End to End Delay Performance Analysis of Video Conferencing over LTE

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Abstract— *Mental development to use the data, such as multimedia, video and online games led to the development of a technique called LTE long term evolution. The goal of this paper is to analyze the quality of service (QoS) performance and its effects when video is streamed over LTE .Using OPNET (Optimized Network Engineering Tool). the performance can be simulated having Different scenarios for video conferencing . in addition to we also measured the performance of packet End-to-End delay .*

Keywords—LTE, Real time application, Video, GBR, QoS.

I. INTRODUCTION

Long Term Evolution (LTE) It is a system that has been developed due to the high demand for data usage in the mobile devices in terms of the flow of the media, for example, video conferencing, Voip, Internet TV, online games. Long Term Evolution (LTE)[1] is radio access network technology standardized in Third Generation Partnership Project (3GPP)[2] in release 8. the 4G technology come to achieves increasing in data rates and more improved performance. Wireless networks are Gone through three stages ,stage one was involved about voice traffic for voice calling, stage tow was involved about data traffic, third stage Now it is video traffic .Video traffic will be more complex to manage, more efficient way of optimization is desired to get high quality of service. It is a real challenge to do video communication through mobile broadband due to limited bandwidth and high reliability and quality [3].

1.1 Overview of 3GPP LTE

Long Term Evolution (LTE) is The next evolution of the Radio Access Network (RAN) .3GPP developed LTE to support increase data rates and high efficiency, high data rate with high QoS. LTE supports a different range of bandwidth such as 1.4MHz, 3.0MHz, 5MHz, 10MHz, 15MHz and 20MHz bandwidths [12]. OFDMA (Orthogonal Frequency Multiple Access) the Multiple Access techniques used in LTE downlink and uplink, Single Carrier Frequency Division Multiple Access (SC-FDMA)[13].

LTE is developed to give a high data rate and low latency system as shown in Table 1.is expected to support different types of services .UE are expected to be 20MHz For upload and download.

Table.1: LTE performance requirements [12].

Measured	Requirements
Packet data rates	Downlink: 100 Mbps, Uplink: 50 Mbps For 20MHz spectrum
Mobility Supports	Up to 500 km/h but performed for low speeds from 0 to 15 km/h
Control plane latency (Transition time to active state)	Less than 100ms both in idle and active
User plane latency	Less than 5ms
Control plane capability	More than 200 users per cell for 5MHz spec-trum.
Cell size (Coverage)	5-100km with minor degradation following 30km.
Range flexibility	1.4, 3, 5, 10, 15 and 20MHz

Different publisher paper and thesis analyzed and evaluated the QoS over LTE. The authors of [8] described the LTE interface between the base station and user equipment with three downlink video capacities. They described the impact of system outage criteria and quality of video on air interface video capacities. They also discussed the different notes on quality with the consideration of assuming different cost.

In [9] the authors discuss the effects of various QoS , which assume over LTE mixed service performance. In [10] the author discuss scheduling a new algorithm to load RT wireless video on LTE, taking into account delays, have achieved better video quality. The authors in [11] developed an approach it is semi optimal video. In LTE with QoS environment, to generate considerable MPEG-4 and H.264 transmission rates.

This paper analyzes performance of QoS parameter end-to-end delay for video conferencing in LTE network under different network scenarios, using OPNET modeler.

End-to-End (E2E) delay the Time needed to transport the packet from the Source to Destination in the network, measured in seconds. , E2E delay is a main parameter in QoS used to evaluate the performance of networks [15].The end-to-end delay is related to encoding/decoding delay, transmission delay, propagation delay, processing delay and queen delay.

II. METHODOLOGY

We used OPNET Modeler for the simulation analysis. in This part of the paper describes the network model used in this study. we implemented 3 network scenarios . Scenario 1 is modeled as a Low Load Network, Scenario 2 is modeled as a Medium Load Network and Scenario 3 is modeled as a High Load Network.

III. SIMULATOR ENVIRONMENT

The OPNET Modeler used for simulations, it provides closer results to the real environment. The simulation of Video conference application over the LTE Network designed under the following LTE Network parameters.

Table.2: The environment that has the simulation depending upon

Parameter	value
PDCCH	3
Loading Factor (UL)	Default
Loading Factor (DL)	Default
Inactive Bearer Timeout (sec.)	20
Antenna Gain (dBi)	15 dBi
Battery Capacity	Unlimited
Maximum Transmission Power (w)	0.00394
Operating Power	10
PHY Profile	LTE 20 MHz FDD
Receiver Sensitivity (dBm)	-200 dBm
Periodic Configuration Index	40
Subband Report Repetition Count (k)	1
UL SC-FDMA Channel Configuration Base Frequency (GHz)	1920 MHz
Bandwidth (MHz)	20 MHz
Cyclic Prefix Type	Normal (7 Symbols per Slot)
DL SC-FDMA Channel Configuration Base Frequency (GHz)	2100 MHz

IV. SIMULATION

After setting the simulation parameters for the LTE network with Video Application, the screenshots from the OPNET software shows different LTE Network scenarios.

4.1 Scenario 1 (Low Load) Network

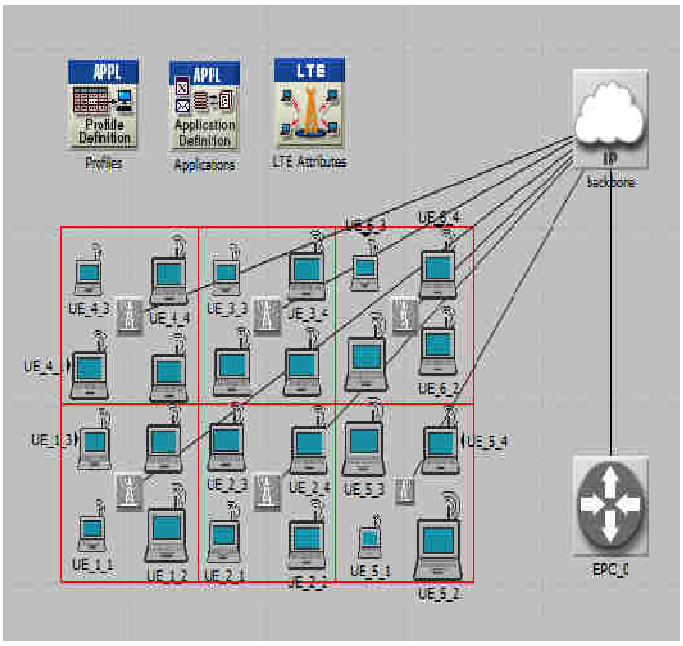

Fig.1: Scenario 1 .

4.2 Scenarios 2/3 (Medium/High Load) Network

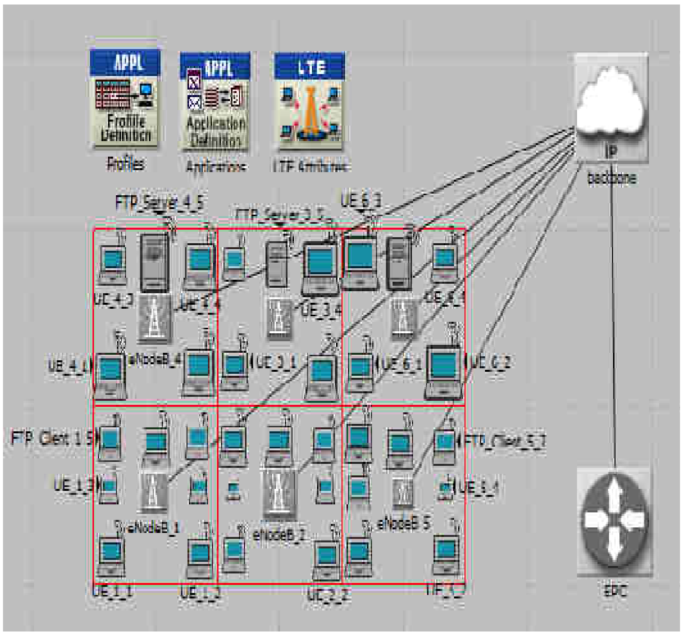

Fig.2: Scenario 2/3.

V. RESULTS

The result of scenario 1(Low Load) , in scenario 1, frame inter-arrival time and frame size for video application are set for Platinum, Gold, Silver and Bronze bearers.

Table.3: E2E delays for Scenario 1(Low Load) Network.

Bearer	Min. (sec.)	Avg. (sec.)	Max. (sec.)	Std. Dev. (sec.)
UE_1_1	0.0210	0.0210	0.0211	1.22E-005
UE_1_2	0.0260	0.0260	0.0261	1.73E-005
UE_1_3	0.0328	0.0329	0.0329	1.42E-005
UE_1_4	0.03990	0.03999	0.03999	1.12E-005

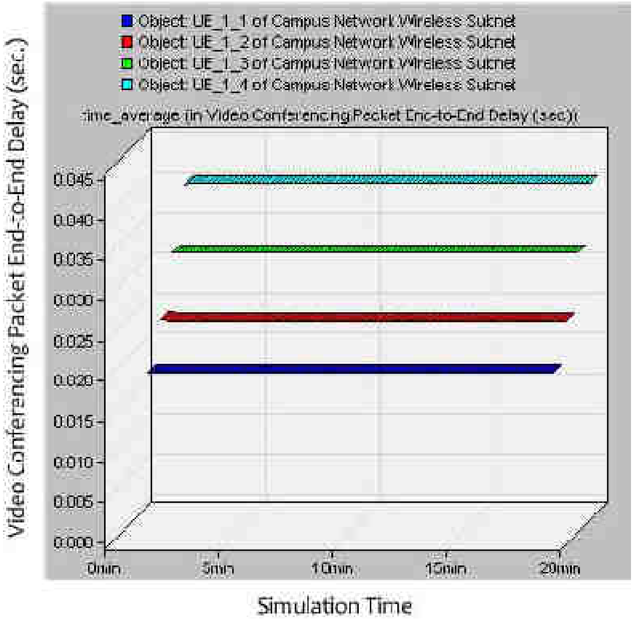

Fig.3: E2E delays for Scenario 1(Low Load) Network

The result of scenario 2 (Medium Load) .

Table.4: E2E delays for Scenario 2(Medium Load) Network.

. Bearer	Min. (sec.)	Avg. (sec.)	Max. (sec.)	Std. Dev. (sec.)
UE_1_1	0.0281	0.0281	0.0288	9.22E-005
UE_1_2	0.040	0.0418	0.0664	0.0031
UE_1_3	0.906	3.150	3.289	0.038
UE_1_4	4.929	39.31	40.681	5.768

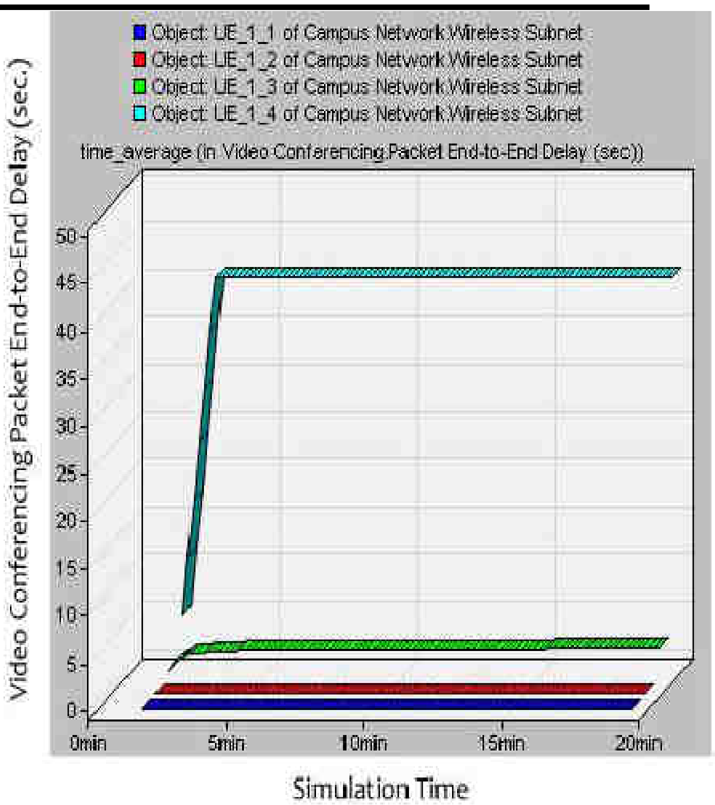

Fig.4: E2E delays for Scenario 2 (Medium Load) Network

The result for high load show in the Figure 5 and Table 5.

Table.5: E2E delays for Scenario 3 (High Load) Network.

Bearer	Min. (sec.)	Avg. (sec.)	Max. (sec.)	Std. Dev. (sec.)
UE_1_1	0.037	0.0371	0.038	0.0002
UE_1_2	0.484	2.490	2.679	0.374
UE_1_3	1.322	2.108	2.117	0.083
UE_1_4	5.551	33.612	34.58	4.428

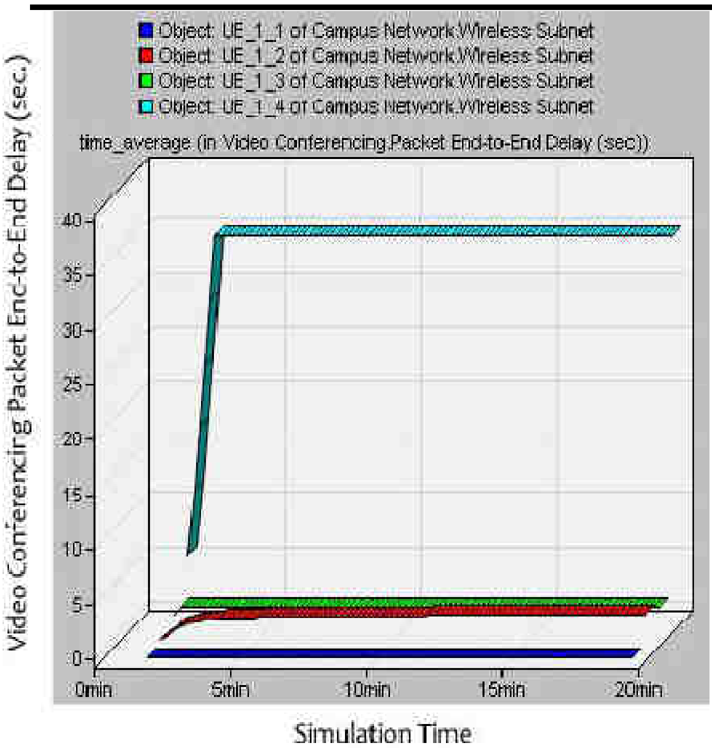

Fig.5: E2E delays for Scenario 3 (High Load) Network

VI. RESULT DISCUSSION

Analysis of end to end delay performance for video conferencing. From the Table (3) and Figure (3) it can be seen that, GBR bearers are able to reduce average delays than NGBR bearers. The delay for GBR and NGBR bearers are acceptable, to achieved QoS goal the end to end delay should be equal or less than 150 ms. The simulation results show that the different levels of end to end delay performance can be achieved by using prioritization associated with LTE QoS.

Table (4) and Figure (4) We can see that tow bearers (Platinum and Gold) are able to reduce average delay, whereas Silver and Bronze are having worst delay performance. From the point of QoS, for Silver and Bronze NGBR the delay is not acceptable. This means that, in order to maintain the quality for an interactive conversational video, the delay should be equal or less than 150ms.

Table (5) and Figure (5) the delay is improved by applying prioritization. For instance, Platinum bearer reduces average delays whereas Gold, Silver and Bronze are having worst delay performance. Delays for these three bearers are not acceptable from QoS point of view. This means that in order to maintain the quality for video conferencing, the delay should be equal or less than 150 ms.

VII. CONCLUSION

In this paper we have investigated the effect of QoS performance for video conferencing in the LTE network with E2E delay, OPNET Modeler has been used to simulate the network, The parameters which was taken in our simulation was shown in table (2).

The simulation result shows that GBR and NGBR bearers have great impact on video conferencing under congested network.

- E2E delay for low load scenario is almost zero for both GBR and NGBR bearers.
- For medium load network, the delay ranges 0.0281~0.041 seconds and 3.150~39 seconds for GBR and NGBR bearers respectively. This indicates that packet partially rejected for NGBR.
- In scenario 3 (High Load) network, only highest priority GBR has tolerable E2E delay of 0.0371 seconds.

We can conclude that, highest priority GBR bearer is getting more opportunity to use available resources in ESP of eNodeB while the network is congested. Compared to GBR bearers' traffic, NGBR are almost rejected.

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