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Future of 5G Wireless System

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ABSTRACT

As we humans have developed as a community together, we have invented different ways to do things more easily and as fast as possible. Nowadays, when we have developed so many ways to make our lives easier and more efficient, we still find newer and better ways to make our lives easier. Some of the ways we keep on developing newer things is by keeping records of most of the things which are done by us and all the things in which we have failed.

To keep such types of data, we need to keep on developing our storage methods and also the methods to transfer that data from one place to another.

Keywords: Automation Latency Speed Networking

INTRODUCTION

The fifth generation of mobile technology is known as 5G. Beyond 4G, 5G is the next significant stage of mobile telecommunication ethics. The future 4G specifications. The 5G network is offering the assistance in product manufacturing documentation, electronic backing discussions, etc. when the consumer grows more become more knowledgeable about mobile phone technology, or she'll search for a good deal all at once. Incorporating all a cell phone's cutting-edge features could have. Hence, the pursuit of novel technologies always the primary driving force.

Behind the best cell phone Colosseum must innovate more than their rivals. The purpose of a 5G- based communications network would fully address the difficulties a 4G Once it has entered, the prototypical would appear.

What is 5g?

A breakthrough is 5G technology. The fifth generation, or 5G, of telecom networks has already begun to outpace the market and will do so on a global scale. A large 5G IoT (Internet of Things) ecosystem is expected to be unleashed by the speed at which 5G technology is developing, allowing networks to support the communication needs of billions of connected devices while striking the right balance between speed, latency, and cost. Specification requirements underpin 5G technology:

• Ninety percentage much less community power use

• 100% coverage

• 99.999 percentage availability

• Up to 10Gbps data rate -10 to 100x speed development over 4G and 4.5G networks

• 1-millisecond latency

• 1000x bandwidth per unit area

• Up to 100x number of coupled devices per unit area (compared with 4G LTE)

Worldwide Initiatives

There are a few 5G forums, research initiatives, and projects taking place all across the world.

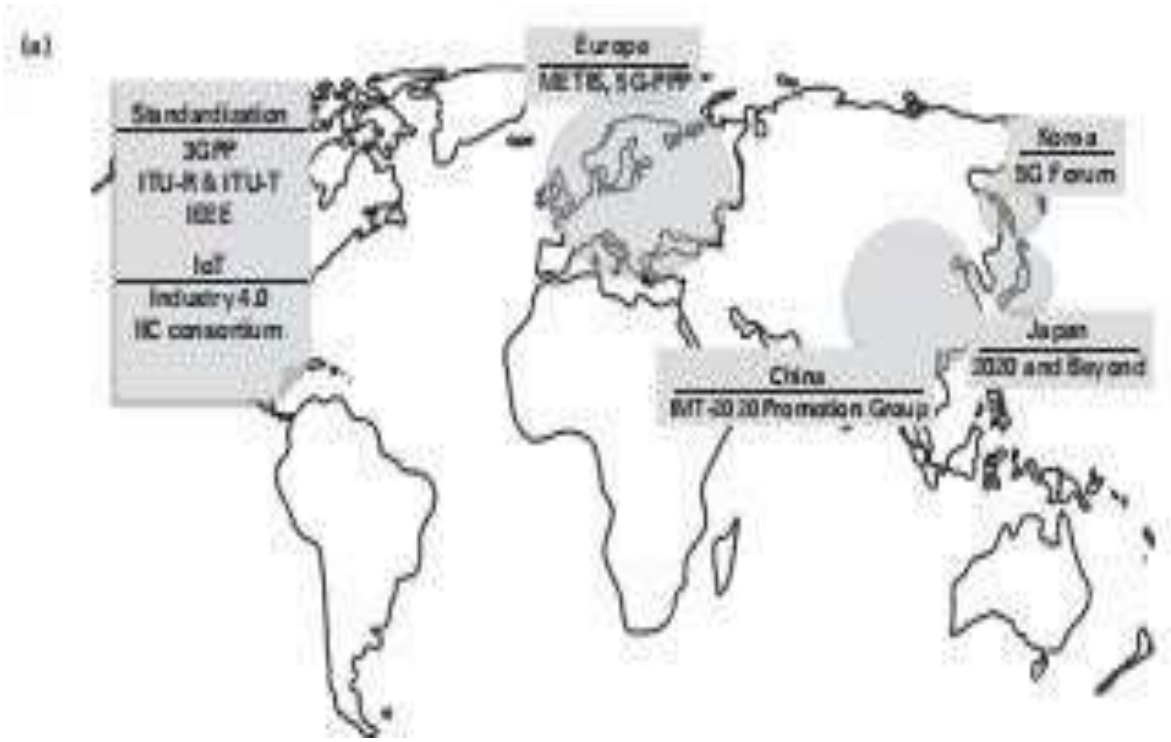
1. The 5G-PPP and METIS

The first comprehensive EU 5G access initiative with an international impact on 5G development is METIS. The seventh framework programme for Europe is the umbrella organisation for METIS (FP7).

. The 5G-PPP program's primary goal is to maintain Europe's leadership in the specific fields where it excels or where there is the possibility to open up new markets, such as smart cities, e-health, intelligent transportation, education, or entertainment.

2. China: In February 2013, China launched the IMT-2020. It was started by the National Development and Reform Commission, the Ministry of Science and Technology, and the Ministry of Industry and Information Technology (MIIT) in China (NDRC).The group's major goals are to facilitate cooperation with foreign businesses and organisations and to encourage the development of 5G technology in China.

The research activities are carried out under the MOST's 863-5G Program, which is a government sponsored research activity on 5G wireless access, while IMT-2020 (5G promotion group) deals with strategic decisions (for example, through white papers on vision and requirements [27] as well as technologies).



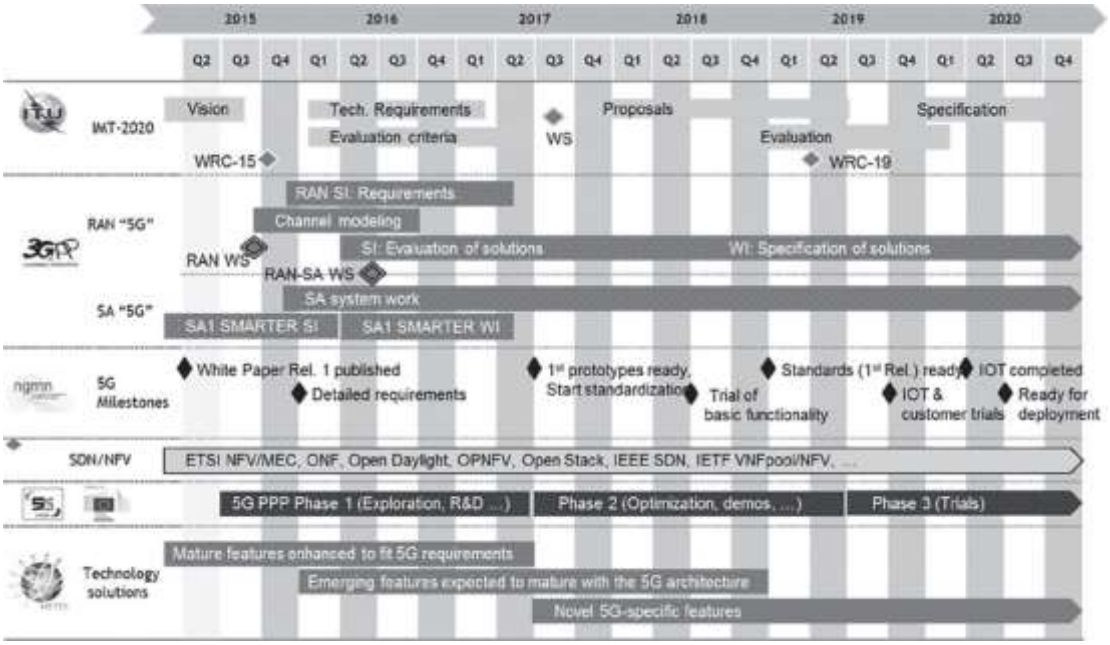
3. Korea: 5G Forum

A similar public-private cooperation programme was established in May 2013 by the 5G Forum in South Korea [28]. The major goals of the event are to create and put forth a national 5G strategy as well as a roadmap for technological innovation. ETRI, SK Telecom, KT, LG-Ericsson, and Samsung are among of its members. The venue also welcomes SMEs. The forum wants to make sure that some 5G pre-commercial trials The Pyeongchang 2018 Winter Olympics will use a subset of technologies.

4. Japan: ARIB 2020

Japan created the ARIB 2020 and Beyond Ad Hoc group in 2013 to research terrestrial mobile communications systems in 2020 and beyond. In September 2013, it was established as a subcommittee under the Advanced Wireless Communications Study Committee (ADWICS). In 2006, ARIB formed ADWICS.

The group's goals are to research system principles, fundamental operations, and distribution. 2020 and beyond mobile communications architecture. The anticipated outputs will be made up of white papers, contributions to the ITU, and other 5G-related organizations.



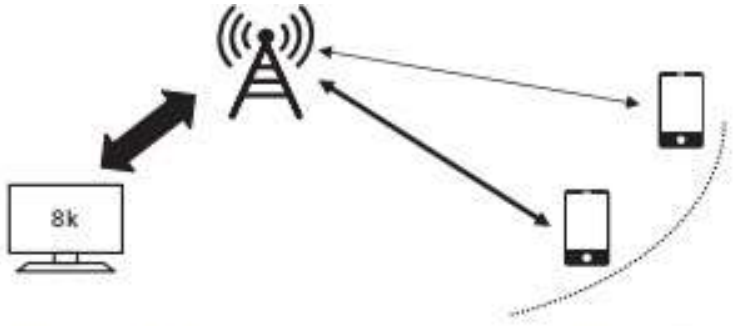
5G System Concept

The 5G system concept described in this section satisfies the criteria outlined in the preceding sections. It must offer a versatile platform in order to do this It shouldn't be geared toward a single "5G killer application," but rather a wide range of use cases, many of which are still in the future. Particularly vertical industries (such as automotive, energy, and manufacturing) will need flexibility to get specialized solutions from a shared network.

Three standard 5G services are:

· Extreme Mobile Broadband (xMBB)

It offers exceptionally fast data rates, low latency, and extensive coverage. As the number of users rises, xMBB offers a more consistent experience throughout the coverage area and smooth performance deterioration. Additionally, xMBB will support dependable communication for purposes like public safety and national security (NSPS).

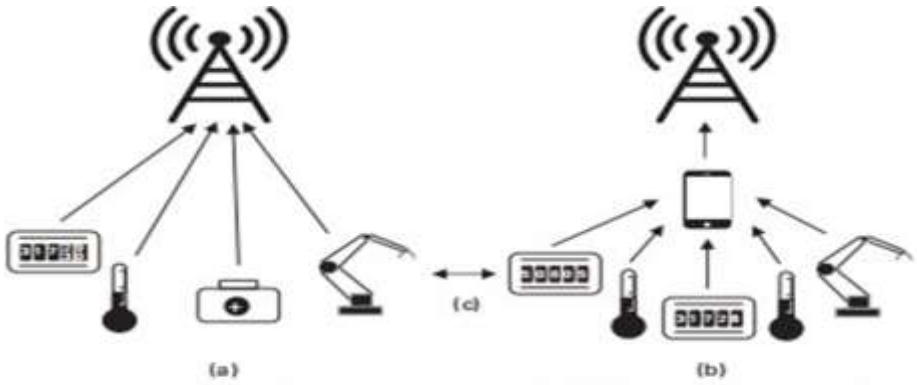


Extreme Mobile Broadband (xMBB) addresses increased peak data rates and increased wide-area rates.

Amplifying today's MBB benefit, the Extraordinary Portable Broadband (xMBB) common 5G benefit offers adaptable communication that can empower modern applications requiring speedier information rates, lower idleness, and a more steady client encounter over the scope area. region; The expected development in information volumes and information will be met by xMBB. rates well past utilization cases for the year 2020.

· Massive Machine-Type Communication (mMTC)

It offers wireless connectivity for tens of billions of network-capable devices, scaling connectivity for an increasing number of devices, effective transmission of small payloads, large area coverage, and deep penetration are prioritised over data rates.



Massive Machine-Type Communication (mMTC) and its three access types, (a) direct network access (MTC-D), (b) access via an aggregation node (MTC-A) and (c) short-range D2D access for mMTC devices (MTC-M).

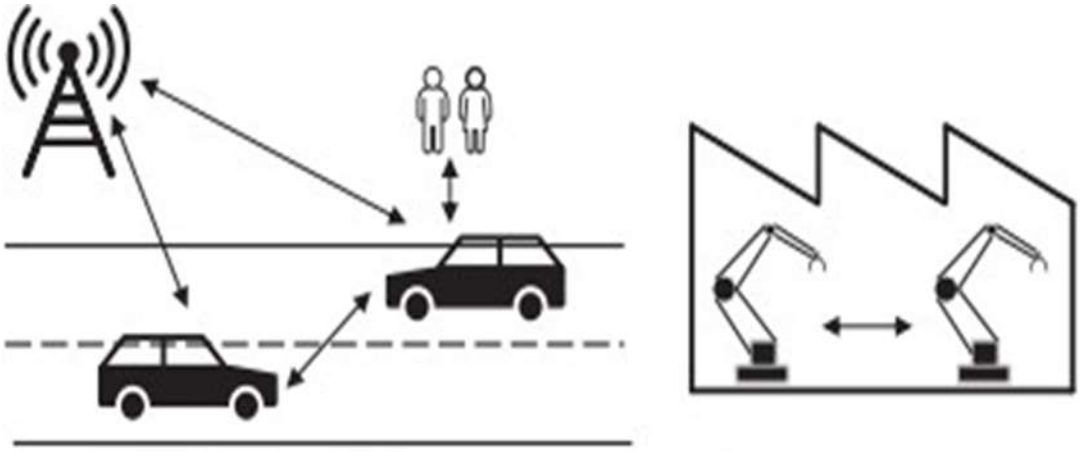
Massive Machine-Type Communication (mMTC) offers effective communication for numerous devices with limited budgets and energy supplies.

The use cases for mMTC are extremely diverse, ranging from the wide-area use case, which deploys enormous numbers of widely dispersed devices (such as sensors and actuators) for surveillance and area- covering measurements, to more local use cases, which connect electronic devices in the smart home that are only used indoors in populated areas or in close proximity to human users, as in the case of body-area networks. In contrast to xMBB, all of these scenarios share a common data payload and intermittent traffic. Due to the huge number of devices and the possibility that they may be deployed once and for all, it is preferable to position processes that use a lot of energy on the infrastructure side and to keep actions on the device side as brief as possible to reduce the device on- time.

·Ultra-reliable Machine-Type Communication (uMTC)

It offers ultra-reliable low-latency communication channels for network services with extremely high availability, latency, and reliability standards, such as V2X communication and industrial manufacturing applications. Priority is given on dependability and minimal latency above data throughput.

For demanding applications, ultra-reliable and low-latency communication is provided via ultra-reliable machine-type communication (uMTC). Road safety and traffic efficiency and industrial manufacturing are two common examples, both of which have strict requirements for minimal latency and extremely high reliability.



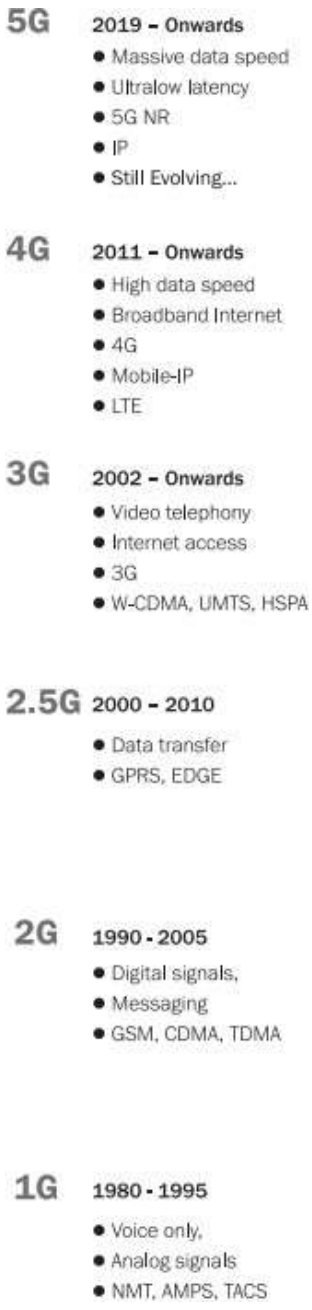
Ultra-reliable Machine-Type Communication (uMTC) with applications to road safety and traffic efficiency and industrial manufacturing.

Information is transmitted between traffic participants utilising vehicle-to-vehicle (V2V), vehicle-to-pedestrian (V2P), or vehicle-to-infrastructure (V2I) communication in road safety and traffic efficiency applications. The name "Vehicle- to-Anything (V2X)" encompasses V2V, V2P, and V2I for applications related to traffic safety and efficiency, which is a small misuse of the nomenclature. There are both recurring and event-driven messages used in V2X communication. The messages are sent on a regular basis to help prevent harmful scenarios from occurring. A traffic participant can

periodically (e.g., every 10 ms) broadcast its position, speed, trajectory, and other information to recipients inside a specific range (e.g. 100 m). When an abnormal and/or risky scenario is identified, such as approaching automobiles or accidents, the event-driven alerts are sent out.

The Evolution of Cellular Mobile Networks

The image illustrates the generations of cellular mobile communication. The following is a brief explanation of each generation:



First Generation 1G

First-generation wireless telephone technology, or 1G, is used in cell phones. They were first released in 1980 and were analogue cell phones. Nippon Telephone and Telegraph (NTT) in Tokyo, Japan, launched the first mobile phone network in the world in 1979. Nordic Mobile Telephone (NMT) and (TACS) were the two most widely used analogue systems in Europe, but additional analogue systems were also developed in the 1980s.

Second Generation (2G To 2.7G)

Second-generation wireless cell phones, or 2G, were introduced in the early 1990s and were based on digital technologies. 2G was introduced in Finland in 1991. Services like text messaging, photo messaging, and MMS were offered via 2G. For both sender and recipient, 2G offers improved security.

2.5 G -GPRS (General packet Radio Service)

GPRS is an extension of the existing 2G network that increases the data speeds these networks can sustain while enabling the launch of packet-based applications. The 2G-Systems that have implemented a packet switched domain in addition to a circuit switched domain are referred to as "second and a half generation.

" The word "2.5 G" is colloquial. GPRS offered data rates using database HLR, VLR, EIR, and AuC with HSCSD, GPRS,

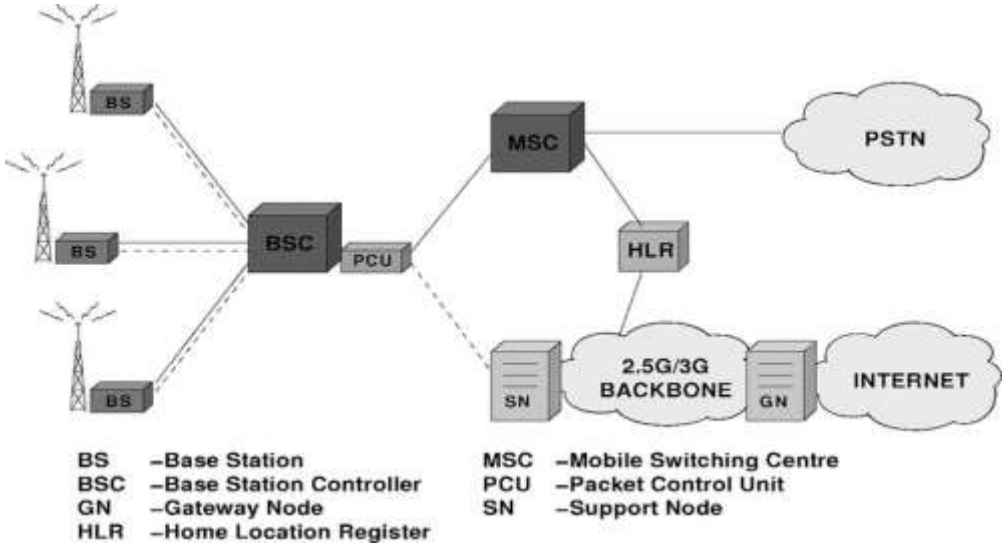
and EDGE technologies ranging from 56 Kbps to 384 Kbps. It offers services like access to the World Wide Wireless Web (WWW), Multimedia Messaging Service (MMS), and Wireless Application Protocol (WAP) access, as well as internet communication services like email..

2.75- EDGE (Enhanced Data rates for GSM Evolution)

8PSK encoding enabled the evolution of GPRS networks into EDGE networks. A backward-compatible digital mobile phone technology known as Enhanced Data Rates for GSM Evolution, Enhanced GPRS (EGPRS), or IMT Single Carrier (IMT-SC), is an addition to regular GSM that permits improved data transmission rates. Beginning in 2003, Cingular (now AT & T) in the United States began rolling out EDGE on GSM networks.

3G (Third Generation)

Third-generation (3G) mobile phone standards and technologies, which replaced 2G and came before 4G. It is based on a plan developed by the International Telecommunication Union (ITU) to create a global frequency band in the 2000 MHz region that will support a single, universal wireless communication standard for all nations worldwide. This program's name is International Mobile Telephone 2000 (IMT- 2000), Standard.



3.5 G – HSDPA (High-Speed Downlink Packet Access)

High-Speed Downlink Packet Access (HSDPA), often known as 3.5G (or "312 G"), is a mobile phone protocol that offers UMTS-based 3G networks a smooth evolutionary path that enables faster data transfer rates. With data transmission speeds of up to 8–10 Mbit/s (and 20 Mbit/s for MIMO systems) over a 5MHz bandwidth in the WCDMA downlink, HSDPA is a

packet-based data service. HSDPA implementations include Adaptive Modulation and Coding (AMC), Multiple- Input Multiple-Output (MIMO), Hybrid Automatic Request (HARQ), quick cell search, and sophisticated receiver design.

4G (Fourth Generation)

With a focus on high-speed data transfer, such as 0-100MBPS while either the server or the data receiver set is travelling at a speed of 60 Kmph, 4G is a concept of interoperability between various types of networks. The data flow would be at least 1 GBPS if the server and receiver were stationary. The fourth generation of wireless networks, or 4G, will eventually take the place of 3G networks. In another aspect, 4G is merely a move away from the constraints and issues of 3G, which is struggling to gain traction and deliver on its throughput and performance promises.

5G (Fifth Generation)

The term "5G" (also known as "5th generation mobile networks" or "5th generation wireless systems") is sometimes used in research papers and projects to refer to the next 4G standards, which are anticipated to be finished between 2011 and 2013. The name "5G" has not yet been used in any official specification or document that has been made available to the public by telecommunications corporations or standardisation organisations like 3GPP, WiMAX Forum, or ITU-R. Beyond 4G and LTE Advanced, fresh 3GPP standard releases are ongoing but are not regarded as new mobile generations.

COMPARISION OF 1G TO 5G

	1G	2G/2.5G/2.75G	3G	4G	5G
Band Width	2kbps	14-64kbps	2mbps	200mbps	>1 GBPS
Technology	Analog	Digital	CDMA2000, UMTS, EDGE	Wi-Fi max , LTE, WI-FI	WWWW
Core network	PSTN	PSTN	packet network	Internet	Internet
Multiplexing	FDMA	TDMA	CDMA	CDMA	CDMA
Switching	Circuit	Circuit and packet	packet	all packet	all packets
Primary services	Analog phone cell	Digital phone call and messaging	phone calls, messaging, data	All IP services (including voice message)	High speed, high capacity and provide broadcasting of data in GBPS
Key differentiator	Mobility	Secure, mass adoption	Better internet experience	Faster broadband internet, lower latency.	Better coverage and no dropped calls, much lower latency, better performance
Weakness	poor spectral efficiency	Limited data rates, difficulty to support demand for internet	Real work fails to match type, failure of WAP for internet access	Battery use is more, required complicated and expensive hardware	???????

Comparison table from 1G to 5G

Applications of the 5G network :

• Autonomous vehicles: Autonomous vehicles are the vehicles which onboard computer with high compute power to use them to control cars automatically or without any person required to monitor over it. Autonomous vehicles are the future because of their efficient use of fuel by using proper route to travel between locations, less chance of any accidental damage because of low latency which can be provided by a computer more effectively than a human being, more proper control over the traffic because of the communication which can be done and should be done between different autonomous vehicles to travel efficiently and cause as little traffic as possible, and much more.

(a) Autonomous vehicle control

• Media on demand: As the life of people are getting more kinetic and less of time is available when people are still at a location like home or at friends or at relative to use a proper WIFI wireless system to use the internet. Due to which mobile networks or network which can be available at different location and not at a particular area is used.

These mobile networks help us connect to the internet even when we are in a constant motion and cannot be still at a location just to use a network.

Industrial automation: As we know that we have developed our industries and now the industries work at a very high speed and efficiently. And to do so the industries use the automated machines(or robots) to do most of the physical works which require strength and speed which can be provided a machine more efficiently than a human being. Because of the use of the machines (or robots) we have improved our production and now we have machines (or robots) which can do repeated task at speed of hundred or even thousands in a minute.

) Media on demand

Large outdoor events: Large events which are outdoors or sometime inside huge buildings and are for a limited time period and a large number of people visit the events in the limited time. Some examples of these events are sports events, exhibitions, festivals, concerts, tech events and so on.

Use cases	Requirements	DesDedvalue
Autonomous vehicle control	L aiency	5 ms
	.Ai ailability	99.999%
	Rel iab ility	99.999%
Emergency commu nicafion	.Ai ailability	99.9* 8 i icii iii discos cry rare
	Energy effi ciency	1 week battery life
FadoqceBautomadon	L aiency	Hnw'n io below' 1 iris
	Rel iab ility	Hnw'n io pack ei I oss of less ili an 10
High-speed train	Trnffic i o mne density	100 Gbp kin' in DL. and
		50 Mbps/knr in ML
	Experienced user throughput	50 Al bps i n DL. and
		25 Al bps i n ML
	Mobility	500 kin/ii
	Latency	10 iris
	Experienced user throughput	30 Al bps
Large outdoor event	Traffic volume density	900 Gbp kin'
	Connection density	4 subscribers per iii'
	Reliability	Aitnge probability < 1 * 8
	Connection density	1.000.000 dci ices per kin'
Massive amount of	Availability	99.9* 8 cor' erage
geographically spread devices	Energy efficiency	10 y enrs banery li fe
Media on demand	Experienced user throughput	15 Al bps
	Latency	
		5 s st ari app tic aii on)
		200 n t a tier possible li nk
	Connection density	4000 dev' ices per km'
	Traffic volume density	50 Cibps/kin'
	Availability	95% coverage
Remote surgery and	Latency	Down to below 1 ms
ezamin afion	Reliability	99.999%
Shopping mak	Experienced user throughput	300 Mbps in DL. and
		60 Al bps i n ML
	.Ai ailability	.Hi I enst 95*8 for all app tic ati one. and
		9F 8 for sa fety-related app tic ai ions
	Rel iab ility	.Hi I enst 95 * 8 for all app tic ati one. and
		9F 8 for sa fety-related app tic ai ions
Smart city	Experienced user throughput	300 Mbps in DL. and
		60 Mbps in UL
	Traffic volume density	700 Gbps/km^2
	Connection density	200 000 users per km^2
Stadium	Experienced user throughput	0.3–20 Mbps
	Traffic volume density	0.1–10 Mbps/m^2
Teleprotecfion in smart grid	Latency	8 ms
network	Reliability	99.999%
Traffic jam	Traffic volume density	480 Gbp kin'
	Experienced user throughput	100 Mbps in DL. and 2. 0 Al bps in ML
	Availability	95%
Virtual and augmented reality	Experienced user throughput	4—28 Mbps
	Latency	10 iris RTT

Advantages of 5G wireless system

• Higher download and upload speed: The fifth generation of mobile network will provide higher download and upload speed as compared to previous generation of mobile network

(4G mobile network), 5G will provide up to 20 time the speed of 4G.

• Lower latency: latency is the delay between entering the request for some information and the information showing up on an output device. The previous generation of mobile network 4G provided latency from a range of 60 millisecond to 98 millisecond, whereas the upcoming generation of mobile network 5G will be able to provide low latency of below 5 milliseconds, which is very low as compared to the previous generation of mobile network 4G which will enable us to do different work more efficiently and will also enable new industries to grow.

• Technology development: Through the help of 5G current technology will be able to work more efficiently, will provide low points of error and will work faster as compared to previously. Some examples of technology which will benefit from 5G network are broadcasting, media on demand, autonomous devices, etc. 5G will also benefit to develop new industries to be formed some of which are Al , VR(virtual reality) , AR(Augmented reality) , etc.

• Better control of dense device area: One of the major advantages which 5G will provide over previous wireless network(4G) is that it will be able to manage more devices per tower. This will help majorly on large events like sports event, technological events, or any other events where there are a large number of people in a area and constant use of network is required at these places the 5G network will improve the experience for the people using the service.

• Disadvantages of 5G wireless system

• Low range: The new fifth generation of wireless system although provides high speed with a very low latency but it comes at a cost which is range of the wireless network which is proportional to the speed provided by it. 5G which provide high speed of 10 to 100 times with the use of millimeter wave (mm Wave) which of frequency from 24 GHz to 300 GHz which is travel less distance as compared to 4G or LTE and mmWave are so low range that it gets blocked by having any thing in between the receiver and the source.

• Initial cost of rollout is high: As it is with all the new technology development to be available at a public level is expensive, so is with the 5G wireless technology. 5G will be expensive at infrastructure level because of construction of new network towers require to use new technology used in 5G like mmWave(millimeter wave) , and because of its low coverage area more of the network towers will be required per square kilometer.

• Limitation of rural access: The connectivity which is promised to be available with the new 5G network by the companies which are provided by the companies is true but first will be provided to the urban region because of high population density which will enable network providing companies to be efficient with their spent money. It doesn't mean that rural area will not get 5G network, it will be provided to that area but after much time of rollout in urban area.

• Battery drain: When it come to the cellular device (or Mobile devices) connected to 5G network, its seem that their battery standby is not as good as when the device used previous generation of wireless network. It is due to the constant collection of high band frequency network of 5G, it is also due to constant processing of data obtained of 5G which is much higher as compared the 4G network.

• Lower upload speed: Upload speed of 5G wireless network has not increased at same rate at which the download speed has extended when compared to previous generation of wireless network. It is because it still uses the 4G bands as compared to the newer mm Wave to do so. Still the 5G network will provide up to 30% faster upload speed as compared to 4G wireless network, it will be from 25 Mbps to 100 Mbps, theoretically.

Reference

S. No.	Author	Work
[1]	Nahar, T and Rawat, S (2021)	Survey of various bandwidth enhancement techniques used for 5G antennas.
[2]	Patnaik, A and Kartikeyan, MV (2021)	Compact dual and triple band antennas for 5G-IOT applications. International Journal of Microwave and Wireless Technologies
[3]	del Peral-Rosado, JA, Raulefs, R, Lopez-Salcedo, JA and Seco-Granados, G (2018)	Survey of cellular mobile radio localization methods: from 1G to 5G.
[4]	Osseiran, A, Monserrat, JF and Marsch, P (2016)	5G Mobile and Wireless Communications Technology.
[5]	Hussain, R (2021)	Shared-aperture slot-based sub-6-GHz and mm-wave IoT antenna for 5G applications.

[6]	Malik, SA, Muzaffar, K, Mir, AH and Moon, AH (2021)	Extremely close integration of dual band sub-6 GHz 4G antenna with unidirectional mm-wave 5G antenna.
[7]	Gonzalez, SRM and Marquez, RTR (2019)	Microstrip antenna design for 3.1–4.2 GHz frequency band applied to 5G mobile devices.
[8]	Bang, J and Choi, J (2018)	A SAR reduced mm-wave beam-steerable array antenna with dual-mode operation for fully metal-covered 5G cellular handsets.
[9]	Imran, D, Farooqi, MM, Khattak, MI, Ullah, Z, Khan, MI, Kha ttak, MA and Dar, H (2018)	Millimeter wave microstrip patch antenna for 5G mobile communication.
[10]	Zhang, W, Weng, Z and Wang, L (2018)	Design of a dual-band MIMO antenna for 5G smartphone application, International Workshop on Antenna Technology (iWAT).
[11]	An, W, Li, Y, Fu, H, Ma, J, Chen, W and Feng, B (2018)	Low-profile and wideband microstrip antenna with stable gain for 5G wireless applications.
[12]	A. El-Amine, M. Iturralde, H. A. Haj Hassan and L. Nuaymi(2019)	A Distributed Q-Learning Approach for Adaptive Sleep Modes in 5G Networks
[13]	J. F. Valenzuela-Valdés, Á. Palomares, J. C. GonzálezMacías, A. Valenzuela-Valdés, P. Padilla and F. LunaValero(2018)	On the Ultra-Dense Small Cell Deployment for 5G Networks.
[14]	Naser Al-Falahy and Omar Y. Alani(2017)	Technologies for 5G Networks: Challenges and Opportunities
[15]	Zhiqiang Wei, et al(2016)	A Survey of Downlink Nonorthogonal Multiple Access for 5G Wireless Communication Networks
[16]	Lim, Y.-G., Taehun Jung, Kim, K. S., & Chae, C.-B. (2017)	Waveform multiplexing for 5G: A concept and 3D evaluation.
[17]	M.Chen, et al(2015)	EMC:emotion-aware mobile cloud computing in 5G
[18]	Roman, R., Lopez, J., & Mambo, M. (2018)	Mobile edge computing, fog et al.: A survey and analysis of security threats and challenges.
[19]	Jilani, S.F.; Munoz, M.O.; Abbasi, Q.H.; Alomainy(2019)	Millimeter-wave liquid crystal polymer based conformal antenna array for 5G applications
[20]	Addad, R. A., Taleb, T., Flinck, H., Bagaa, M., & Dutra, D. (2020)	Network slice mobility in next generation mobile systems: Challenges and potential solutions.