not repeat the same mistake which their counterparts might have made.

Let's take the case of 5G in France that has been commercially available since November 2020. A recent study done by us showed that there exists a gap in the quality of experience delivered by TSPs on 5G. The study was the first of its kind, measured experience on real devices placed in actual customer locations across nine major French cities. It revealed that while the incumbent operator provided average speeds of 146 Mbps, the newer operator is left far behind at 28 Mbps, which is a speed one would expect on 4G. These discrepancies between operators could be a result of different deployment strategies.

Such discrepancies can be problematic as they finally impact end customers. And in today's time when the nation is grappling a devastating second wave of the Covid-19 pandemic, providing seamless digital experience so that digital applications ranging from education and work to entertainment and dining can continue remotely.

Keywords: 5G, Network band, IoT, Chip, Technology, Application, Gbps

Introduction

5G is the next generation of mobile standards outlined by the International Telecommunication Union.

The ITU may be a specialised agency of the world organisation for data and technology accountable for the allocation of world radio-frequency spectrum and also the development of its key standards.

5G technology will give information speeds of ten Gbps and on top of and it'll be twenty times quicker than 4G. In addition to the info rate, 5G can cut back latency and energy savings, and mass device properties are potential.



This can pave the method for next-generation applications like autonomous vehicles, sensible homes, and cities, video game applications, the net of Things, and large-scale machine-to-machine communication for industries.

5G Networks

Mobile networks have seen a significant transformation since launch of 1st generation mobile services that were capable of transmitting solely voice calls.

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This generation of mobile networks (fourth-generation, or 4G) is adept at handling higher information speeds needed for transmission streaming, besides providing basic network operations like voice calls, messages & internet browsing. However, with the ever-changing property wants, rising mobile information traffic and a replacement class of connected-ecosystem merchandise, there's a desire for a newer generation of mobile network that may give even higher information speeds at low latency and increased turnout to handle additional coincident connections while not inflicting disruptions. And, this can specifically what 5G telephone is all concerning.

5G is the fifth-generation cellular network technology. It's designed to boost network connections by addressing the bequest problems with speed, latency and utility, that the sooner generations and also the current generation of mobile networks couldn't address. 5G is secure to deliver information speed at a rate one hundred times quicker than 4G networks. Significantly, it's designed to transmit information virtually instantly with a network latency of but 10ms. It'll even have associate degree increased turnout to handle additional coincident connections at time than current-generation networks.

Globally, 5G network readying is speedily moving from trials to early commercialization. In India, network operators like Airtel, Vodafone plan, Reliance Jio, etc, have already partnered with vendors like Ericsson, Huawei and Samsung for planned trials someday by the tip of this year, before the service's forecast industrial rollout in 2020. As per the GSM Association, a trade body that represents the interests of mobile network operators worldwide, the subsequent developments have taken place in Bharat on the 5G front:

5G Trials in India

In the initial section, these trials are going to be for six months, together with a two month amount for

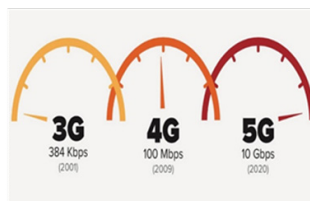
acquisition and fixing of the instrumentality. In these half-dozen months, telcoms are going to be needed to check their wind off in urban areas, semi-urban areas in addition to rural areas. During this era, the telcoms are going to be given experimental spectrum in varied bands, like the mid-band of three.2 GHz to 3.67 GHz, the metric linear unit wave band of 24.25 GHz per second to 28.5 GHz, and others.

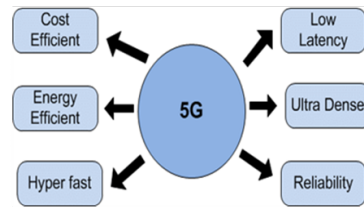
While the low band spectrum has shown nice promise in terms of coverage and speed of web and knowledge exchange, the most speed is restricted to a hundred Mbps (Megabits per second). This implies that whereas telcos will use and install it for business cellular telephone users the United Nations agency might not have specific demands for terribly high speed web, the low band spectrum might not be best for specialised desires of the trade.

The mid-band spectrum, on the other hand, offers higher speeds compared to the low band, however it has limitations in terms of coverage space and penetration of signals. Telcos and firms, that have taken the lead on 5G, have indicated that this band is also utilized by industries and specialised manufacturing plant units for building captive networks which will be molded into the requirements of that exact trade.

The Main Differences between 3G, 4G, and 5G

- 3G technology is a third-generation mobile phone service that offers faster speeds, higher frequency, and better bandwidth than the second generation.
- At the same time, 4G technology is the fourth generation technology of mobile service, which is completely based on Internet Protocol.
- 5G will be many times faster, smarter, and technically efficient than 4G. 5G is a mixture of telecom / telecom technology, which generates very little radiation while using very little energy and provides very high data speeds through extensive connectivity.





- It is also designed as a network for the Internet of Things (IoT). This will not only connect people but also utility machines, industrial equipment, automobiles, city infrastructure, public safety, etc.
- On a 3G network, consumers can transmit data at 2 megabytes in seconds while 4G technology speeds up to 100mbps.
- The higher the bandwidth, the higher the data transfer speed.
- 3G technology works on the wide-area network concept while 4G technology works on the concept of local area network.
- 5G networks can run on the 3400 MHz, 3500 MHz, and 3600 MHz bands, but the 3500 MHz bands are considered ideal.
- In addition, the millimeter-wave spectrum can play an important role in 5G. Millimeter waves operate at 30 to 300 GHz frequencies. Till now these waves are used in satellite networks and radar systems.

Features of 5G

- High rate (1 Gbps for hotspots, transfer speed 100 Mbps and transfer speed of 50Mbps for wide-area coverage).
- Comprehensive property (1 million connections per sq. kilogram meter area)
- Mobility at high speed (up to five hundred klick / h speed i.e., for the high-speed train).
- It can still take a protracted time for this technology to show into reality, however it's enough potential to utterly amend our current mode of interaction with wireless devices.



Key Pillars of 5G Technology

Augmented Mobile Broadband: A dedicated mobile complete band is useful to supply ultra-high-speed web service in densely inhabited urban areas. except for this it's additionally capable of providing video game and increased reality services.

Massive Machine Type Communication: It can even offer web service to an outsized range of connected devices. This permits a high density of property in IoT and for a good town, good power system, good Industries, etc.

Ultra-Reliable Low-Latency Communication: This meets the demanding demand to scale back the delay to as low as one unit of time. This technology permits communication in mission-critical applications and therefore makes application doable in artificial intelligence and autonomous vehicles.

The Applications of 5G

5G is a broad term. Generally speaking, it has applications in three fields:

- Mobile data and voice
- Enterprise solutions
- IoT connectivity

5G for smartphone users deals with the first field. The enterprise sector will, no doubt, relish it further, with applications in industries like driverless cars, smart cities, uses inside the medical sector, smart machinery, smart manufacturing, etc. With relevance the third field, IoT, the telecommunications and mobile industries are proclaiming for years that 5G will connect internet of Things (IoT) devices in massive numbers. Everything around us is aiming to be connected. it. For smartphone users, the latter a pair of fields unit academically attention-grabbing, but it's the first field-mobile information and voice-which actually matters for end users.

For smartphone users, 5G refers to faster data-much, thick faster in some cases. The new networks

put together promise incredibly low latency, on par with wired broadband. This could be a large deal to be used in cases like multiplayer cloud recreation that trust terribly low latency where as 4G networks haven't managed to induce latency all the manner right down to wired broadband levels, 5G is promising merely that.

5G can have a thick higher system of measurement and network information capability. Supposedly, it won't be as engulfed as 4G was once a huge variety of users began exploiting the network. For carriers that have engulfed 4G networks, 5G will represent improved quality of service, less period, and a way higher consumer experience.

It's all concerning the speeds, though. The 5G specification targets 20Gbps most downlink speeds, that is 10 times over the very best 4G LTE electronic equipment chip (which go as high as 2Gbps). Of course, 20Gbps is barely a theoretical target to date. The most effective electronic equipment chips discharged by chip vendors Qualcomm and Samsung will go as high as a theoretical maximum of seven.5Gbps (when victimization metric linear unit wave 5G) and 5Gbps (when victimization sub-6GHz 5G). within the globe, some millimetre Wave 5G networks have gone as high as one.5Gbps downlink, whereas sub-6GHz 5G networks have gone as high as 600-700Mbps.

Network Bands



Sub-6GHz - Low Band and Middle Band

There are 2 forms of 5G. One is sub-6GHz 5G, which may be thought of as the true successor to 4G LTE. The opposite is mm wave 5G (mm Wave). Once you examine 1Gbps downlink speeds and line-of-sight to node needs, you're reading concerning millimetre Waves. Once you examine reliable 5G networks that really work inside and with real-world speeds of 100-500Mbps, you're reading concerning sub-6GHz.

Most shoppers can solely experience sub-6GHz, as a result globally, carriers are intelligent enough to

treat millimetre waves with caution. In some countries like the U.S., though, carriers have (cynically, in my opinion) launched millimetre Wave initial as a result of the initial lack of accessible sub-6GHz spectrum where as countries like Russia, Japan, and Republic of Korea have joined the millimetre Wave bandwagon, the overwhelming majority of the planet has chosen to play it safe with sub-6GHz.

What do these terms mean, though?

Sub-6GHz 5G (also spoken as sub-6) means that the radio frequencies of the network bands square measure under 6GHz. (As an associate degree aside, all 4G bands measure sub-6GHz.) mm Wave, on the opposite hand, means that the radio frequencies of the bands square measure more than 6GHz. millimetre Wave bands vary from 24GHz all the thanks to 100GHz, however in observation, carriers have extended networks starting from 26GHz-39GHz to this point.

Sub-6GHz is of 2 types: Low Band and Middle Band

Low band 5G is analogous to the FDD-LTE bands that square measure employed in 4G networks nowadays. These bands have all-time low radio frequencies of the 5G "layer cake" dubbed by T-Mobile. T-Mobile encompasses a 600MHz "nationwide" 5G network within the U.S., for instance, whereas AT&T encompasses a similar 700MHz network. Low radio frequency bands like these square measure the simplest at penetrating obstacles like buildings, trees, and reaching as far as geographically attainable from a given carrier-installed node. This makes these bands the best selection for providing nice indoor coverage. Conversely, however, their low frequencies means that they need all-time low capability to hold knowledge, which, in turn, means that speeds won't be that nice.

The U.S. has gone all-in with low band and millimetre Wave, missing the crucial middle band a part of the equation. Each T-Mobile and AT&T's nationwide 5G networks square measure accessible to many various individuals, however their knowledge speeds aren't spectacular in the slightest degree. At most, they'll reach 225 Mbps, however

within the universe, it's much more possible for them to succeed in 50-100Mbps, with speeds going as low as 20-30 Mbps, that is indistinguishable from average 4G.

5G networks in alternative components of the planet, like Republic of Korea, Japan, and the UK, don't suffer from this issue as they need to emphasise the requirement for middle the band. Low band networks can still be an area of the cake, except for currently, the U.S. is putting an excessive amount of stress on them. The matter is combined by the actual fact that carriers lack the vital spectrum necessary to alter these low band networks to attain their full potential in terms of information speeds.

Mid band is the best selection for building a 5G network. middle band frequencies like the favoured three.5GHz band moreover because the a pair of.5GHz band aren't the simplest at penetrating obstacles not like low band frequencies nor will they carry the maximum amount knowledge as millimetre Wave frequencies. They aren't the simplest for either indoor coverage or for the best knowledge speeds, however they're the simplest expert. Mid-band coverage is appropriate as long as carriers square measure willing to put in the acceptable variety of nodes at any given location. Also, knowledge speeds aren't a difficulty as long as there's enough accessible spectrum for carriers to use. After all, 4G bands like TDD-LTE band forty (2300MHz) also are middle band, and carriers like Jio and China Mobile have used them successfully in Republic of India and China severally.

The spectrum issue is wherever the U.S. carriers suddenly met a roadblock. Up till now, none of the 3 major carriers within the U.S. have extended a middle band network for many various individuals. Once merging with Sprint, T-Mobile has started building a middle band network, however it's accessible solely during a few cities to this point. Verizon and AT&T have nevertheless to roll out middle band 5G networks as a result of they don't even have the accessible spectrum. The U.S. FCC freed up valuable spectrum within the C Band earlier this year, abundant later than alternative countries. Verizon and AT&T have expressed their commitment to roll out their middle band networks in 2021. Shoppers will solely wait.

Consumers of middle band 5G networks in countries like Republic of Korea have reportable nice speeds, and that's the model the remainder of the planet ought to follow

Carriers

In June 2020, 35 countries had extended some sort of a 5G network up till now. Their square measures 195 countries within the world, thus there's still quite a way to go before 5G networks square measure is offered in even half the world's countries. At this time, Qualcomm can denote that 5G adoption has been quicker than 4G LTE to this point. quite a few additional networks square measure explicit to travel board 2021.

In some countries like China, Asian nations, and the U.S., 5G networks square measure offered for various individuals. In distinction, there isn't one live 5G network in Asian nation, for instance. Generally, the roll out of 5G has started earlier in developed countries, whereas rising markets square measure taking their time. An optimistic argument may be created that at intervals 5 years, most of the planet can have it. Right now, though, for several places, it's still a distant dream.

Examples of carriers that have extended 5G on a meaningfully substantial basis embrace China Mobile, SK Telecom, T-Mobile, AT&T, EE, and more

Chip Vendors



Now, there are 2 types of chip vendors. Vendors like Huawei, Nokia, Ericsson, Samsung, and ZTE sell 5G network chips to carriers to make base stations and carrier nodes, because of political and security allegations, Huawei has been blocked from merchandising or having any half within the 5G networks of most Western countries, particularly the U.S. This leaves Ericsson and Nokia to hold the mantle. On the opposite hand, it's usually accepted

that Huawei contains a technological advantage in network chips, and China's 5G networks are designed by Huawei. With the trade ban on HiSilicon, though, it's unclear however things can proceed within the future.

The other form of chip vendors square measure people who sell electronic equipment chips to smartphone device manufacturers. Qualcomm is the prime example here, however Samsung Systems LSI and MediaTek conjointly play a section. Huawei's HiSilicon Group's electronic equipment chips were employed by Huawei itself, however with the approaching dissolution of HiSilicon, this appears to be coming back to associate finish.

Qualcomm's first-generation X50 5G modem-RF system was proclaimed back in Gregorian calendar month 2016, and it steam-powered the primary wave of 5G phones in early 2019. The 7nm second-generation X55 modem-RF system steam-powered some late 2019 flower 855-powered phones, however it came into widespread use in 2020. It's paired with the flagship flower 865 SoC, which doesn't have associated integrated electronic equipment of its own. The 5nm third-generation X60 electronic equipment was proclaimed by Qualcomm in Feb 2020, and it'll possibly show up in phones launching early next year. It brings innovations like carrier aggregation of various 5G modes, higher downlink speeds, and more.

Conclusion

According to the GSMA Intelligence report released in May 2019 by the world telecommunication business body, Asian nations can have 92 large integer distinctive mobile subscribers by the year 2025. In India, 5G connections are projected to reach in 88 million by 2025.

Currently, the amount of mobile subscribers is calculated to support the amount of SIMs issued, however the amount of actual mobile subscribers isn't noted because of the likelihood of 1 client having multiple SIMs.

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Therefore, efforts square measure being intense to see the amount of individuals United Nations agency square measure actually connected or mobile customers.

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