- **Guaranteed Bit Rate Bearer (GBR):**

Minimum guaranteed bit rate (GBR) bearers are mainly used for applications such as VoIP and other real time voice calling applications. Each bearer associated with a predetermined GBR QoS parameter value. If the traffic carried by the GBR bearer conforms to the value associated with the GBR bearer, then there is no chance of congestion related packet loss on the service which utilizing the GBR bearer. A Guaranteed Bit Rate (GBR) bearer usually is established "on demand basis" because it blocks all transmission resources by reserving them during an admission control function.

- **Non-Guaranteed Bit Rate Bearer(Non-GBR)**

Non-GBR bearer doesn't guarantee any particular bit rate service. This bearer is mainly used for applications such as web browsing and FTP transfer. A service which utilizing Non-GBR bearer is highly prone to congestion related packet losses. It does not block any specific transmission resources. A non-GBR bearer is established in the default or dedicated bearer and get remain established for a longer period of time.

QoS Parameters:

A bearer has two or four QoS parameter depending on whether it is providing real time or best effort service [11]:

- QoS Class Indicator (QCI)
- Allocation and Retention Priority (ARP)
- Guaranteed Bit Rate (GBR) – real-time services only
- Maximum Bit Rate (MBR) – real-time services only

1. QoS Class Indicator (QCI):

QCI an important QoS parameter which specifies the forwarding treatment to the traffic or the IP packets received on a specific bearer. The forwarding treatment to a specific traffic may include scheduling weights, admission thresholds, queue management thresholds, link-layer protocol configuration, etc.

The 3rd Generation Partnership Project (3GPP) has defined a set of standardized QCI types, which are summarized in Table [9][10][11] listed below:

Table1[9][10][11]: 3GPP Standardized QCI Attributes

QCI	*Bearer Type*	*Priority*	*Packet Delay Ms*	*Packet Error Loss Rate*	*Example of services*
1	GBR	2	100	10^2	Conversational voice(VoIP)
2	GBR	4	150	10^3	Conversational video (live Streaming)
3	GBR	3	50	10^3	Real-time gaming
4	GBR	5	300	10^5	Non-conversation video (Video streaming)
5	Non-GBR	1	100	10^3	IMS signalling
6	Non-GBR	6	300	10^5	Video (Buffered streaming) TCP-based (e.g., www, Email, chat, FTP P2P files sharing, prog. Video, etc.)
7	Non-GBR	7	100	10^5	Voice, video (live streaming), interactive gaming
8	Non-GBR	8	300	10^3	Video (buffered streaming) TCP-based (e.g., www, email, chat, FTP P2P file sharing, progressive video, etc.)
9	Non-GBR	9	300	10^5	Video (buffered streaming) TCP-based (e.g., www, email, chat, FTP P2P file sharing, progressive video, etc.)

2. Allocation and Retention Priority (ARP):

This priority parameter is mainly used to indicate the priority of allocation and retention of service data flow. The ARP indicates whether a bearer establishment/modification request can be accepted or rejected in case of conflicts in demand for network resources or during network congestion. ARP can be used by the eNodeB in order to drop a flow which having a low ARP in order to free up the network capacity. ARP can become an important parameter in case of handover when a mobile user moves to a highly congested cell.

3. Maximum bit rate (MBR):

Maximum bit rate is specified for GBR bearers and is applicable only for real-time services. MBR specifies the maximum bit rate that traffic on bearer can't exceed.

4. Guaranteed bit rate (GBR):

Guaranteed bit rate is mainly defined for GBR bearer only. It mainly specifies the bit rate that a network guarantees for a particular bearer. In 3GPP Release 8 and beyond, the MBR must be set equal to the GBR, which means that the guaranteed rate is also the maximum bit rate that is allowed by the system.

In addition to all above four parameters, 3GPP also add a new parameter called the aggregate maximum bit rate **(AMBR)** parameter which is applied only on a group of non-GBR bearers. AMBR enables operators to limit the total amount of bit rate consumed by a single subscriber. This AMBR parameter is enforced both in uplink and downlink direction [9][11][13].

QoS Provisioning Mechanism:

There are various types of QoS based mechanism. These are discussed below [6]:

Scheduling:

Scheduling mainly refers to the process of dividing and allocating resources such as available bandwidth, delay etc. among the users that are involved in data transmission process. Various scheduling algorithms are used for providing better QoS. All these scheduling algorithms aim at providing better performance in terms of throughput, link utilization, fairness and complexity. In LTE, OFDMA is

used for downlink (DL) transmission and SC-FDMA mainly used for uplink (UL) transmission. These two scheduling method take having main focus on power consumption issue of mobile terminal. A better scheduling algorithm must be chosen in order to support better QoS in network.

Inter-Cell Mitigation
In LTE network, inter-cell interference may limit the performance of system in terms of spectral efficiency and data rates, especially at cell edges. Various Inter-cell mitigation techniques are used in LTE and categorized as:

- Interference cancellation by receiver processing
- interference randomization by frequency hopping using scrambling sequence
- Interference co-ordination through resource usage restriction.

Different approaches mainly formulate the ICIC (Inter-cell Interference Co-ordination) problem. This is also an important QoS mechanism.

Uplink Power Control:
Power control mechanism mainly refers to the process of setting up the power levels with the goal keeping in mind such as improving system capacity, coverage, data rates and reduction in power consumption. As for uplink transmission SC-FDMA is mainly used but it may be susceptible to some problem. So a better uplink power control mechanism may improve QoS of system or a network.

Rate Policing:
In LTE network system a better rate policing mechanism must be required both for uplink and downlink transmission**.** Rate policing mechanism mainly applied on each bearer. In LTE upper limit for GBR (Guaranteed Bit Rate) bearer is provided by MBR (Maximum Bit Rate) and for a group of non-GBR bearer is provided by AMBR (Aggregate Maximum Bit Rate). A better rate policing mechanism must be required for better QoS.

Pre-emption Handling for Radio Resource Allocation:
A pre-emption handling mechanism plays a vital role in QoS provisioning in wireless network, in case of congestion due to network overload. Based on QoS attributes and priority associated with each attribute, these pre-emption mechanisms, allow the higher priority process to pre-empt resources from low priority process. A better pre-emption handling mechanism must be required.

2. Conclusion

The 3rd Generation partnership Project (3GPP) LTE is a future oriented radio access system which is mainly designed in order to support the huge traffic demand of user which vary both in magnitude and variety. Future end users may require high speed internet, Mobile TV, Online gaming, video calling etc. The 3GPP Release 8 gave a flat Architecture of LTE which includes E-UTRAN and EPC. LTE come into existence with features such as High data rate, improved latency, High coverage area, High spectral efficiency, Low cost and simplified structure .LTE based on OFDMA, SC-FDMA and MIMO technologies. In LTE QoS is provided through bearer. A QoS bearer mechanism must be provided with different QCI. Different QoS provisioning mechanism such as scheduling, inter-cell mitigation, rate policing mechanism and rate control etc. QoS also provide future work related to its QoS supporting mechanism. By selecting anyone and finding its related problem and then find solution is a better future related work.

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