International Conference on Machine Learning and Data Engineering Achieving Low Latency and High Reliability in 5G and 6G Communication System

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Abstract

The 4G technology is already introduced in 2010 where the user can access the internet at anywhere and anytime. Here Mobile Broad Band (MBB) is the only application scenario. 5G technology had been launched in the year 2020. In comparison to 4G, 5G is far advanced. When 4G is updated to 5G, there will be increase in wireless communication system in an exponential manner. It has three application scenarios i.e eMBB, URLLC and mMTC. Among them, URLLC is the most critical condition. In URLLC, two terms are increase in Reliability and reduction of Latency and their interrelation. URLLC will be used in vehicles, factories etc to improve the smartness. During the reign of 5G, several techniques such as TSN, D2D, CoMP, MEC, Mobile Caching etc. are used for the reduction of latency and increase in reliability. 5G will not able to fulfill the all the user demand such as sense of touch. 6G is another new technology updated from 5G and it will be launched around 2030. The application scenarios present in 6G will be enhanced in comparison to 5G. Here the URLLC will convert into enhanced URLLC. The reasons for the decrease in latency and improvement of reliability such as Artificial Intelligence, TeraHertz Communication, 3D networking, Tactile Internet, Full automation etc. This article presents the review of reliability and latency both in 5G and 6G. This article describes the features of reliability and latency for both 5G and 6G, their comparison, reasons and factors regarding the increase in reliability and reduction of latency. It will be helpful for the researchers to carry out some research works in critical conditions in future.

Keywords: URLLC; eMBB; mMTC; massive MIMO; 3GPP; SON; AI; UAV; feMBB; eURLLC; uMUB; uHSLLC; uHDD

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1. Introduction

When 4G was existing in the world in 2010, the facility for using mobile phones were increased, the usage of voice and video data present in the mobile phones can be accessed by the users at anytime and anywhere. Figure 1 shows the comparison of 4G and 5G regarding speed, latency and connection density already given in [1]. Accessing the internet becomes familiar by the usage of High Speed Packet Access (HSPA)[0]. After few years it had been estimated that there should be great demand of massive devices in the world which cannot fulfilled by the 4G wireless communication. Hence the existence of 5G communication system is necessary which can able to solve the mobile data traffic system and increase the capability thousand times more than the previous stage.

Fifth Generation (5G) technology is the upcoming platform in the wireless communication system which give existence to various emerging technologies in the future. The design of 5G New Radio (NR) is progressed by Third Generation Project (3GPP) . The cells present in 5G technologies take the responsibilities represented as centralized user, centralized service and centralized network [0]. The centralized user facilitates connectivity for all days with full activity and good support for the users without any disturbances.. The centralized service supports smart vehicular system, intelligent monitoring services, roadside unit etc. The centralized network operator can able to take the responsibility to deliver energy efficiency, scalability and infrastructure having high security. For 5G, there are three different categories [0] which are enhanced mobile broadband (eMBB), massive machine-type communications (mMTC), and ultra-reliable and low-latency communications (URLLC). Among them, URLLC is the key usage scenarios which fulfill the various opportunities in 5G. Researchers in various fields can estimate that URLLC will have a good importance which provides connections in various applications, sectors etc. from vertical domains.

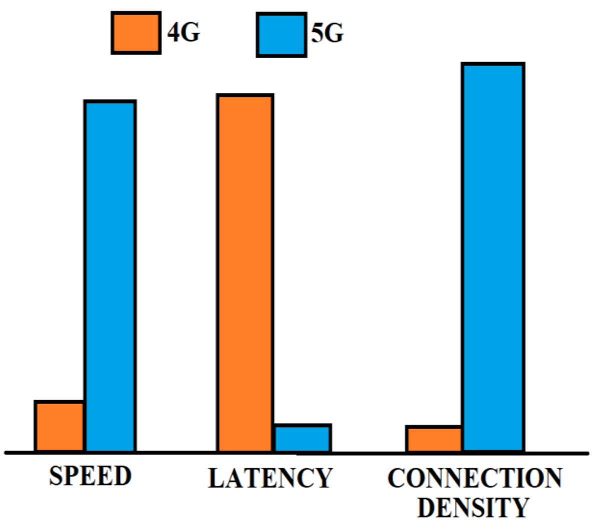

Fig. 1.Speed, latency and connection density between 4G and 5G [**Error! Reference source not found.**]

The URLLC is a service which can able to transmit packets by fulfilling the requirements of latency, availability and reliability. With the help of URLLC, various emerging technologies like the process of automation; wireless control etc. can be enabled. These lead to the development of smart factory, smart vehicle which will be utilized for the improvement of safety, efficiency and tactile internet. The URLLC have the important role in 5G which provide various opportunities for the telecommunication industries in the real world. According to Release 15 [0], the 3GPP Radio Access Network (RAN) want to complete the whole procedure from source to destination by fulfilling the reduction of latency to 1 ms and the reliability to 99.999%. It is utilized for the situations in which the transmission of data should follow the time accuracy and expected delivery which leads to the high reliability and low latency. The high reliability (99.999%) and low latency (1 ms) from one end to another end determine the Quality of Service (QoS) for 5G URLLC. The QoS [0] for 5G URLLC cannot be fulfilled if the reliability for the delivery of packets or messaged will be less than 99.999% and the latency will be reduced to 1 ms. The QoS in URLLC will facilitate the process of automation applicable in vehicles. In the process of automation , there include the cooperative and protective functions, monitoring and control of smart devices, medical equipments, UAV(Unmanned Aerial Vehicles) , robots, smart industries. The QoS is one of the important target for URLLC. For obtaining data having ultra high reliability, the retransmission called hybrid automatic repeat request (HARQ) should be applied but the conditions for latency will not achieved. But the low latency can be obtained when the block error can be reduced during the retransmission of HARQ. The resultant shows the minimization of spectral efficiency [0]. The URLLC in 5G denotes the interrelation between latency, reliability along with the capacity in the Radio Access Network (RAN) [0]. Side by side, these should be dependant also. If the capacity in RAN will have great importance, then the reliability and latency will not preferred. In order to implement URLLC, the latency and reliability should be preferred more than the capacity. Hence the capacity should be reduced. Figure 2 shows the importance of reliability, latency and capacity with different colours and the better balance between 3 objectives. The new URLLC Self Organized Network (SON) is activated which shows the importance of reliability, capacity and latency (green in colour) .

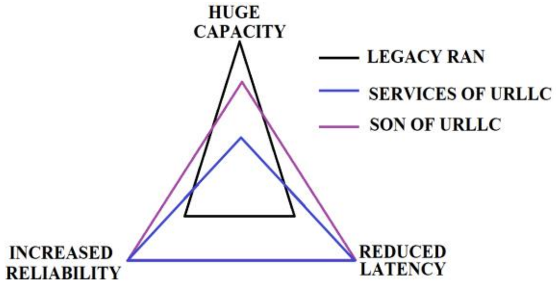

Fig. 2. Latency, Reliability and Capacity

In 5G platform, ultra reliability and low latency have great importance and these are interrelated [5]. It will utilize for specific services:

- Process of automation in V2X (Vehicle to Everything) for various applications such as intersection management, removal of road accidents, improvement of traffic efficiency, unmanned vehicles etc.
- Usage of robotic operations in massive Machine Type Communications (mMTC) for controlling industrial applications in smart factories
- Applying the process of automation for various purposes such as distribution of energy, function of monitoring and control of smart grids
- Online programs such as entertainment, infotainment, games etc.

The investigation of network latency is executed by third generation partnership project (3GPP) and its target is the reduction of latency. The new proposal for the reduction of latency is the optimization of Radio Resource Management (RRM).The RRM includes the reduction of Transmission Time Interval (TTI) [6]. As a result, the latency is reduced to 0.5 ms from 1 ms during Orthogonal Frequency Division Multiplexing (OFDM). One of the reliable wireless communications which can able to reduce the latency from 1ms to approximate zero is Device to Device (D2D) communication. It will enable the users to communicate directly with each other without the usage of evolved NodeB (eNB). The optimization of resource management should be done in such a way that the latency will be reduced and the system capacity will be increased. For enabling the mission critical applications in the future, the requirement of ultra-reliable and low latency communication is necessary. The mission critical applications include the process of automation in vehicles, factories, reality system etc. In URLLC, the requirement for reliability is 99.999% which means the probability of packet success $1\text{-}10^{-5}$ and the user plane latency should be less than 1 ms. In 4G LTE, the user plane latency is more than 4 ms, and it is not possible to 4217ulfil the latency requirement of less than 1 ms utilizing the framework in LTE-Advanced. The user plane latency consists of queuing delay, frame alignment, processing delay during transmission and reception. Thus to 4217ulfil the reduction of latency for less than 1 ms, there will be requirement of new frame structures. The new frame structures which have been proposed for the design of URLLC include the concept of mini slot and wider subcarrier spacing. The new frame structures which have been proposed for the design of URLLC include the concept of mini slot and wider subcarrier spacing [0]. The slot length for mini slot is smaller than LTE-Advanced. In mini slot, each of the slot with a Orthogonal Frequency Division Multiplexing symbol perform the reduction of latency.

For solving the limitations in 5G, there should be the requirement of the new technology called sixth generation (6G) wireless system which is expected to be launched around 2030[7]. The 6G system includes the development and update of the 5G technologies such as massive throughput, increase in reliability, minimizing the power consumption, bulk connectivity etc. The new features include Artificial Intelligence (AI), increase in smartness of the devices, automation in vehicles, perfect sensing and three dimensional (3D) mapping, capacity to manage large volumes of data having massive data rate connectivity for a device. In case of 6G, the Quality of Service (QoS) will be far superior in comparison to 5G.Here the system will be protective in such a way that the user data cannot access easily. Every user will feel comfortable to use any devices when 6G come into existence. The data rate for 6G will be much higher i.e. 1 Tb/s than 5G. Due the availability of high data rate, 6G will able to facilitate the whole world. The wireless connectivity in 6G will be 1000 times more in comparison to 5G. Due the availability of high data rate, 6G will able to facilitate the whole world. The wireless connectivity in 6G will be 1000 times more in comparison to 5G. The latency will be less than 1 ms for long range communication. For applying the process of automation in various devices, the usage of Artificial Intelligence (AI) is mandatory. The technologies used for the development of 6G are three dimensional (3D) networking, advanced wireless communication, power transfer in wireless mode, unmanned aerial vehicles (UAV), Tera Hertz (THz) band, Artificial Intelligence (AI) etc [7]. The 5G advanced wireless communications gives rise to formation of intelligent network which is possible by the usage of AI. It has been assumed that 5G will able to fulfil its target by the year 2030. Realization of 6G forms a network environment with complete intelligence with new services.

Organisation of the paper: Article 2 includes the comparison of the layers of 4G and 5G, brief idea of 5G and 6G along with their comparison. The features of URLLC in 5G regarding the estimation of the values for reliability and latency are specified in Article 3. In Article 4, the explanation Latency and Reliability in 5G along with Mission Critical Applications is provided whereas Article 5 describes the factors for reducing latency and increase in Reliability in 5G such as cognitive radio, Time Sensitive Networking, Device to Device, Mobile Edge Computing etc. The limitations and problems in 5G and shows the way to improve 6G is mentioned in Article 6. The advent of 6G and also the advancement of 6G than 5G is defined in Article 7. Article 8 specifies the reasons for increasing Reliability and reducing Latency for 6G.

Papers contribution: The papers contribution is highlighted as follows:

1) Contribution towards reliability in communication: The reliability in single reception from satellite communication system is questionable during rain events. 5G URLLC aims to complement the above by utilizing diversity reception. On this context of system reliability, this paper reviewed several papers and addresses this reliability issues.
2) Contribution towards latency in communication: The root cause of reduction of latency is due to various parameters such as delay, time synchronisation of packet delivery, priority etc. Time Sensitive Networking, Mobile Edge Computing etc.

Motivation: The above paper contribution towards achieving 5G URLLC system usually helps society to realize the smarter world .Several start up companies are approaching the authors to help them in providing the reference design of 5G URLLC system which they are willing to commercialize. With this motivation the authors are working in designing and developing the above system.

2. 5G and 6G

2.1 5G: 5G is the revolution for the year 2020 in the world of telecommunication. It is the mobile communication network that can able to solve the limitations in 4G such as massive data rate, heterogeneous connectivity, huge capacity, Quality of Experience (QoE), low latency, less expensive, ultra reliability etc. The 5G model is the internet protocol based model which increases the level of priority for the user [9]. The 5G communication network is dedicated upon the requirements for the user. The user can utilize the mobile device as a handset or feels very easy to handle it. It is denoted as smartness of the devices. The open system interconnection protocol; layers for 5G include Open Wireless Architecture (OWA), lower network layer, upper network layer, Open Transport Protocol (OTP) [9], Application services. The OWA in 5G includes the physical and data link layer of 4G. The network layer in 4G includes the upper and lower network layer in 5G. The 5G OTP includes the session layer and transport layer in 4G. The Application services in 5G consist of application layer and presentation layer in 4G.

Table 1: Layers of OSI for 4G and 5G

4G	5G
Application Layer	Application Services
Presentation Layer	
Session Layer	Open Transport Protocol (OTP)
Transport Layer	
Network Layer	Upper Network Layer
	Lower Network Layer
Data Link Layer	Open Wireless Architecture (OWA)
Physical Layer	

In comparison to 4G, there are various opportunities available in 5G i.e. surveillance of 4K cameras for video streaming, television services, online medicine services, downloading of ultra high definition maps done by the connected vehicles at high speed in urban areas for emergency purposes. 5G technology [10] can able to support 4 gadgets per square metre with a gadget and its throughput is 30 Mbps. When the environment become highly dense, 5G can sustain 2 lakh devices per square kilometre having 60 Mbps and 300 Mbps with a device for downloading and uploading purposes. The 5G technology can also able to support one million devices per square kilometer. Hence the term massive Machine Type Communication or massive Internet of Things (mIoT) is derived. The latency requirement for eMBB is 4 ms and for mission critical application is 0.5 ms. 5G can sustain delay sensitive mode for public safety utilized for vehicular applications. As a result, the term URLLC is derived. For developing 5G, there will be requirement of various techniques such as developing the Millimetre-wave Radio Access Technologies (RAT), development of hyper dense tiny cell, self organizing network (SON), evolving the surviving RAT, Machine Type Communication (MTC), spectrum sharing, update of backhaul links, allocation in new spectrum etc. 5G have the capability of high data rate, high protective, dense coverage, smartness etc. The data rate in the network is 10 Gbps, latency from source to destination in air is 1 ms and its transportability is 500 kilometres per hour. The target of 5G is to fulfil the development of ultra reliable communication among the people and also to develop the communication between people and machines.

2.2 6G: 6G will deliver much more improved communication services in comparison to 5G such as broad bandwidth, low latency and huge connectivity. Hence in 6G, the Internet of Things (IoT) will convert into Internet of Everything (IoE) [11]. The Terahertz will be used which provide accession to massive wireless connections at the same time. The target of 6G is towards the dedication of sea, land and air network. The review, research, development, dedication of 6G had begun in 2020 and expects to be fulfilling in the year 2030. Although 5G is already acts a great role in International Communication Technologies (ICT), after a certain time, the 6G will act another important role in ICT. The Artificial Intelligence is already utilized in 5G, and in 6G, there will be the update of intelligences so that the smartness of the devices will be improved. As a result, the 6G becomes user friendly. There are technological advantages for 6G mobile communications i.e. high data rates, high speed full coverage, batteries with long term power, development of the communication in non network areas such as remote rural areas, desert, sea, cold desert etc. The high data rate is obtained due to the usage of spectrum from 100 GHz to 10 THz. The high speed full coverage will increase the density of 6G technology. The density will be 100 per cubic metre. As a result, massive devices will be accessed in a simultaneous chain. As a result, the smartness will be applicable to different devices such as homes, factories, cities, hospitals, institution etc. The 6G batteries should be less expensive, massive storage area, huge energetic etc. During the charging of battery, the transfer of energy will be in wireless mode [11]. The lifetime of battery will be a very long period than the previous stage. Solid state batteries and grapheme batteries will be utilised. The communication will be available in various non network areas such as oceans, desert areas, deep forest, remote areas, cold desert etc as in 6G; there will be the development of Low Earth Orbits (LEO) [11] which should have low weight and less expensive. Multiple antenna system will be utilised for maximising throughput, electromagnetic propagation, high accuracy and fulfilling the complexity of the advanced technology. There are many technologies that can enable 6G mobile communication such as shift from GHz to THz, artificial intelligence, sensing accuracy, Quantum system, full duplex mode, polar coding , orbital angular momentum technology, resource allocation in multi dimension mode, power transfer in wireless mode, automation, wireless brain computer interaction etc.

The 6G is much more advanced than 5G due to the inclusion of new characteristics such as density of the network, increase in throughput, ultra reliability, minimization of power consumption, dense connectivity etc. Side by side, the new services include Artificial Intelligence, execution of smart data, automation, computation etc. The 6G technology is capable to manage gigantic amount of data having high data rate. As a result, the limitations in 5G will be overcome. There will be the improvement of the performance and the Quality of Service (QoS) in comparison to 5G. The data will be more protective and secured. The user will feel comfortable during the utilization of any kind of devices in 6G environment. The 6G provide huge facilitations, increase various opportunities and give rise to a new global environment. As the data rate is expressed in Terabit per second, there will be the facility of massive wireless connectivity which will be 1000 times more than 5G. The long range communication facility is possible with a very low latency having less than 1 ms. For following the process of automation, there will be the requirement of Artificial Intelligence (AI). The display of Video signals will be more prominent for the users. The most essential technologies which will be required in 6G are Artificial Intelligence, three dimensional networking, power transmission in wireless system, optical wireless communication (OWC), TeraHertz (THz) band, Unmanned Aerial Vehicle (UAV), The service requirements for the development of 6G technologies are URLLC, eMBB, mMTC, integration of AI, Tactile internet, maximizing throughput, increase in network capacity, huge energy efficiency, less congestion in backhaul and access network, increase in security and protection of data.

2.3 5G vs 6G : There is a lot of difference between 5G and 6G given in Table 2.

Table 2. Comparison between 5G and 6G

Parameter	5G	6G
Peak data rate for each device [12]	10 Gbps	1 Tbps
Time taken from one end to another end (ms) [12] [7]	10	1
Latency (ms) [14] [15]	1	0.1
Reliability (in percentage) [13]	99.999%	99.99999%
Transmission capacity [14]	Local Area	Wide Area
Smartness [7]	Partly	Fully
Extended Reality [7]	Partly	Fully
Frequency of operation [8]	3 to 300 GHz	≤ 1 THz
Highest Frequency [12]	90 GHz	10 THz
Connection density (devices per square km) [14]	10 lakhs	1000 lakhs
Process of automation [7]	Partly	Fully
Delay jitter [15]	Not utilized	10^{-3}
Highest Mobility [13] [7][15]	500 km/hour	1000 km/hour
Utilization of Architecture [12]	Massive MIMO	Intelligence
Efficiency of Energy (bits per joule) [14]	100	200
Data rate [14][16]	a. 100 Megabits per second [14] b. 1 to 20 Gbps [16]	a. 20 Gigabits per second [14] b. ≥ 1 THz [16]
Haptic communication [12] [7]	Partly	Fully
TeraHertz communication [12]	Finite	Extensive
Highest spectral efficiency(bps per	30	100

Hertz) [12]		
Service types	Augmented Reality/ Virtual Reality	Tactile Internet
Data Security [13]	High	Very High
Wireless Environment [13]	Partly	Fully
Delay in processing (ns) [13]	≤100	≤10
Smart devices	Distinct	Integrated
Satellite integration [7] [8]	Not Applicable	Fully
Efficiency in spectrum (bps per Hertz) [14]	100	200 to 300
Width	Global deep	Ground local
Capacity in Area Traffic(Mbps per square meter) [15]	10	1000
Highest channel bandwidth	1 GHz	100 GHz
Network	User oriented	Service oriented
Data rate (uplink) [8]	10 Gbps	1 Tbps
Data rate (downlink) [8]	20 Gbps	1 Tbps
Data rate (Experienced) [15]	0.1 Gbps	1 Gbps
User plane latency (ms) [8]	0.5	0.1
Control plane latency(ms) [8]	10	1
Packet Error Rate [15]	10^{-5}	10^{-9}
Internet	Internet of Things (IoT)	Internet of Everything (IoE)
Power expenditure [13]	Not Mentioned	Very low
Year of launching [16]	2020	2030 expected
Delay in radio signal (ns) [16]	100	10
Bandwidth [16]	250 MHz to 1 GHz	≥ 1 THz
Spectrum range [16]	3 to 300 GHz	1 to 10 THz
Service types [16] [13]	uRLLC, eMBB and mMTC	a. uHDD, uHSLLC, uMUB and mMTc [16] b. MBRLLC/mURLLC/HCS/MPS [13]
Band of frequencies [13]	a. Microwave (sub-6 GHz) b. Millimeter wave (28 GHz)	a. Microwave (sub-6 GHz) b. Millimeter wave utilized in mobile communication c. sub THz d. Non Radio Frequencies i.e optical, VLC, laser etc

From the above table, it is clear that 6G is more advanced than 5G. The latency in 6G is 10 times lower than 5G.The reliability is 100 times greater than 5G. The connection density is 100 times more, the energy efficiency is 2 times more, data rate is 200 times more, and spectrum efficiency is 2 to 3 times more. From [14], the communication latency for synchronization in 6G is determined to be 5 times less than 5G. In 6G, eMBB will update to uMUB (ubiquitous Mobile Ultra Broadband)[17], URLLC will update to uHSLLC (ultra High Speed and Low Latency Communication)[17], mMTC will update to uHDD (ultra High Data Density) [17] as given in Figure 3.

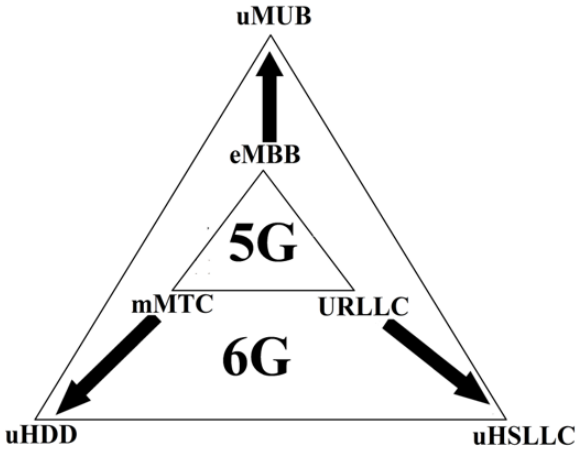

Fig. 3 Conversions from 5G to 6G

3. URLLC

There are three service categories in 5G i.e mMTC, eMBB and URLLC [10]. Among them, URLLC is the service which is more critical and challengeable. In URLLC, two requirements i.e. ultra reliability and low latency are compulsory. In order to minimize the latency, short packet should be utilized. As a result, the channel coding gain will be degraded which will decrease the reliability. Side by side, to increase the reliability, there should be the requirement of various resources. Hence the latency will increase. The URLLC specifies the delivery of information or data having the increase in reliability and minimization of latency. In order to maintain the increase in reliability with the decrease in latency, the service requirements for URLLC, physical layer, structure for packet and frame , techniques for the increase in reliability and schemes for multiplexing should be specified.

For minimizing the latency there will be need for network resources such as bandwidth, efficiency of coding etc. For the completion of the service in URLLC, the key factors include the minimization of latency, increase in reliability along with their coexistence [18]. The coexistence specifies the coexistence of URLLC with eMBB data and mMTC data. For obtaining the Quality of Service (QoS), various performance parameters include the minimization of latency, increase in reliability, high throughput, and improvement of efficiency in energy.

The broadband services for conventional mobile are utilized in Long Term Evolution (LTE) present in the 4G networks. In URLLC, the critical packets are delivered while channels are varying with high resiliency having the load conditions. For specific use cases, the transmissions for URLLC is required by the Third Generation Partnership (3GPP) in the Radio Access Network (RAN) [19] having the latency of 1 ms present on the user plane (UP) and obtained the reliability of 99.999% in which the size of the packet is 32 bytes. In many situations, the size of the packet is extended to 300 bytes but the latency varies from 1 ms to 15 ms and the reliability varies from 0.99999 to 0.99999999. The URLLC is one of the most important service type in 5G technology which contain the process of automation in industry, closed loop control, mobility in electronic health system, drone system. The main target of URLLC is the application of the process of automation during transportation. When the vehicles are at high speed, the signals are interrupted due to link failure. Due to URLLC, the time for the interruption and handover should be decreased and reached approximately to 0 ms.

4. Latency and Reliability in 5G

4.1 Latency: Normally, in low latency communication, the total time can be expressed as a sum of the four distinct latency components. They are the time taken for transmitting a packet, time required for the signal to travel from sender to receiver, time required for channel estimation, encoding and decoding for the first transmission and time for the retransmission. The requirement of time for the transmission of a packet is called time to transmit latency (T_{tp}). The time required for the

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signal to transmit from sender to receiver is called propagation latency(T_{pl}). Then the processing of the signal will start which include estimation, encoding and decoding for the channel during first transmission. It is denoted by T_{ps}. The time taken for the retransmission is denoted by T_{ret}. The total time is said to be physical layer latency [18] denoted by T_{total}. It is expressed by

$$T_{total}= T_{tp}+ T_{pl}+ T_{ps}+ T_{ret}$$

According to Third Generation Partnership Project(3GPP), the physical layer latency should be less than or equal to 0.5 ms. The time for transmitting a packet in 4G is 1 ms and as a result, the physical layer latency cannot be fulfilled. In 5G, a new frame structure is designed which supports URLLC with eMBB and mMTC. In 5G, the packet length varies from 1 to 10 Mb and has various symbol numerologies in which subcarrier spacing, sampling rate, symbol duration etc. are included. The control signaling develops the transmission protocol for decreasing the latency. Here the latency time should nominally be around 0.5 ms to 1 ms. User plane latency is the one way latency for successful reception of a packet, and it includes the time for one or more retransmission if packet reception fails. It includes the transmission processing latency, transmission time, and reception processing latency given in Figure 4.

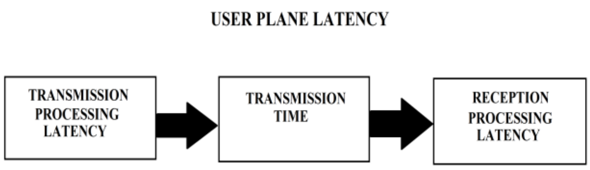

Fig 4. User Plane Latency definition

4.2 Reliability: In case of Ultra- Reliability in the 4G LTE system, the Block Error Rate(BLER) is 10^{-2} [18] . It can be performed by various processes i.e channel coding, retransmission mechanism etc. In case of 5G NR, the increase in reliability should be more than the 4G LTE system which means that the target BLER within 1 msec period should be 10^{-5}. In real time response such as remote surgery or autonomous driving, the BLER should be 10^{-7}[18]. In order to reduce the BLER , there should be an improvement in the channel estimation performance. During packet transmission, if any loss caused by channel estimation, then this loss should be minimised. If any application based on URLLC, then it should require low latency and high reliability. On the other hand, eMBB requires high data rates. For the existence of both URLLC with eMBB or URLLC with mMTC in a simultaneous chain, a coexistence method is required to achieve Quality of Service (QoS).

4.3 Mission Critical Applications: There are many emerging areas for mission critical applications which include Tele surgery, intelligent transportation, industry automation, tactile internet, augmented/virtual reality, fault detection, frequency and voltage control in smart grids etc [22]. The latency of these applications should necessarily be minimized and on the other hand reliability must be improved.

For new generation of services such as vehicular mobility management, there is a requirement of both reliability and low latency. Basically it means the control of autonomous vehicles [23] which involves sending of warning signals among the vehicles, roadside units, pedestrian, infrastructure etc. As a result, traffic accidents will be avoided. There are several technological transformations in transportation industry which includes automated driving, road safety and traffic efficiency There are many emerging areas for mission critical applications which include telesurgery, intelligent transportation, industry automation, tactile internet, augmented/virtual reality, fault detection, frequency and voltage control in smart grids etc [13].. The latency of these applications should necessarily be minimized and on the other hand reliability must be improved.

For new generation of services such as vehicular mobility management, there is a requirement of both reliability and low latency. Basically it means the control of autonomous vehicles [7] which involves sending of warning signals among the vehicles, roadside units, pedestrian, infrastructure etc. As a result, traffic accidents will be avoided. There are several technological transformations in transportation industry which includes automated driving, road safety and traffic efficiency services etc. These transformations are possible due to the realization of URLLC. Due to these transformations, vehicles are fully connected. These vehicles can be applicable to complex road situations by following the process of cooperation rather than reliable information. The information should be reached within extremely short time. The vehicle should be unmanned in which vehicles can operate itself by receiving information roadside unit, other vehicles, pedestrian etc. The use cases of this applications are automatic overtake, cooperative collision avoidance, high density platooning services etc. These transformations are possible due to the realization of URLLC. Due to these transformations, vehicles are fully connected. These vehicles can be applicable to complex road situations by following the process of cooperation rather than reliable information. The information should be reached within extremely short time. The vehicle should be unmanned in which vehicles can operate itself by receiving information roadside unit, other vehicles, pedestrian etc. The use cases of this applications are automatic overtake, cooperative collision avoidance, high density platooning etc.

5. Factors for reducing latency and increase in Reliability in 5G

5.1 Time Sensitive Networking (TSN): A set of standards which is developed on the basis of audio video bridging(AVB) is called Time Sensitive Networking(TSN). It will develop Internet of Things and vehicles having high bandwidth, interoperability and low cost. Basically TSN is the IEEE 802.1Q defined standard technology to provide deterministic messaging on standard Ethernet. It can be managed centrally and keep the promise of delivery and minimizing jitter for real time applications. The development of TSN is to enable deterministic communication on standard Ethernet. Time is the primary aspect of TSN. TSN is a technology focussed on time. Transmission of information from one point to another point in a fixed and predictable amount of time is provided by TSN. There are five components in the TSN solutions i.e. TSN flow, End devices, bridges, central network controller (CNC), centralised user configuration (CNC) [20]. The TSN is the renaming of the existing AVB (Audio/Video Bridging) .TSN is the enhancement and improvement of AVB [21]. Occupation of its own bandwidth by each audio/video stream and keeping the transmission of other data streams unaffected is the basic principle of AVB/TSN. The main features of TSN are bandwidth, security, interoperability, low cost, delay and synchronization. The typical applications of TSN are professional audio and video, automotive control, industrial areas etc. For providing a complete real time communication, the development of a TSN standard file by IEEE 802.1 had been created and it can be divided into three basic components i.e time synchronization, scheduling and traffic shaping, stream management and fault tolerance. The guaranteed data delivery in a guaranteed time window is provided by TSN. The guaranteed time window means bounded low latency, low delay variation, extremely low data loss. Various kinds of applications having Quality of Service (QoS) requirements from time and/or mission critical data traffic. Time synchronisation is embedded into the 5G cellular system. The time synchronised components through the Precision Time Protocol are the radio network components. There are four components in URLLC i.e Low Latency, Time Synchronisation, Resource management and Reliability. On the other hand, the four components of TSN are traffic shaping, Time Synchronisation, Resource management and Reliability [21] . The low latency of URLLC is related to traffic shaping of TSN. The features of TSN have a good match with 5G URLLC. Combination and integration of 5G URLLC and TSN takes place. As a result, deterministic connectivity from one end to other end is created.

5.2 Device-to-Device Communication: D2D [22] basically means the direct communication between two devices. Radio signals are transferred from one device to another. Due to facility of direct communication between the devices having no usage of network system, the decrease in latency is achievable. The D2D communication is suitable for vehicle to vehicle (V2V) communication at short distance providing real time messages regarding safety, avoiding collision, automation during overtake. It cannot be used for large distance communication. For maintaining the device to device communication, interference management techniques must be followed.

5.3 CoMP: The potential solution to achieve high reliability is the Coordinated Multi-Point (CoMP). The transmission and reception of CoMP is a key solution which alleviate the inter cell interference present in 4G mobile communication [23]. Large scale multiple inputs, multiple-output (MIMO) system consisting of several distributed antenna groups can be called as the CoMP system. The CoMP techniques can be broadly classified into coordinated scheduling, coordinated beamforming (CS/CB) , JT (Joint Transmission) and transmission point selection. The performance of the CoMP system is dependent upon the feedback quality which includes accuracy and delay. In the CoMP , there are options for spatial diversity, enhanced reliability and capacity. The different CoMP options are present i.e Coherent Joint Transmission with Interference Nulling (CJT-MU), Coherent Joint Transmission without Interference Nulling (CJT-SU) and non coherent joint transmission (NCJT)[23]. The options are transparent to the User Equipment (UE). Due to interference nulling, the scheduling of multiple users on the same time frequency resources is done by CJT-MU. The scheduling of a single user on a given set of time frequency resources is done by CJT-SU. In NCJT, there is no requirement of channel knowledge for precoding and it relies on static precoding matrix such as small delay cyclic delay diversity (SCDD) or precoding cycle. Having similarity in CJTSU, the scheduling of a single user on a given set of time-frequency resources due to the lack of interference are done by NCJT. Large signal to interference plus noise ratio (SINR) gain is provided by CJT-MU and CJT-SU than that of NCJT. The diversity gain CJT-MU is similar to CJT-SU.

5.4 Mobile Edge Computing: The target of Mobile Edge Computing (MEC)[22] is to process the jobs applying the process of computation for the jobs collected from the mobile devices. Installations of the edge computer are being done at the base stations. Edge computers are connected to the cloud directly in wireless mode. User can easily access the data utilizing edge computer without the usage of cloud or data. Due to facility of edge computer, latency for delivery of data from source to destination will be decreased. The functions present in the edge computer are done in a software platform and a new term arises called Software as a Service (SaaS) [22]. The processing of data can be totally fulfilled without depending on various aspects i.e. environmental conditions, launching of software, resource allocation of computer.

5.5 Mobile Caching: The mobile caching system [22] used for delivering the data has the great importance regarding the reduction of latency and the increase in reliability. Installation of the mobile cache system will be done on all base stations. When cache content is delivered by a user, the content is accepted and returned by the base station having no usage of remote server. There are many caching schemes. Among them frequently used information, geo-based caching etc. should be deployed. Downloading of the selected data are done from the remote servers. The cached files are downloaded and uploaded having very low latency. These operations are done in an individual network having no usage of network bandwidth which is delay sensitive. In the real world, applying the process of caching is quite difficult as the size of cache at each base station is not so more but the amount of data is very large.

5.6 Ultra-fast Signal Processing: For decreasing the latency, several new techniques for ultra fast signal processing [22] are utilized. These techniques are utilized not only to reduce the latency but to increase the reliability. For the reduction of the latency, the channel estimation to be proposed and implemented should be improved. Least Square estimation should be utilized for the isolation of Channel State Information (CSI) [22] in which different reference symbols are associated. Here minimum complex two dimensional biharmonic interpolation methods will be deployed to obtain the CSI present in the entire resource block. The resultant graph for this interpolation method is smoother than whatever obtained in other method. Based on the simulation, the reduction of latency following the process of computation by channel estimation is more in comparison to MMSE based method having the bandwidth of 5 MHz having the system throughput. Development of the removal of interference having ultra fast multilayer technologies is needed in which quick MIMO detection is enabled for massive number of transmitting and receiving antennas.

5.7 Short Error Control Codes: When the data rate is less than the Shannon Channel capacity, then the coding method used for decreasing error during transmission is turbo coding and low density parity check (LDPC) [22]. The increase or decrease in latency of the network is according to the size of the data block. It is specific that short code reduces the latencies. In Polyansku-Poor-Verdu (PPV) [22], the length of the block is limited. The problems related to latency, throughput, reliability on Gaussian channels have been solved when new parameter called channel dispersion have been introduced. A new problem arises called capacity loss at limited block lengths. Due to the application of polar codes and LDPC, the block error rates for the PPV bound will be i.e. the error block length ranges from 7 to 10 out of the total block length consisting of several hundred symbols [24]. But still there is one limitation i.e. latency regarding to decoding. The convolution code solves this problem as the fast decoding is provided by it. As a result, the Block Error Rate (BLER) will be 10^{-9}.

5.8 Small Transmission Time Interval (TTI): When the duration of the TTI [25] in 4G LTE will be 1 ms, then the duration of TTI in 5G will be 0.125 ms. In order to decrease the duration of the TTI, the number of OFDM symbols must be decreased or the size of each OFDM symbol for each TTI must be reduced. The size of OFDM symbol will decrease when the subcarrier spacing will increase. There are many slots in 4G LTE. Each slot contains 14 OFDM symbols and the transmission takes place within the TTI. In 4G LTE, the subcarrier spacing is only 15 KHz and the TTI is 1ms.In 5G NR, there are different numerologies, hence the slot lengths are different. The subcarrier spacing is ranging from 15 kHz to 240 kHz [26]. As the subcarrier spacing(SCS) is increased, the TTI will be shortened given in Table 3. The TTI is the inverse of the sub carrier spacing and is expressed by

$$\mathrm{TTI} = 1/\mathrm{SCS}$$

Table 3. Different Numerologies for 5G

μ	Number of slots	Subcarrier Spacing (KHz)	TTI
0	1	15	1 ms
1	2	30	0.5 ms=500 μs
2	4	60	0.25 ms=250 μs
3	8	120	0.125 ms=125 μs
4	16	240	0.0625 ms= 62.5 μs

Other than numerologies, another important term is also present in 5G NR called mini slot. A mini slot [26] can able to reduce TTI. A mini slot contain 2,4 or 7 OFDM symbols and non slot based transmission present in 5G NR. Hence there will be an opportunity for fast transmissions which indicates the transmission having low latency.

5.9 Non-orthogonal multiple access (NOMA): Day by day the number of devices is increasing but the number of resources is not enough. Due to transmission following orthogonal, there will be the resultant of interference among signals. The reliability of the signal will be deteriorated. In order to remove the deterioration due to unreliability, a new technology arises called Non Orthogonal Multiple Access (NOMA) [22]. It is a technique in which the limited numbers of resources are utilized for massive number of devices. The reduction of latency in NOMA is possible because it can able to support large number of users than approaches which is conventional orthogonal based. Interference can be cancelled by using Successive Interference Cancellation (SIC) [25]. As a result, the reliability of the signal can be obtained.

5.10 URLLC and eMBB multiplexing: The partitioning of the resource which may be semi static or static located between URLLC and eMBB [25] can be expressed in latency or reliability. For achieving high reliability in URLLC, there should be requirement of more resources on frequency domain having the allocation in the transmission for uplink. The wideband resources for uplink transmission are used for increasing reliability and reduce reliability. There is a requirement for the preemption of scheduled traffic by scheduling techniques applying intelligences after the arrival of the packet having low latency penetrating into the transmission of the eMBB. Maximizing the outage capacity of URLLC impact the traffic of the eMBB in minimal situation simultaneously. When eMBB and URLLC share the equal radio spectrum, there will be the need of dynamic multiplexing [3] over the bandwidth of the entire system. As a result, the spectral efficiency of both eMBB and URLLC will be maximized. Due to the application of dynamic multiplexing, the capacity of eMBB will jump from 0 to 20.52 Mbps. It can be obtained by the calculation of spectral efficiency on the downlink which is full buffered and its value is 4.18 bps per hertz.

5.11 Multiple Input Multiple Outputs (MIMO): It plays a diversity role regarding the transmission of signals from source to destination. Side by side, the dealings with the effect of fast fading are possible with the help of MIMO [27] antenna system. As a result, the requirements for reliability will be fulfilled. When the number of arrays for the antenna will be larger, then the advanced techniques for interference mitigation will be used for both user and base station. The system is having multi connectivity system. Various techniques such as network-assisted interference cancellation and suppression (NAICS) receivers, minimum mean square error with interference rejection combining (MMSE-IRC) etc are used. The macroscopic diversity is the diversity which includes the duplication of data, transmission and reception of data in a redundant manner from various base stations. It is required for combating the slow fading effects or shadowing and delivering the robustness of mobility during transmission.

5.12 Cognitive Radio (CR): The presence of cognitive radio provides the improvement of spectral efficiency for smart antennas. The CR [28] gives opportunity to avail the congested spectrum present in the cellular network. In the cellular network, specific spectrum is authorized only for licensed users. In many cases, it seems that these spectrums are underused. In this situation, the CR facilitates the secondary users to utilize these spectrums. Determination of the spectrum holes or white spaces which are not used by the primary users is done by the secondary users. The secondary user does not need to interfere with the primary users. The secondary users can able to use these spectrums without having any interference with the primary users. In 5G communication systems, the CR plays an important role to assist Dynamic Spectrum Sharing (DSS) [29] among the 5G network elements. There are massive number of heterogeneous network elements present in the infrastructure of 5G communication system such as sharing of the common spectrum by the frequency bands for both primary and secondary users i.e. Dynamic Spectrum Access (DSA). As a result, the spectrum efficiency of the overall system can be increased. Basically the spectrum sharing involves the utility of the same spectrum by two or many users. The accession of the channel is due to the presence of CR by keeping the policies for the existing spectrum allocation unchanged.

6. Limitations in 5G

When 4G is shifted to 5G, it has been imagined that 5G is more advanced than 4G. Recently it has been analyzed that there are various short comings in 5G technologies. 5G already provide ultra high reliability and reduction of latency in the communication system. But the problem takes place during the transmission of short packet, the process of sensing present in URLLC [17] . As a result, the transmission of services such as Augmented Reality (AR) , Virtual Reality (VR) and Mixed Reality (MR) related to Ultra reliability and low latency is not fulfilled completely. In 5G technologies, several functions such as computation, control, sensing etc. are present but they are not converged. In 6G, these functions will converge. As a the Internet of Things (IoT) will convert to Internet of Everything (IoE).

The protective system present in 5G technologies is not so much reliable. It cannot be applied on very big platforms such as Software Defined Networks (SDN) [30]. The mechanism system for 5G is not enough to make the belief between the controller and the applications for management. Enemies can destroy the software platform i.e. virtual infrastructure manager and insert some false coding to hamper the Network Function Virtualization (NFV) [30]. In 5G, the key driver is URLLC and it is applied only in the edge of the network where there is no real integration throughout the entire network. In 5G technologies, the heterogeneous network is specified but the integration of the network is unavailable. The network integration to three dimensional can be done by the expansion. The expansion is possible in the main network due to the inclusion of aerial and mesh network. The capability of 5G is not enough to protect the environment of the system from various threats and attacks caused by enemies or destructors. Improvement of the future network system should be done when the size of massive nodes are adjusted. In order to design 5G, the frequencies for millimeter wave are ranging from 20 to 100 GHz. It will become impossible for the achievements of high data rate due to the presence of power amplifiers without linearity, weak analog to digital converter, phase noise [31] .Hence in order to achieve high data rate, the next step is to increase the range of frequencies ranging from 100 GHz to few Tera Hertz. The reliability for 5G is limited to 10^{-5}. For full implementation on smart cities, full automation on machines and vehicles, this reliability is not applicable. In order to fulfill the target, increase in specific amount of magnitude is necessary. Hence the reliability should be 10^{-9}.

7. The advent of 6G

The 6G will be launched around 2030. Already scientists or researchers are dedicating and focused towards the development and innovations in 6G wireless communication systems. The 6G will provide high accuracy in phase synchronization. 6G will be far more advanced than 5G. The features of 6G communication system which will be totally in wireless mode include low latency having 10 times less, massive connectivity having 100 times more, high efficiency in cost, spectral and energy, conversion of data rate from Gbps to Tbps, 100% automation due to increase in intelligences, full coverage, accurateness in sub-centimeter geo-location, time synchronization in sub millisecond . The 6G will be human centric rather than data centric, application centric or device centric. The coverage area for 6G wireless communication system includes the network in air, space, ground, sea having full integration. As a result, the global network coverage will be obtained. For obtaining high data rate, all type of spectra such as Microwave, Millimeter wave, Tera Hertz etc are utilized. For activating applications and increasing the facilities for the user, the combination of 6G communication system with Artificial Intelligence (AI) and Machine Learning (ML). As a result, the management of network will be easy and the process of automation can be achieved. The AI has been initiated in 5G network but more and more updated in 6G wireless environment. 5G have three scenarios i.e eMBB, URLLC and mMTC. While shifting from 5G to 6G, there will be the enhancement and extension of these application scenarios. According to [33], eMBB will extend to further enhanced Mobile Broad Band (feMBB), mMTC will convert into ultra massive Machine Type Communication (umMTC) and URLLC will update to enhanced URLLC (eURLLC). A part from these, other application scenarios is Long Distance and High Mobility Communication (LDHMC) and Extreme Low Power Communication (ELPC) given in Figure 5. In [16], there are four application scenarios i.e. uMUB, uHSLLC, uHDD, mMTC given in Figure 6.

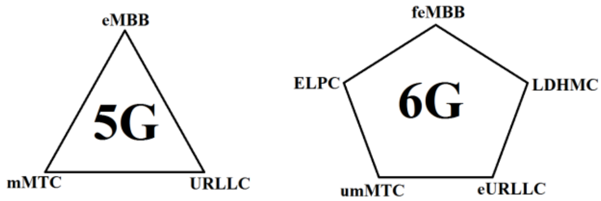

Fig. 5 Application scenarios of 5G and 6G [31]

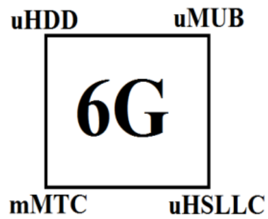

Fig. 6 Application scenarios of 6G [16]

Here Internet of Everything (IoT) will convert into Internet of Everything (IoE) [7]. In IoE, the massive number of devices, objects, sensors, users, procedures, data, and computational components are integrated seamlessly and coordinated autonomously utilizing the infrastructure of the internet. IoE basically means full support of internet will be provided. IoE is improved version of IoT where data, users, physical objects and procedures are integrated in one frame. Various type of networks such as non-terrestrial and terrestrial networks are integrated. The satellite communication is supported by 6G so that the connectivity will be increased and full coverage can be provided. The TeraHertz and Millimeter wave frequencies which belong to ultra high frequencies are utilized. Driverless vehicle having full automation is expected to be launched during the reign of 6G. The term Full in 6G technologies and it will be used in various categories such as full coverage, full spectra, full dimension, full convergence, full photonics, full artificial intelligence, full wireless, full internet etc [17]. The requirement for application scenarios given in [17] are ultra low latency and ultra broad band in a simultaneous chain. The transitions from 5G to 6G increase the better opportunities for the user and there is a conversion from connected things to connected intelligence. The 6G wireless communication system will give rise to smart environment. In the smart environment, there will be the usage of AI based M2M which leads to the improvement in life standard, monitoring of the environment, process of automation etc. In 6G, the extension of the coverage area and the enhancement of the network capacity is possible due to the integration of space, air and terrestrial network. Hence 6G will be helpful in space, air, ground, underwater communication. Extension of the coverage area in wireless mode is possible in large area due to the presence of the communication in satellite, Unmanned Aerial Vehicle (UAV), maritime etc.

8. Reasons for increasing Reliability and reducing Latency in 6G

8.1 Three Dimension (3D) networking: Integration of the ground and the airborne network facilitate users regarding the support for communications. The base stations in 3D [7] are facilitated using low orbit satellites and Unmanned Aerial Vehicles (UAVs). Conversion from 2D to 3D gives rise to the insertion of an extra dimension expressed in terms of degrees of freedom and altitude. The coverage in 3D is availed due to the presence of the heterogeneous network in 6G communication system. Here terrestrial networks , satellite system, UAV network etc are integrated in 6G communication systems to provide whole coverage in which mountains, desert, ocean, remote areas etc. can be accessed.

8.2 Massive MIMO and Intelligent Reflecting Surfaces: The massive MIMO [7] have the important role in 6G wireless communication which can able to support all application scenarios present in 6G communication system. The techniques of MIMO facilitate the improvement of spectral efficiency. Development of MIMO technique provides the development of spectral efficiency. The massive MIMO will be applicable to both 5G and 6G as it provide improved efficiencies both in energy and spectral mode, increase in data rates and efficiencies. The massive MIMO is shifted to IRS [7] which provides big surface area used for wireless communication and heterogeneous devices. The IRS is the new and advanced technology used in hardware mode. It has a meta surface which contain multiple reflecting diodes. The reflection of incident electromagnetic signals having an adjustable phase shift reflecting diodes can be done with the help of reflecting diodes. As a result, the intelligent surfaces are reconfigured and designated as MIMO 2.0 in 6G. Side by side, the integration of index modulation can be done by these materials. As a result, the spectral efficiency is increased in 6G communication system. Increase in reliability is achieved.

8.3 Artificial Intelligence: In 4G, there is no AI [7] . AI is first applied in 5G technology limitedly. AI is the most essential, advanced and new technology for 6G communication system. Intelligence is the fundamental concept in 6G communication system. Here Machine Learning (ML) will be advanced. As a result, creation of smart network is possible used for real time 6G wireless communication. In communication technologies, AI [32] will facilitate the simplification and improvement during the transmission of real time data. Side by side AI also provides the increase in efficiency and decrease the processing time for the communication system. As a result, there is an increase in reliability and decrease in latency. AI also helps to perform few functions such as network selection, handover etc. which will be time consuming. AI will be able to play an important job for device to device and device to user. The wireless environment will convert from “connected things” to “connected intelligence”.

8.4 TeraHertz communication: TeraHertz [34] communication is the key element for 6G. As a result, the data rates having ultra high speed ranging from Gigabit per second (Gbps) to Terabit per second (Tbps) can be achieved. As a result, the latency will be reduced and the reliability will be increased. Side by side, in this communication, high bandwidth is supported which will be used in various applications. The frequency for spectrum band is ranging from 0.1 to 10 TeraHertz and the wavelength is ranging from 0.03 mm to 3 mm. The frequency band for TeraHertz communication lies between infrared band and Millimeter wave band. The THz communication has facility to provide more bandwidth in comparison to Millimeter wave frequency and the propagation condition can be fulfilled. The THz communication is operating at high frequency range and can be utilized for different applications in remote sensing present in 6G network. The applications are ranging macro scale to micro scale.

8.5 Tactile Internet: Tactile Internet [35] is an advanced internet based architecture in which haptic communication can be enabled. In this platform, the real time applications are enabled. The real time applications have the coverage from robotics to haptic communication in which Augmented Reality, Extended Reality, Virtual Reality, Autonomous vehicles, tele-surgery etc. The tactile based network involves the combination of low latency and high reliability. The tactile internet give rise to a virtual world which is equivalent to activities of human having the function of touch sensing, strong interaction seems like interaction in physical mode from anywhere. The touch sensing of the human is integrated with the machines having intelligent system. The facility of touch sensing, strong virtual interaction, sense of feelings, virtual motion etc is available due to the transmission of haptic data. According to [33], tactile Internet architecture have three separate zones i.e. Master zone, Controller zone and Network zone.

8.6 Holographic communication: It is one of the most critical applications present in 6G wireless communication. It is an advanced communication system used both in social and professional purposes. In holographic communication, user will feel the sense of touch by staying at separate locations. The sense of touch is due to the improvement in audio visual communication. Holographic communication basically deals with massive amount of data. The data rate for holographic communications are expressed in Terabits per second (Tb/s) limited to 4 Tb/s and the latency will be ultra low expressed in sub milliseconds. Hence it will become impossible for 5G to undertake holographic communication.

8.7 Full Automation: The process of automation [7] is due to the presence of Artificial Intelligence. The process of automation will totally full in 6G. The process of automation will be applied in devices, systems, control procedure etc. The revolution of Industry 4.0 begins with the advent of 5G which consists of the application of internet, physical system, process of manufacturing etc utilizing the exchange of data and the procedure of automation. The automation systems in 6G have high data rate and low latency used in all application scenarios in 6G. The ultra reliability in 6G wireless communication system is due to the transmission of error free data from transmitter to receiver having no loss of data.

8.8 Analysis of massive data: The analysis of massive data [35] is said to be Big data analytics. It is a complex procedure which includes the analysis of massive amount of different data sets or big data. The sources of massive data where the collection of massive data can be fulfilled are social networks, videos, sensors, images etc. The technology regarding the analysis of massive data is used for managing massive amount of data in 6G. The execution of massive amount of data and its analysis with the tools for deep learning form the environment for 6G wireless communication systems using the process of automation and self optimization. The machine learning is combined with massive data reduce the delay for End to End (E2E) present in 6G system by utilizing predictive analysis.

9. Conclusion

Day to day, the technologies are developing and advantages for the user will be increased. The generation while shifting from 4G to 5G, there are various new technologies which have advanced and exciting features. The 5G wireless communication system already launched globally in 2020 have some important features in which the users are satisfied and impressed. In this paper, we present the features of low latency and high reliability for both 5G and 6G. URLLC is the one of the application scenario which will be utilized in mission critical applications. It will be utilized in vehicles and factories. 5G will not be able to provide all features as per user need such as sense of touch. The process of automation and intelligence are utilized in 5G but the facility of full automation and intelligence will not be fulfill as the requirement of bandwidth, data rate, frequency etc. for full automation is not available. There are various techniques used in 5G for the support of URLLC such as Time Sensitive Networking, device to device, Coordinated Multi Point, Mobile Edge Computer, Mobile Caching etc. Hence there must be the advent of 6G to fulfill the user needs. URLLC in 6G will be far more advanced in comparison to 5G. Researchers and scientists are on phase of study, dedication, and concentration towards the development of 6G wireless communication system. The techniques used in 6G for supporting URLLC are Artificial Intelligence, TeraHertz Communication, 3D networking, Tactile Internet, Full automation etc. By utilizing the parameters for both 5G and 6G, we can able to develop various technologies for both 5G and 6G communication system in future. During COVID 19, pandemic situation occurs, at that time the presence of online system provided by 4G assists the whole world to undergo few applications using internet such as education, marketing, banking etc. There remains few limitations such as factory, vehicles etc. We hope that due to the presence of IoT in 5G, these limitations can be overcome up to an extent. The two new terminals in 5G i.e. mMTC, URLLC can able to provide more facilities to increase the smartness in the society. mMTC can able to convert from factory to smart factory whereas URLLC can able to convert from vehicle to smart vehicle. Hence we say that during pandemic situation, the facility of 5G will facilitate upto an extent. The 6G communication system is far more advanced than 5G. The conversion of IoT to IoE will increase the smartness and as a result, a smart environment will be formed. The process of automation had started at the advent of 5G and there will be the update of full automation during 6G. As result, there will be large facilities available from 2030 to survive the pandemic situation. On the other hand, the parameters for 5G and 6G give a good support during disaster situation. During disaster situation, the mobile tower breaks down due to high speed storm. As a result, the network totally fails and communication with the mobile phones totally stops. In future, the development of 5G and 6G will increase the facility to get rid of the disaster situation. The relay system innovated during 5G will further develop the communication system to be usable in the rural or remote areas. The future systems are expanding with the help of AI in three directions i.e. extension, experience and expansion [36]. The extension denotes the development in rural areas. Towards experience, the physical world will be converging with the digital world towards a Metaverse enabled virtual world with immersive experience Also the 5G-6G will undergo expansion with the addition of new use case of indoor sensing and localization with the use case towards disaster monitoring, control and recovery.

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