

# Unification of LTE-WIMAX Network for Efficient Services

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**Abstract:** This study has been done to unify two networks Long Term Evolution (LTE) with Wi-Max to enhance the quality of network and to move a stem forward beyond 3G and 4G. The unification is done using OPNET simulator. The simulation study has shown that the proposed network outperform for various parameters like load, throughput and delay. Unification proves to be a better idea to improve network, as network is able to handle more users at same time and fulfill current need. Various devices are deployed in proposed scenarios. In this work, we have discussed three scenarios: Wi-MAX, LTE and Unified Wi-MAX-LTE.

**IndexTerms - Component,formatting,style,styling,insert.**

## I. INTRODUCTION

LTE is an advanced technology of UMTS as well as CDMA. LTE very much important because it provides around 50 times better performance over cellular networks. LTE Project initiate around 2004 by the telecommunication body known as "3GPP (Third generation Partnership Project)".SAE on the other hand mainly working on GPRS/3G network packet core n/w solutions. LTE is generally used to represent both 3GPP and SAE concepts.LTE evolving from the 3GPP systems nowadays known as UMTS, which further evolving from the GSM. The Concepts of LTE, UMTS are also evolved and also related with the concepts like (E-UTRA) and (E-UTRAN) which are specifically for the radio and terrestrial networks.

LTE provides great standards particularly for a high and effective speed network. The biggest challenge which needs to be analyzed is the particular networks bandwidth which needs rapid speed. Spectrum frequency normally counted as big for these types of particular networks because they tend to support quicker data rate and effective voice communication concepts.

**Table 1.1 of LTE comparison with 2G/3G technologies (Tutorials point.com)**

LTE	2G/3G
E-UTRAN	GERAN & UTRAN
S-GW	SGSN
PDN-GW	GGSN
HSS	HLR
MME	VLR
Diameter	SS7-MAP/ANSI-41/RADIUS
GTPc-v2	DiameterGTPc-v0 and v1
PMIP	MIP
It provides 4G networks with around Huge network speed of around 300 mbps with voice, data and video data facilities as well.	On the other hand 2G/3G network nearly about 3 mbps with voice and data services only.

**1.1 WIMAX scenario:** - In this scenario we are using 2 base stations which are further connected to a cloud IP by using 10 Base T connections and in this design we have used 5 mobile devices in each cell. When any mobile subscriber want to register to service he must enter from the authentication Module and all the information regarding client is further maintained to this scenario with the help of packet data. DHCP is used in the entire framework to a lot the network address and to deliver IP configuration parameters so that addresses can effectively allocated to each mobile devices.

**Table 1.2 WIMAX Parameters with their values**

Parameter	Value
Base Station	2
No of cells	2
Mobile Nodes	10
Backbone Cloud IP	1
Authentication Module	Device Defined
Node Connection	10 Base T

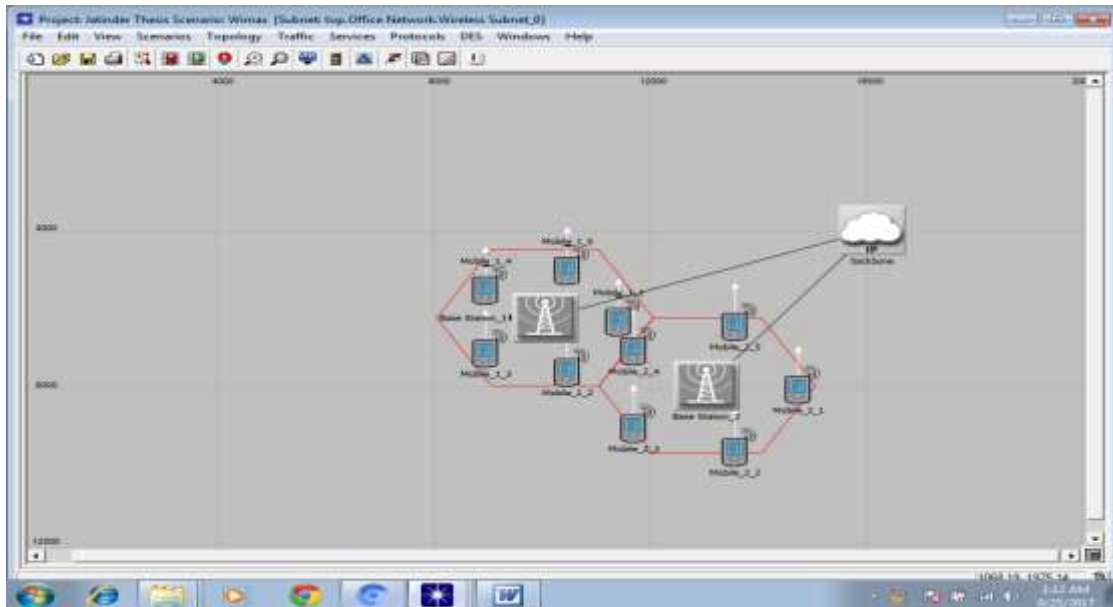
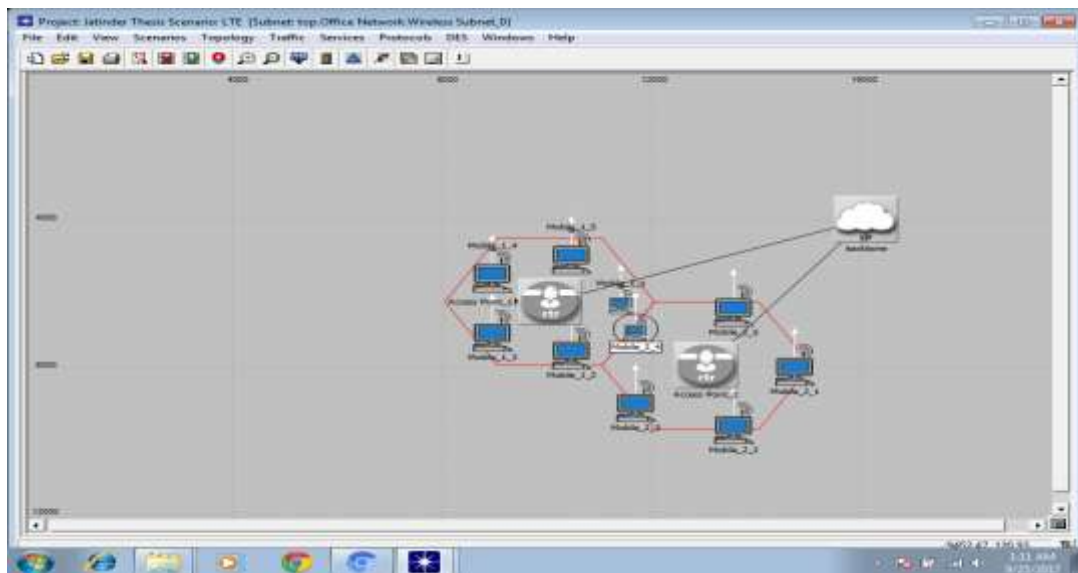


Figure 1.1 WIMAX Design Scenarios (Project Screenshot)

**1.2 LTE:** - In this scenario we are using 2 Routers which are further connected to a cloud IP by using 10 Base T connections and in this design we have also used 5 mobile devices in each cell.



When any mobile subscriber want to register to service he must enter from the authentication Module and all the information regarding client is further maintained to this scenario with the help of packet data. DHCP is used in the entire framework to a lot the network address and to deliver IP configuration parameters so that addresses can effectively allocated to each mobile devices.

### 1.3 LTE Design scenario

**LTE WIMAX:** - In the purposed scenario the WIMAX and the WLAN configuration are tightly completed together, they are connected with a 4G, LTE core with a high-speed network i.e. 10 Base T and in this network we are using DS-3 interface which is a multimedia interface to support high speed packet data and IMS is configured and it is connected to router as well as base station. Whenever a subscriber want to register in the network with the help of IMS core client must activated packet data protocol to enter When WIMAX and LTE network are together unified a user must register in HLR of LTE to save the home location of the client which require a key agreement which is implemented in mobile devices. The DHCP is used to configure IP addresses and client will obtain their addresses which are used for identification purpose.

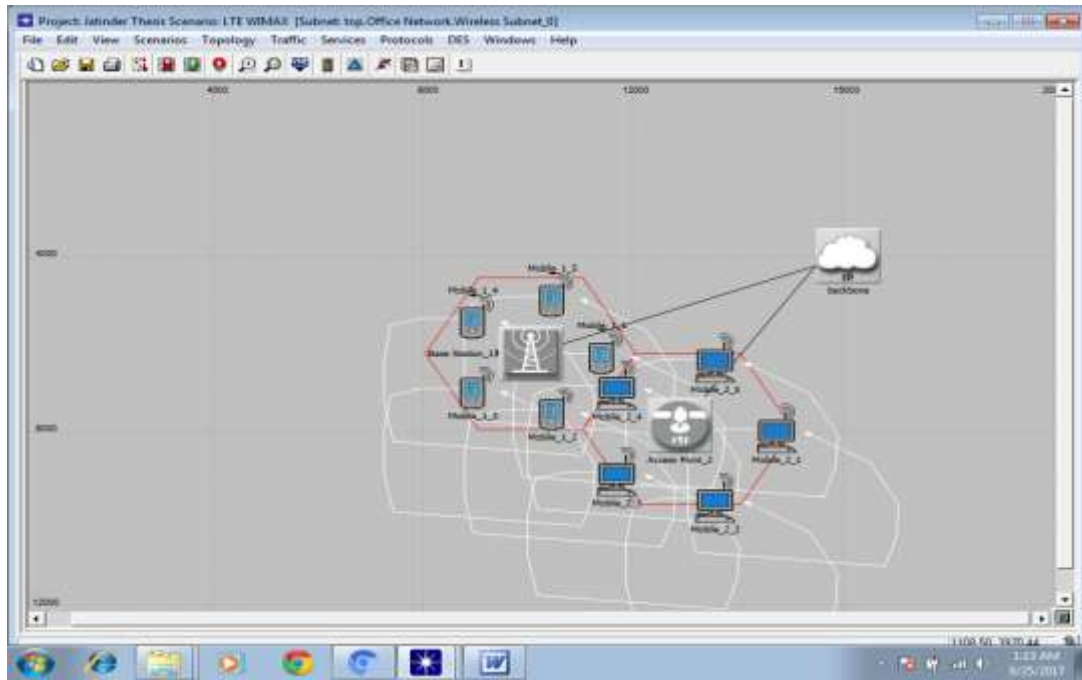


Figure 1.3 LTE-WiMAX unified scenario

**LTE WIMAX unified Large Network:** - In the purposed scenario the WIMAX and the WLAN configuration are tightly completed together, they are connected with a 4G, LTE core with a high-speed network i.e. 10 Base T and in this network we are using DS-3 interface which is a multimedia interface to support high speed packet data and IMS is configured and it is connected to router as well as base station. Whenever a subscriber want to register in the network with the help of IMS core client must activated packet data protocol to enter When WIMAX and LTE network are together unified a user must register in HLR of LTE to save the home location of the client which require a key agreement which is implemented in mobile devices. If mobility devices are used in the network and the data call is not of local Home location then VLR initiated which means Visitor Location Register. Thus scenario design for the protocol is shown in figure 1.3.

**WIMAX network in OPNET Modeller:** The network consists of a single cell-based structure containing one base station for each technology and some mobile users. The base station is then connected to a backbone. Here we are considering the basic data applications using packet data with high-speed streaming. The assumption is that each user has activated packet data, when enter in the network during authentication. As authentication module need packet data for authenticity of mobile node. The different traffic characteristics are defined at the base node as per the different QoS requirements of the traffic. The application is defined in the application definition. The traffic was simulated to be end-to-end between the devices of the two cells In the WIMAX-lte scenario, a wireless station connected with antenna or router sends/receives data with a device in the other cell, but within the same access technology. Both networks were configured in a multiple-input and multiple-output (MIMO) setup with two antennas.

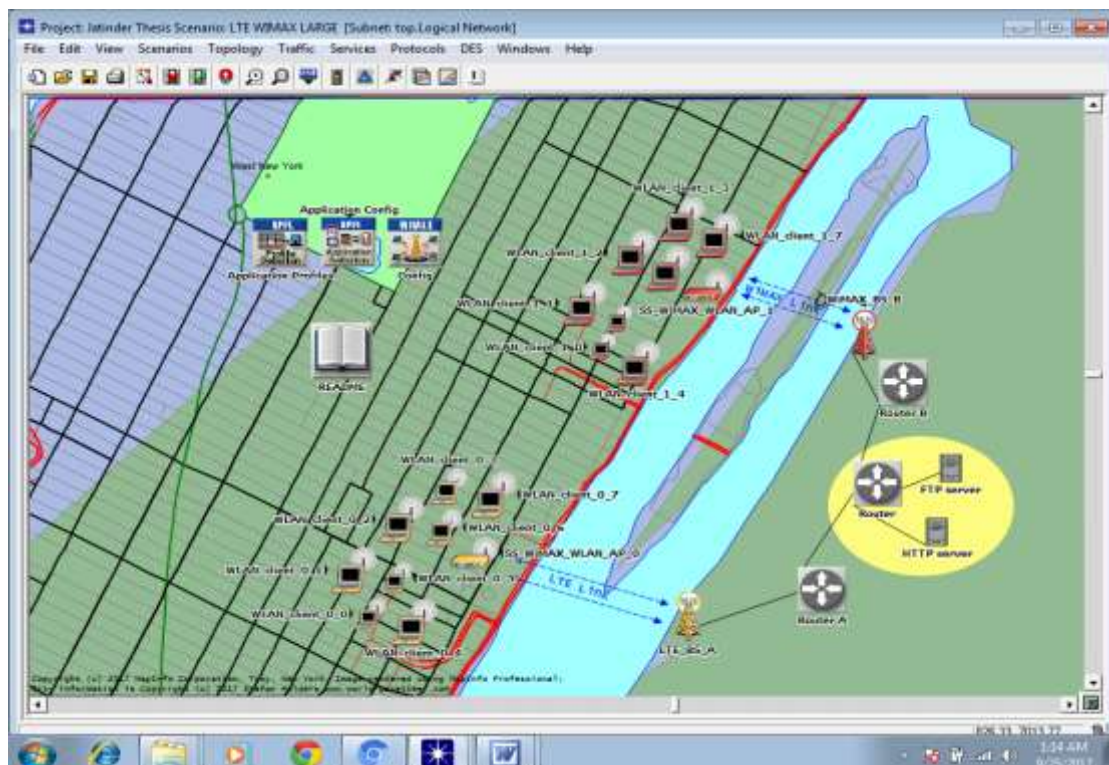


Figure 1.4 LTE-WiMAX Large Network Scenario design.

**Network Description:** - Simulations are performed using OPNET to validate the analytical models. We simulate a simple LTE- The scheduling algorithm was modified in the networks. When we talk about the design scenario's of The WIMAX and the WLAN configuration, they are tightly completed together, they are connected with a 4G, LTE core with a high-speed network i.e. 10 Base T and in this network we are using DS-3 interface which is a multimedia interface to support high speed packet data and IMS is configured and it is connected to router as well as base station. Whenever a subscriber want to register in the network with the help of IMS core client must activated packet data protocol to enter When WIMAX and LTE network are together unified.

## II. LITERATURE REVIEW

**Aldmour et al. [1]** proposed the view points between LTE & WIMAX network technology which further discuss various factors for checking the effectiveness of both the network technologies. "It also emphasis on reviewing the technical points of both the technologies along with the factors that defines the existence of both LTE and WIMAX networks together". The author encouraging regarding the hybrid model of both networks i.e. LTE and WIMAX is very much useful." LTE becoming the upcoming great in telecommunication; field along with LTE, VoLTE (Voice over long term evolution) is also upcoming future technology for many of the major mobile giants. On the other hand WIMAX also had some merits for user like very easy installation as well very easy to set up. WIMAX provides very simpler method for user access and many of the data services.

**Miyim, Ismail, Nordin, & Ismail et al. [2]** proposed to work on an intelligent algorithm for a vertical handover transmission technique for wireless networks. In this paper Author used intelligent algorithms which initially calculate the RSSI value. Comparison done with threshold value based on received signal strength. Based on threshold value the handover mechanism from WIMAX to LTE is taken". The ping pong effect is also eliminated using this scheme. This algorithm is saving time to identify best candidate among and provides good methodology to reduce ping pong effect executed intelligently as per the conditions of network.

**Song & Issac et al. [3]** proposed to aim to explore the coexistence of WI-MAX along with Wi-Fi with help of simulation study. The author used the OPNET simulation tool to carry out this study. The author designs the scenarios to study the coexistence of both networks. Author use the base station and hotspot with defined data rate and routing for QOS. The comparison study is carried for various parameters. The study concludes that WIMAX network had edge over Wi-Fi network, but risk of being acquired is still major concern in WIMAX. The transmission speed and range of WIMAX is quite good in contrast with Wi-Fi. So, incorporation of both technologies together is quite useful for transmission and seamless network.

**Clarke et al. [4]** paper aims to meet the need of existing wireless networks by expanding the networks. Author suggested that the current LTE networks are using spectrum quite well but the expansion in networks are increasing day by day. The future technologies like VOLTE and 4G+ are expanding using concept of frequency reusability. Author use higher order antenna and chipset for transmission. Deployment of expanded spectrum gain the possibility to enhance the seamless experience and the migration of customers for one to other region is handled efficiently with no delay in handoff. LTE and Wi-Fi are integrated on same channel; in this case user is also gaining benefits, and expansion is too possible.

**Fortuna et al. [5]** to propose a flexible and robust network and radio model framework with existing standard technology. The method uses cognitive adaption of radio model. The author implements the model using the APIs that are imported using the concept of embedded programming. This also offers enhanced hardware and software which speed us the transmission and also results in decreasing the overall global cost. The system designed for driving network control interface and configuration. The trade-off between configuration and flexibility requirement is important to identify a suitable abstraction model. In this network architecture to minimize the overhead control signals the centralized network structure is used. The unified model results in reducing delay and enhancing data delivery.

**Polak et al. [6]** to identify the co-existence of DVB-T2 and Long Term Evolution. The vector error magnitude is used as major parameter to check the QOS of the network. The EVM is used as threshold value to check the minimum value of signal quality to accept. The channel fading method is applied. The author explores that low density parity check decoding on modulation error ratio needed for achieving QEF operation. The hybrid model is acceptable in terms of its performance and author suggested to increase the network scalability.

**Ali et al. [7]** proposed to aim on Frequency reusability in Long Term Evolution Network to reduce the Packet Loss. In this paper author use soft frequency reuse technique, where each cell allocated same bandwidth but total SFR is greater than occupied bandwidth. The OPNET is used to carry out simulation study. The network is designed to minimize packet loss and for effective handover delay. The SFR and proposed FR method is combined to prove the significance of proposed work. SFR technique is used by author along with proposed work as it has high capacity which results in reducing packet loss. The new method almost saves 25% of bandwidth. The saved bandwidth also controls the rate of collision and packet loss.

## III. RESULTS AND DISCUSSION

In this chapter we have discussed regarding all the results with different-2 parameters like delay, throughput, load, response time etc. We have discussed and show some pictorial representation of LTE, WIMAX and unified LTE-WIMAX Scenario with the help of various parameters.

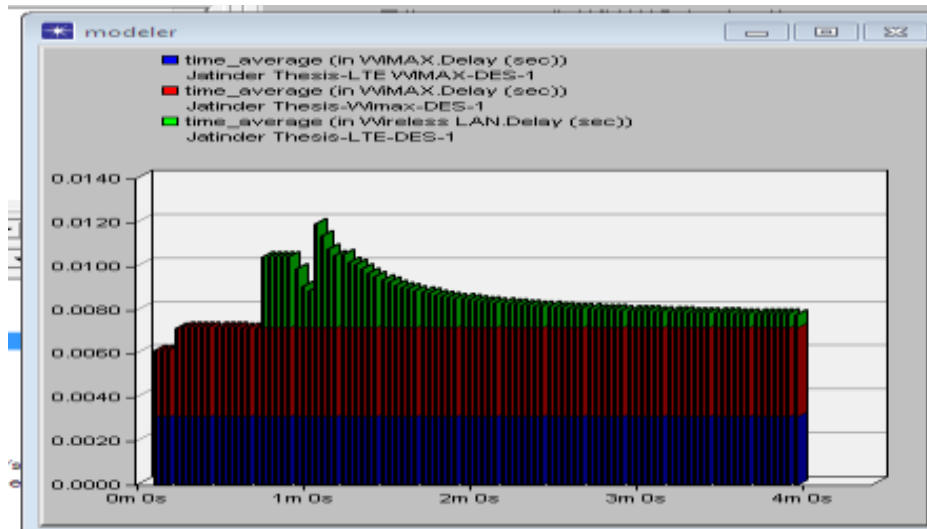


Figure 3.1 Delay LTE, WIMAX and LTE-WIMAX unified

**Delay** is the time taken by a source to send packets to destination node. The graph above represents the delay for LTE, WIMAX and proposed LTE-WIMAX unified scenario. The delay for LTE is clearly represented in a given diagram, which shows that delay is high for LTE although Delay for LTE reduces as the time progress but comparatively to the WIMAX it is still very much higher..On the other hand the delay of WIMAX graph is very less and when we compared to LTE as you can clearly see it far more consistent and lesser whereas proposed LTE-WIMAX shows least delay. The unification combines the functionality of both LTE and WIMAX. The technologies are tightly coupled together and direct connections are made using 10 base T interface.

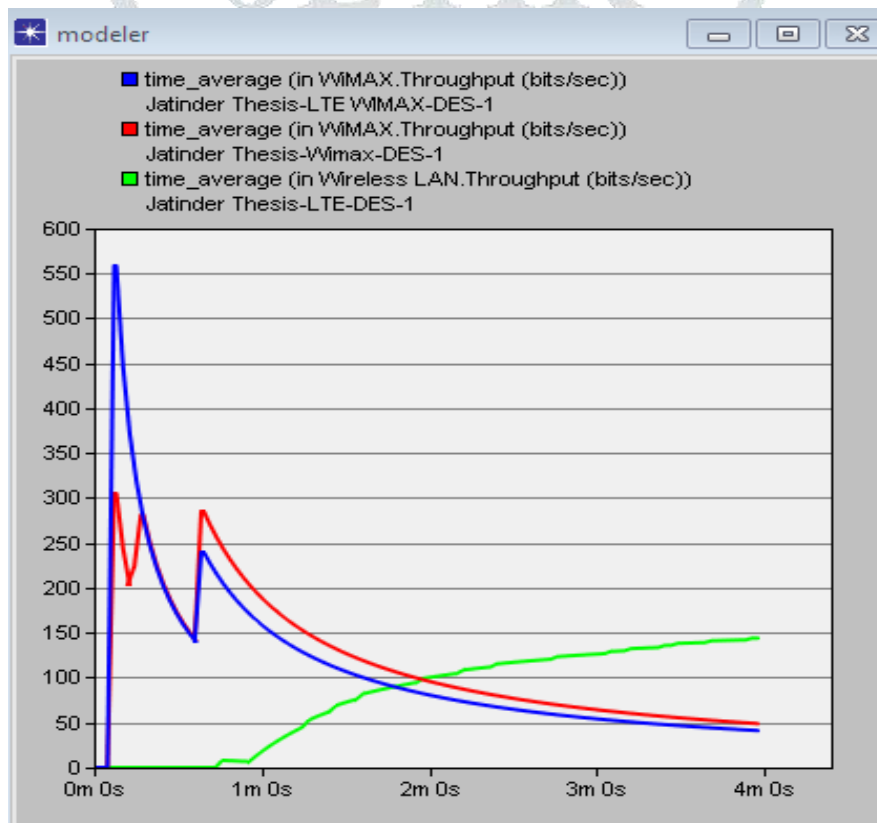


Figure 3.2 Throughput LTE, WIMAX and LTE-WIMAX scenario

**Throughput** is defined as number of requests fulfilled per second. The response time for all the services are depending on speed of the connection. Higher throughput signifies high response rate. The throughput of LTE graph is not as good, but still it shows some upward trend as the time progress, but upward trend can be taken as bit late in most of the cases. On the other hand in WIMAX graph it starts on a great peak but as the time progress it shows some downward trend, which is acceptable and understandable. On the other hand the throughput shown by proposed network is quite acceptable. The proposed network shown high incline at start of network, but as the time progress, the result it follows downward trend. But the performance is still very effective and acceptable.

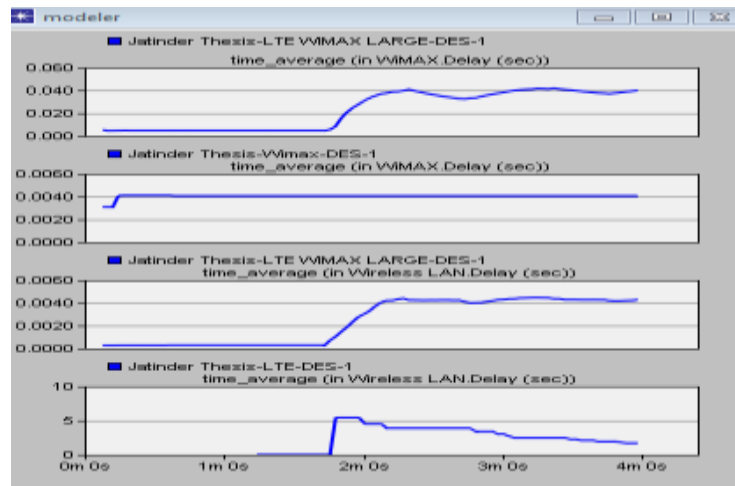


Figure 3.3 Delay LTE, WIMAX and LTE-WIMAX Large network

The graph above represents the delay for LTE, WIMAX and LTE-WIMAX unified large network scenario. In this network we have used 16 mobile station nodes so the delay parameter as compared to purposed LTE-WIMAX unified delay can be vary. So here the delay for LTE is clearly represented in a given diagram, which shows that delay is high for LTE although Delay for LTE reduces as the time progress but comparatively to the WIMAX it is still very much higher. On the other hand the delay of WIMAX graph is very less and when we compared to LTE as you can clearly see it far more consistent and lesser. When we compared to LTE-WIMAX large unified network graph then this is quite visible that delay is not higher if we combined both network technologies together with 16 mobile nodes as compared to 10 mobile nodes in both the previous scenario graphs.

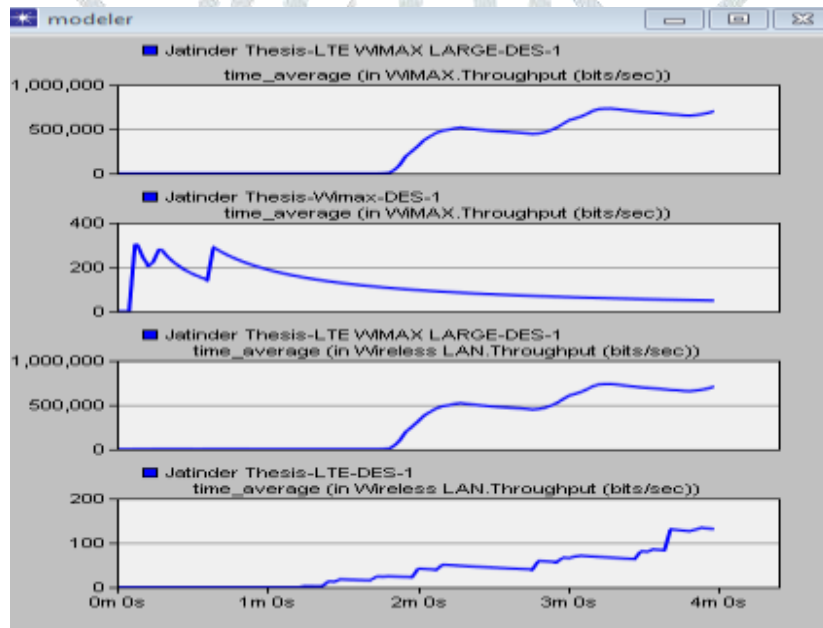
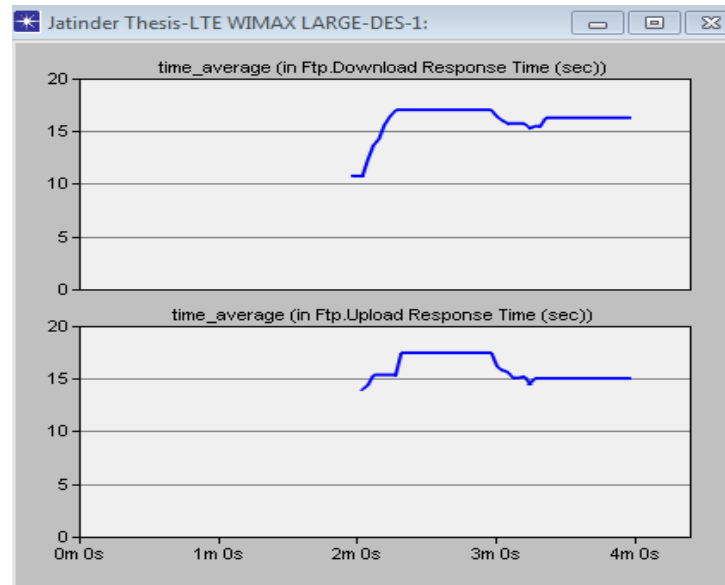


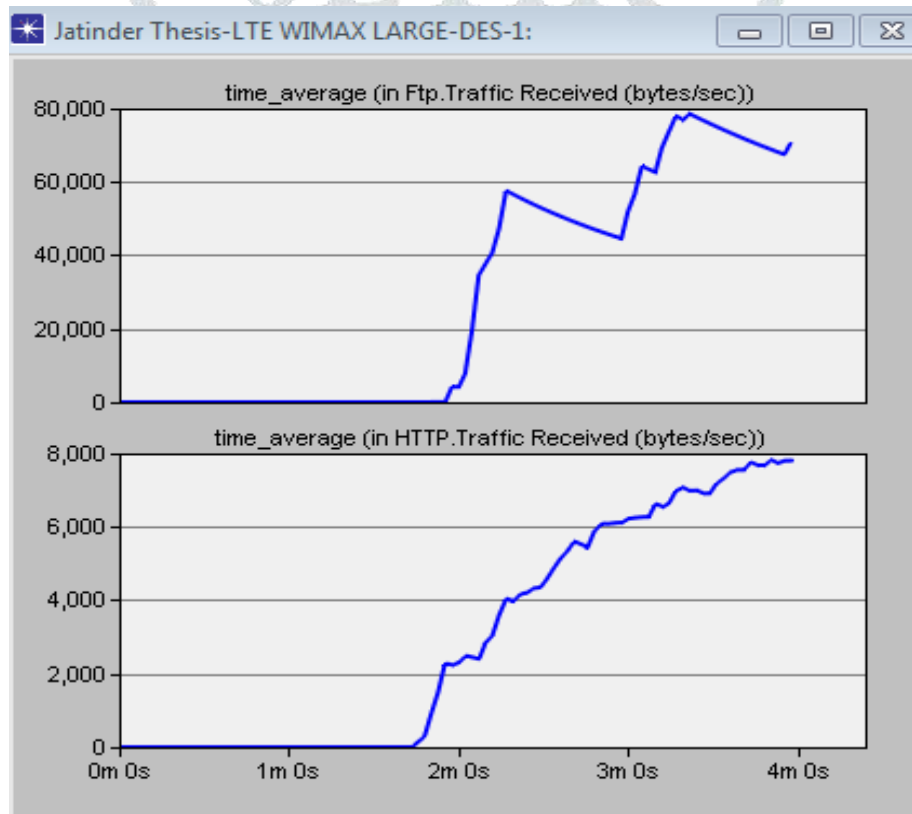
Figure 3.4 Throughputs LTE, WIMAX and LTE-WIMAX

The response time for all the services are depending on speed of the connection. Higher throughput signifies high response rate. The throughput of LTE graph is not as good, but still it shows some upward trend as the time progress, but upward trend can be taken as bit late in most of the cases. On the other hand in WIMAX graph it starts on a great peak but as the time progress it shows some downward trend, which is acceptable and understandable. The throughput of LTE-WIMAX large unified network show bit slower start but as the time progress it show great upward trend which is very effective and acceptable, so if combined more number of mobile nodes in this network then the throughput still be very effective and very encouraging for the future perspective.



**Figure 3.5 FTP Response Time**

The graph represents the upload and downloads response time for FTP. File transfer protocol provide the way to access application for upload file for request. The upload speed is quite desirable then download speed, as FTP deals with uploading of files. The designed network shows higher upload response time than download, and also both upload and download graphs shows consistency as the time progress so as the result we can see the unification can enhance the network performance.



**Figure 3.6 LTE WIMAX large network received Ftp-Http traffic scenario**

This scenario displaying the LTE WIMAX large network unification HTTP and FTP traffic result while receiving the packets by bytes per sec. As the result is very much obvious that traffic received capability of FTP is very much higher as compared to HTTP. So the unification can further more enhance the performance in terms of traffic handling concepts perspective.

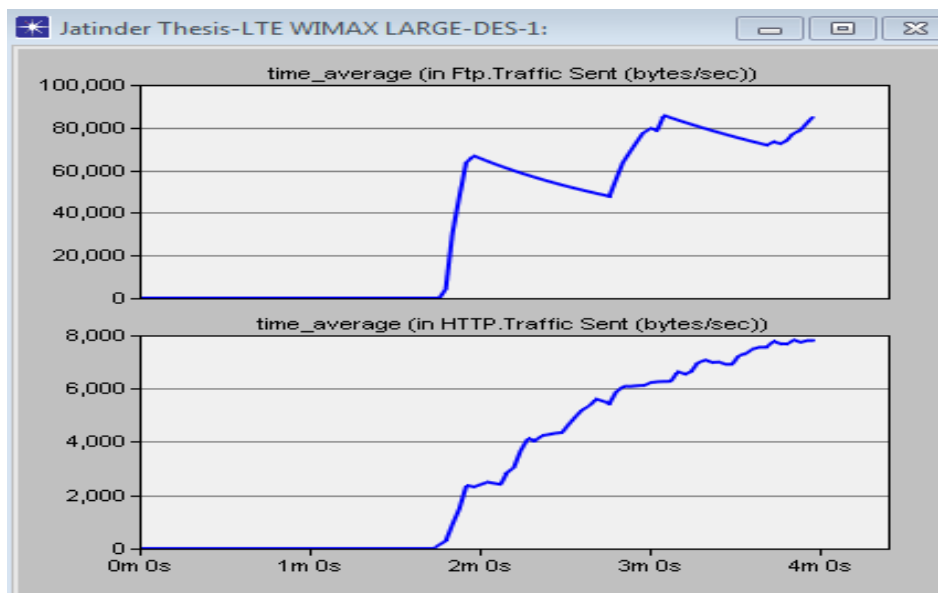


Figure 3.7 LTE WIMAX large network Sent Http traffic scenario

This scenario displaying the LTE WIMAX large network unification HTTP and FTP traffic result while sending the packets by bytes per sec. Again much like the traffic received graph comparison of FTP and HTTP is very obvious that FTP can handle the traffic in terms of sending the packets onto the network is very much higher as compared to HTTP capability. So furthermore unification of both can suddenly enhance the performance.

#### IV. CONCLUSION

In this work, a tightly coupled architecture for integration of LTE/WIMAX is proposed. The network is proposed for handling next generation data traffic where LTE/WIMAX are unified using IP multimedia subsystem (IMS). The significance of proposed work lies in the term that an attempt has been made to upgrade the network from UMTS to LTE by coupling both the proposed architectures together. The proposed network is a heterogeneous network composed of various devices like cloud IP, base station, router, mobile devices etc. In proposed work, we use least number of additional supportive devices to minimize the network cost. Implementation work is carried out using opnet modular 14.5. The proposed network shows the improved results for delay, throughput and traffic received, sent as IMS registration require PDP (Packet data traffic). Thus, in this work the data services are extended beyond 3G which offer user various network seamless high quality services like video chat, file transfer or any multimedia service. The controlled authorization and factors like mobility and handover are also taken under consideration while scenario designing. Therefore, the unification of both the technologies shows effective results which are quite acceptable and utilized the network in a better manner.

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