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Survey on Low Latency for 3gpp Lte

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Abstract: **The rapidly increasing number of mobile devices, capacious data, and higher data rate are pushing to rethink the current generation of the cellular mobile communication. The next or fifth generation (5G) of the cellular networks is expected to meet the requirements. Pervasive connectivity, low latency and very high data transfer are the unique features of 5G networks. Long Term Evolution is a standard for high-speed wireless communication for mobile phones and data terminals, based on the GSM/EDGE and UMTS/HSPA technologies. It increases the capacity and speed using a different radio interface together with core network improvements. LTE is the upgrade path for carriers with both GSM/UMTS networks and CDMA2000 networks. The different LTE frequencies and bands used in different countries mean that only multi-band phones are able to use LTE in all countries where it is supported. LTE is commonly marketed as 4G LTE, but it does not meet the technical criteria of a 4G wireless service, as specified in the 3GPP Release 8 and 9 document series, for LTE Advanced.**

***Keywords*: CDMA2000, GSM/EDGE, UMTS/HSPA**

I. INTRODUCTION

LTE stands for Long Term Evolution and it was started as a project in 2004 by telecommunication body known as the Third Generation Partnership Project (3GPP). LTE evolved from an earlier

3GPP system known as the Universal Mobile Telecommunication System (UMTS), which in turn evolved from the Global System for Mobile Communications (GSM). First version of LTE was documented in Release 8 of the 3GPP specifications. A rapid increase of mobile data usage and emergence of new applications such as MMOG (Multimedia Online Gaming), mobile TV, Web 2.0, streaming contents have motivated the

3rd Generation Partnership Project (3GPP) to work on the Long-Term Evolution (LTE) on the way towards fourth-generation mobile. The main goal of LTE is to provide a high data rate, low latency and packet optimized radio access technology supporting flexible bandwidth deployments. Same time its network architecture has been designed with the goal to support packet-switched traffic with seamless mobility and great quality of service.

II. LITERATURE SURVEY

Yeon-Jin-Kim[1] proposed a low latency IFFT architecture for 3rd Generation Partnership Project (3GPP) and he explained by reordering the input IFFT data how latency can be reduced. His simulation results shows that latency for 2048- point IFFT is reduced about 42% compared with conventional architecture.

An Li, Robert G. Maunder[2] proposed a fixed-point version of the LTE FPTD algorithm of. They proposed floating-point fully parallel turbo decoder (FPTD) algorithm, which eliminates the serial data dependence, allowing parallel processing and hence significantly reducing the number of clock cycles required. They have used the design flow of Figure1 to propose a novel VLSI implementation of the LTE FPTD, which strikes an attractive trade-off between throughput, latency, and core area and energy consumption. Sun Xiaotong,, Hao Nan, Zheng Naizheng [3] explains by Shortening TTI by reducing subframe length along with backward compatibility design we can achieve significant latency gains for LTE systems. Yousun Hwang[4] proposed a slot TTI(Transmission Time Interval) based radio resource management of LTE. His paper shows latency reduction by slotted TTI and ePDCCH in LTE-A system.

III. LATENCY IN LTE SYSTEM

The time from a user sending a piece of data required download or a webpage to load, to the time when the user gets a response is known as latency, which is sometimes more important than the bit rate offered. The latency can be measured by the time it takes for a small IP packet to travel from the terminal through the network to the internet server, and back. That measure is called round trip time and is illustrated in Figure 1.

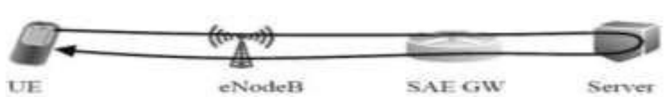

Figure 1. Round trip time measurement

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System latency is more important than the actual peak data rates for many IP based applications. Users are more dependent on applications that is reliable on low latency such as Games, VOIP, Mail & file Sync, Application sharing, Video & voice conference over IP. Latency improvements in LTE can be done by System Architecture, Control plan, User Plane.

A. System Architecture Evolution (SAE)

LTE was designed with less NE, By integrating the Radio Network controller functionality in NodeB/eNodebit enables data traffic to by-pass the RNC and SGSN and network elements to connect the Radio Access Network (RAN) to the core packet network directly. The RTT will improve because there is no Iub related transport set-up delay. The transport connections on all the time and the IP packets are sent immediately.

B. User Plane Latency:

The latency can be measured by the time it takes for a small IP packet to travel from the terminal through the network to the internet server, and back. That measure is called round trip time. (LTE for UMTS) U-Plane latency is defined as one-way transmit time between a packet being available at the IP layer in the UE/E-UTRAN (Evolved UMTS Terrestrial Radio Access Network) edge node and the availability of this packet at the IP layer in the EUTRAN/UE node. U-Plane latency is relevant for the performance of many applications.

C. Control Plane Latency:

Control plane deals with signaling and control functions, while user plane deals with actual user data transmission. C-Plane latency is measured as the time required for the UE (User Equipment) to transit from idle state to active state. In idle state, the UE does not have an RRC connection. Once the RRC is setup, the UE transitions to connected state and then to the active state when it enters the dedicated mode. Latency measurements are done in all phases of the lifetime of a radio access network system. LTE was designed with intention of low latency keeping in mind from the beginning, and as a result today LTE does indeed have better packet data latency than previous generations of the 3GPP RATs. Also, by a wide range of end-users LTE is now recognized to be a system that provides faster access to internet and lower data latencies than previous generations of mobile radio technologies. Since the introduction of LTE in 2009, several improvements had been made, however, mainly targeting the increase of the maximum data rates of the system, e.g. Carrier Aggregation, 8×8 MIMO, etc. To get full benefit of these data rate enhancements; we strongly believe that continuous enhancements of the latency of LTE should also be an important part of the future evolution track of LTE. Packet data latency is a parameter that indirectly influences the perceived data rate of the system. HTTP/TCP is the dominating application and transport layer protocol suite used on the internet today. According to HTTP Archive (http://httparchive.org/trends.php), the typical size of HTTP based transactions over the internet are in the range of a few 10's of Kbytes up to 1 Mbyte. In this size range, the TCP slow start period is a significant part of the total transport period of the packet stream.

During TCP slow start, TCP exponentially increases its congestion window, i.e. the number of segments it brings into flight, until it fully utilizes the throughput LTE can offer. The incremental increases are based on TCP ACKs which are received after one round trip delay in the LTE system. Thus, as it turns out, and is shown below, during TCP slow start the performance is latency limited also in LTE. Hence, improved latency in LTE can improve the perceived data rate for TCP based data transactions, which in its turn reduces the time it takes to complete a data down- or upload. The different areas that can be addressed for LTE latency reductions is shown in figure2. The main areas are:

- the uplink access procedure that starts with the need for a UE to request the permission of the base station to send (i.e. the Scheduling Request (SR) procedure),
- the standardized processing times in LTE that stipulate that for instance retransmissions of data will (at least) take 8 ms
- the current transmission time interval (TTI) of 1 ms

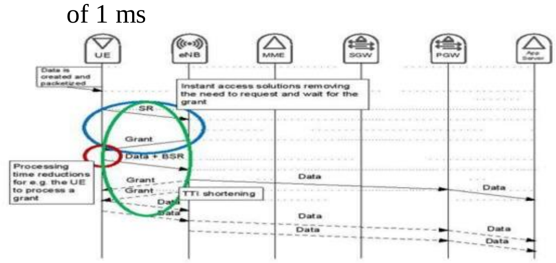

Figure2: Examples of areas that can be addressed for LTE latency reductions

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Latency improvements may not only turn out to be beneficial for TCP down- and uploads. Another example of a benefit could be that radio resource efficiency could be positively impacted by latency reductions. Lower packet data latency could increase the number of transmissions possible within a certain delay bound; hence higher-rate transmissions could be used for the data transmissions thereby freeing up radio resources and potentially improving the capacity of the system.

IV. CONCLUSION

Next generation, 5G wireless systems will be commercially available around 2020, enabling the communication needs of the Networked Society, providing access to information and sharing of data anywhere, anytime by anyone or anything. 5G wireless access will be realized by the evolution of LTE for existing spectrum in combination with new radio access technologies that primarily target new spectrum.

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