COMPARISON BASED ON VARIOUS PERFORMANCE PARAMETERS BETWEEN WIMAX AND LTE USING NS2

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Abstract: In telecommunications, 4G is the fourth generation of cell phone mobile communications standards. There are many features associated with 4G, which make it promising. On the other hand, new applications required to be supported by new mobile systems include a variety; VoIP, video conference, multimedia messaging, multiplayer games, virtual private networks (VPN), etc. All these applications require higher throughput, wider BW, smaller delay and innovative transmission methods that will give higher spectral efficiency and good quality. Two leading emerging technologies are: LTE (Long Term Evolution standardized by third generation partnership project (3GPP) and WiMAX (the IEEE802.16e, the worldwide interoperability for microwave access) are considered able to fulfil the 4G requirements announced by ITU-R which is known as International Mobile Telecommunications Advanced (IMT-Advanced) In this project we will attempt to perform the system-level simulation of these technologies (and also simulate at the link level wherever necessary) and compare them on certain performance parameters by developing comparable 7-cell scenarios for both LTE and WiMAX. Actually, two types of simulations are possible-one on link-level and the other on system level. Merging both increases computing complexity. Therefore we go for certain abstractions and instead focus on system level simulation.

Keywords: LTE (Long Term Evolution), WiMAX (Worldwide Interoperability for Microwave Access), Technologies.

I. INTRODUCTION

In telecommunications, 4G is the fourth generation of cell phone mobile communications standards. There are many features associated with 4G, which make it promising. On the other hand, New applications required to be supported by new mobile systems include a variety; VoIP, video conference, multimedia messaging, multi-player games, virtual private networks (VPN), etc. All these applications require higher throughput, wider BW, smaller delay and innovative transmission methods that will give higher spectral efficiency and good quality. Two leading emerging technologies are: LTE[1][4] (Long Term Evolution standardized by third generation partnership project (3GPP) and WiMAX[1][3] (the IEEE802.16e,the worldwide interoperability for microwave access) are considered able to fulfill the 4G requirements announced by ITU-R which is known as International Mobile Telecommunications Advanced (IMT-Advanced).Future scope of both these technologies is enormous. Also, both the technologies have their own advantages and disadvantages. In future, a network may be possible which combines the advantages of both these technologies.

II. WiMAX---INTRODUCTION

WiMAX [3] is a technology to provide wireless broadband access in multiple deployment scenarios. The standardization entity of this technology is the IEEE (Institute of Electrical and Electronics Engineers) lead by the 802.16 working group. In2002 this group developed a line-of-sight operation standard, which used frequencies in the range of 11-66 GHz. Then in 2004 the IEEE 802.16-2004 (also 802.16dor Fixed WiMAX) standard was released, which offered point-to-point and point-to-multi-point operations. At the end of 2005 another standard (802.16-2005 or802.16e) was approved which provided services to mobile terminals. This standard is well known as Mobile WiMAX. Lately, IEEE 802.16m, standardized in March, 2011, was considered for WiMAX Release 2.0. Release 2.0 offers many folds higher data rates than Release 1.0 and was lately officially recognized as 4G in 2012.

III. LTE--- INTRODUCTION

The work on 3GPP LTE [4] Release 8 started in 2004. The development of LTE was driven by certain aspects. First, the wire line data networks improved and higher data rates were possible. This lead to new applications and services which are often referred to as the \Web 2.0.Second, to cover the mentioned tremendous growth of mobile subscribers new technologies that are specifically designed for higher capacities are needed. In addition, competing standards, for instance WiMAX (IEEE802.16), were under development and the 3GPP was challenged by this competition. Furthermore, the drop of prices for data delivery made it essential for the telecommunication companies (as key partners of 3GPP) to have competing and efficient telecommunication network architecture. With the LTE technology the mobile network operators are not required to maintain an additional complex circuit-switched domain. LTE networks are superior to 3G/HSPA in terms of control plane scalability.

IV. LIMITATIONS Of WiMAX & LTE —[2]

Operating area is the major limitation. Existing wireless networks do not serve rural areas and many buildings in metropolitan areas efficiently. This limitation of today's networks will carry over into future generations of wireless systems. Moreover new cell towers and cell components are required due to use new frequencies. Some other limitations are such as battery life is degraded considerably, it is hard to implement, and it needs complicated hardware. Another disadvantage is that there is a need to design new devices

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which can support the use of 4G technology. Hence consumer is forced to buy a new device to support the 4G services.

V. SIMULATION SOFTWARE: NS2

Many network simulation softwares are available in market. Some of the leading network simulators are Qualnet, Ns-2, JiST/SWANS, Opnet, Omnett, Netsim REAL, SSFNet, J-Simetc. Here we present a quick comparison of various available network simulation softwares. But we have decided to use NS-2(Network Simulator-2) because of its following features and advantages over other simulators:

- Popular used in academia and industries
- Open Source software
- Provides greater accuracy and speed of testing
- Supports large number of external protocols
- Programming can be done using tclscript and/or C++
- Provided with visualization tools
- Complex scenarios can be easily tested
- More ideas can be tested in a smaller timeframe

Network Simulator version 2 (NS-2) is discrete event packet level simulator. The network simulator covers a very large number of applications of different kind of protocols of different network types consisting of different network elements and traffic models. NS-2 is a package of tools that simulates behavior of networks such as creating network topologies, log events that happen under any load, analyze the events and understand the network.

Platform required to run network Simulator

- Unix and Unix like systems
- Linux'
- Free BSD
- SunOS/Solaris
- Windows 95/98/NT/2000/XP (requires Cygwin)

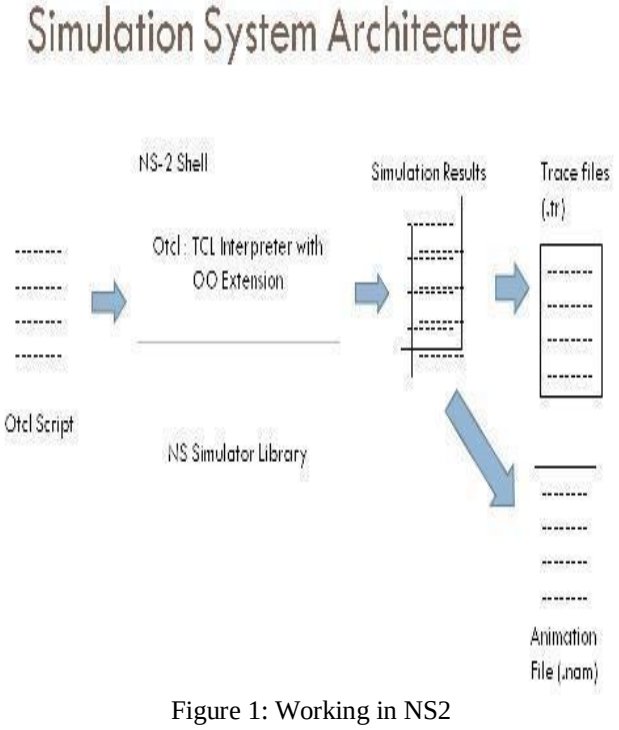

Figure 1: Working in NS2

VI. SIMULATION SETUP

- We have developed 7-cell scenarios for comparison.
- Coverage area of base stations would be 20m in both cases.
- Base station antennas are omni-directional.
- OFDM network interface is used.
- We have worked assuming Two ray propagation model.
- Modulation Scheme chosen for simulation is 64 QAM with FEC correction.
- We have implemented CBR trace with cbr Interval 0.1 seconds and cbr Packet Size of 1000 bytes.
- The agent type would be UDP and the sink type would be Loss Monitor.
- Bandwidth would be 20Mhz for both the scenarios.
- Frame duration in case of WiMAX would be 5ms and in case of LTE, it is
- 10ms but since it is divided into 10 sub frames we will consider the frame rate to be 1ms. Scheduler used is Wimax Scheduler for WiMAX.
- For LTE since there is no such equivalent present in NS2,we chose Wimax Scheduler for LTE also, since it best approximates the process in LTE.
- We have also simulated duplex links of 100Mbps between Correspondence node and Local Mobility Anchor and, Local Mobility Anchor and Router which are parts of PMIPv6.
- The link delays of the two links mentioned are set to be 10ms and 1ms respectively.

VII. PARAMETERS COMPARED

A. Packet delivery ratio:

Packet dropping is where network traffic fails to reach its destination in a timely manner. Most commonly packets get dropped before the destination can be reached PDR = (No. of Packets received / No of Packets sent)*100

B. Jitter:

Jitter is defined as a variation in the delay of received packets. At the sending side, packets are sent in a continuous stream with the packets spaced evenly apart.

Jitter J = (Di+1) - (Di) seconds

where Di+1 is delay of i th +1 packet and Di is the delay of the ith packet.

A low value of jitter is ideal

C. Throughput:

Network throughput is the average rate of successful message delivery over a communication channel. This data may be delivered over a physical or logical link, or pass through a certain network node. The throughput is usually measured in bits per second (bit/s or bps), and sometimes in data packets per second or data packets per time slot.

Throughput T =No.of bytes*8/(Finish time-Start time) bps

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D. Delay:

Delay refers to the amount of time it takes for a bit to be transmitted from source to destination. It can take a long time for a packet to be delivered across intervening networks. In reliable protocols where a receiver acknowledges delivery of each chunk of data, it is possible to measure this as round-trip time. One way to view latency is how long a system holds on to a packet. That system may be a single device like a router, or a complete communication system including routers and links. Delay of packets in the network can be measured through the trace file obtained after the execution of code.

End to end delay D = (Td - Ts) seconds where Td is the packet receive time at the destination and Ts is packet send time at source node.

E. Dropping ratio:

Packet dropping is where network traffic fails to reach its destination in a timely manner. Most commonly packets get dropped before the destination can be reached.

Dropping Ratio = (No.of Packets sent-No.of Packets recieved)/ No.of Packets sent *100

VIII. SIMULATION RESULTS

Seven cell structure:

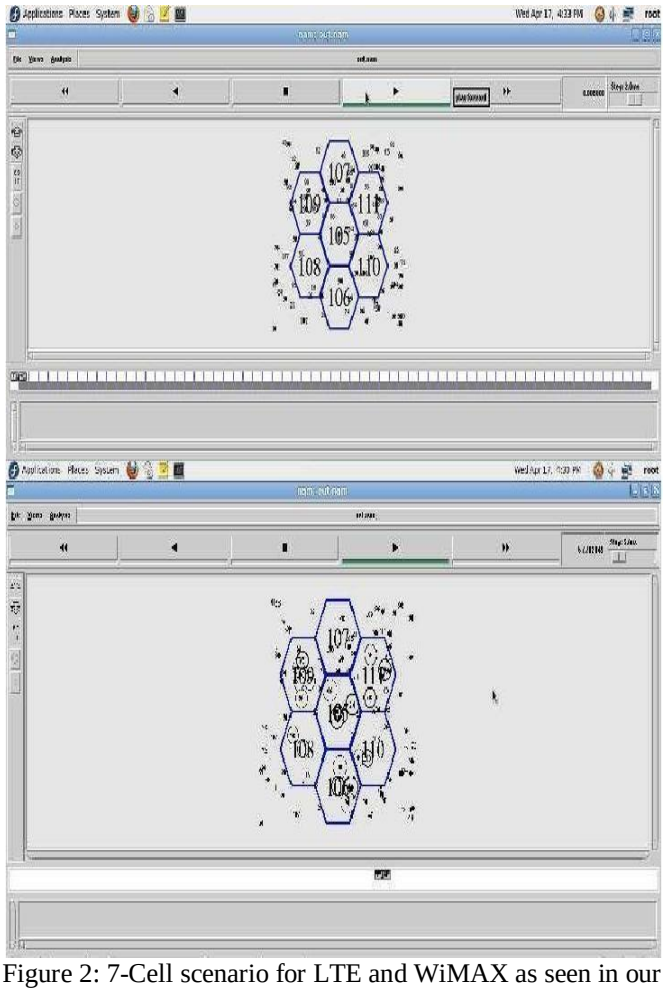

Figure 2: 7-Cell scenario for LTE and WiMAX as seen in our NS-2 simulation

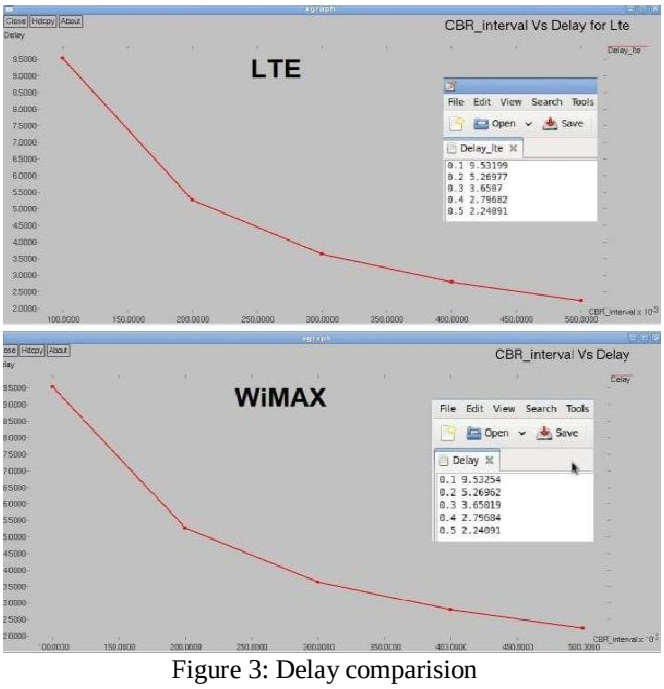

Figure 3: Delay comparision

Packet Delivery ratio:

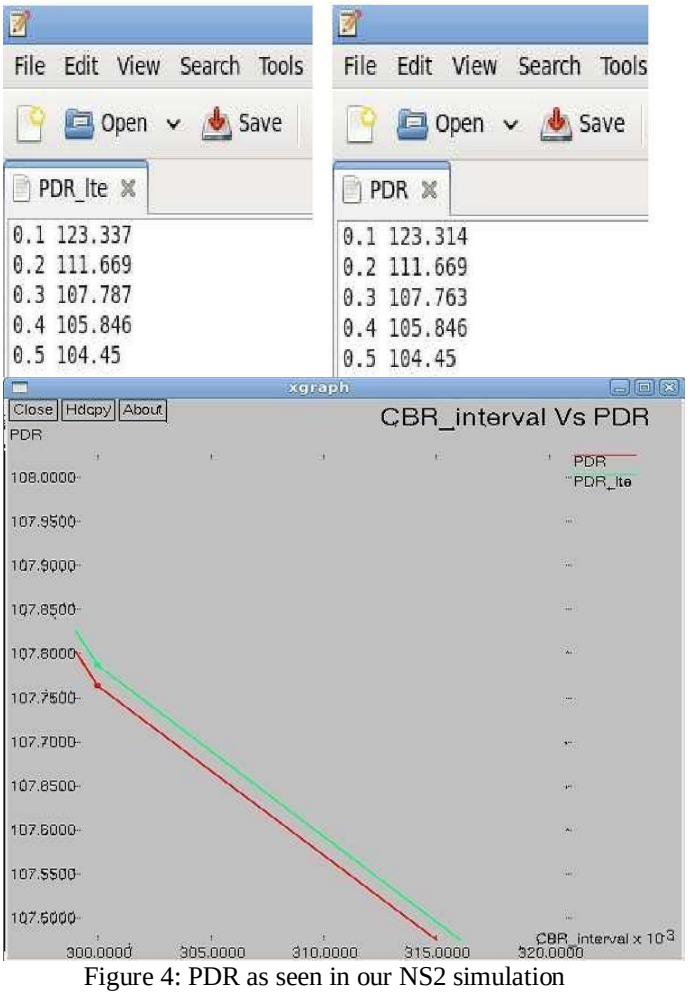

Figure 4: PDR as seen in our NS2 simulation

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Jitter:

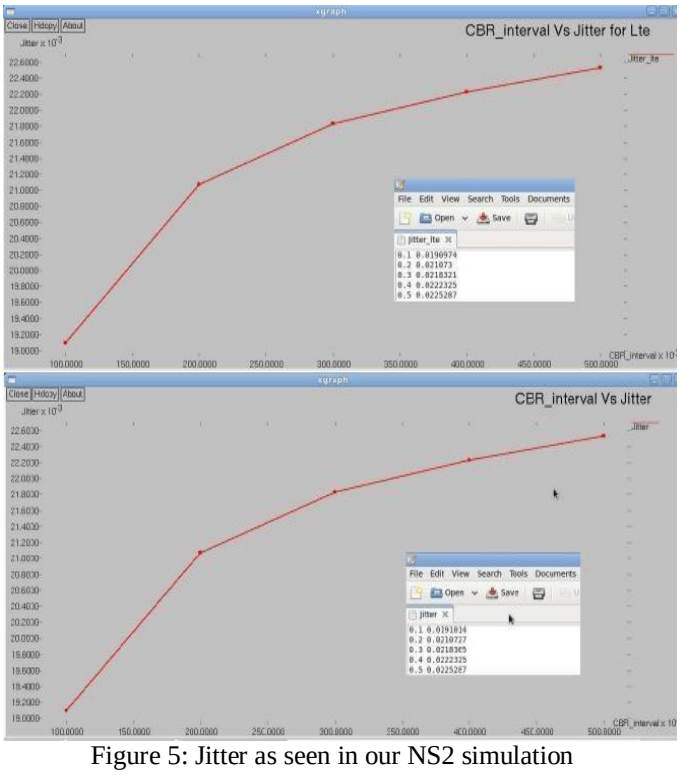

Figure 5: Jitter as seen in our NS2 simulation

Throughput:

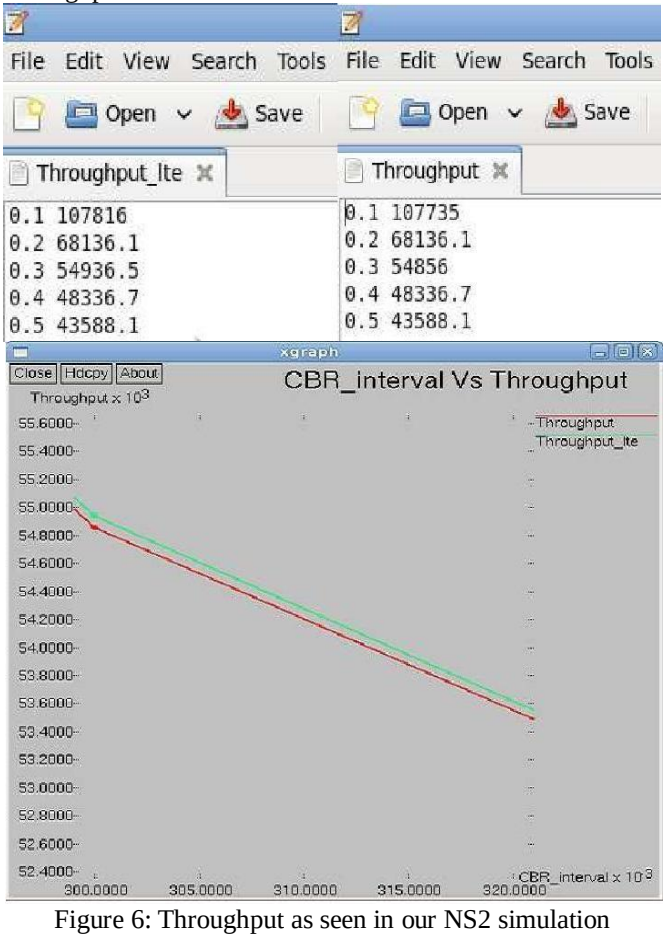

Figure 6: Throughput as seen in our NS2 simulation

Dropping ratio:

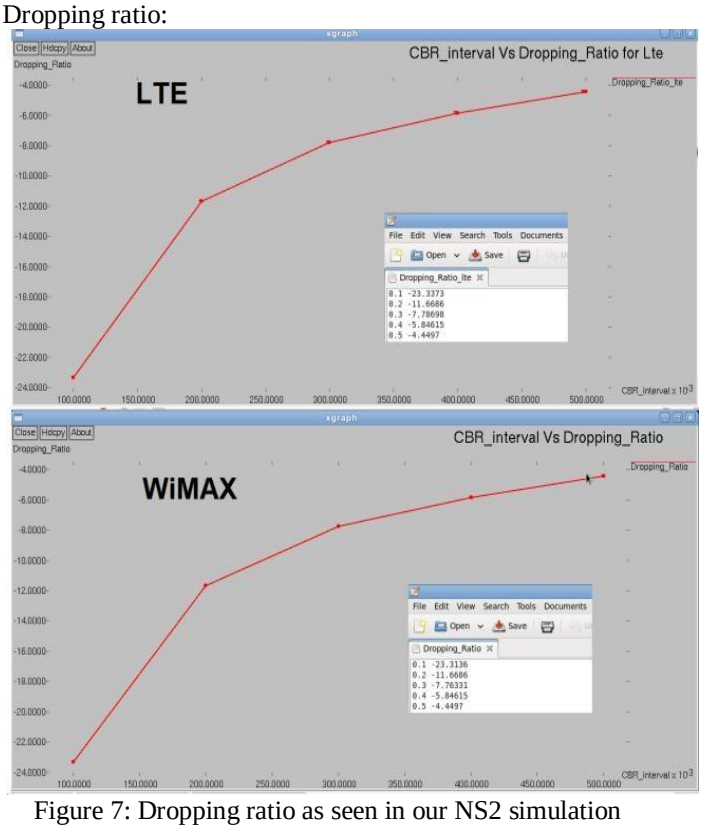

Figure 7: Dropping ratio as seen in our NS2 simulation

IX. SCOPE OF LTE & WiMAX

- Review the current technologies, regulatory factors and industry support impacting the adoption of 4G technologies.
- Identify key changes in consumer usage behaviour that drive the need for the greater speed and spectral efficiency afforded by 4G.
- Understand how legacy technologies will influence vendors' choice of 4G protocol due to the economic and technical implications of deploying each technology.
- Identify the technology family best suited to a c hosen 4G strategy based on each technology's characteristics and individual corporate circumstances.
- Identify the various initiatives in support of each technology candidate in order to revise considered strategies if necessary.

X. CONCLUSION

We conclude that both WiMAX and LTE are technically similar standards. However, there are some differences present in the uplink access method used by both technologies. LTE uses SC-FDMA whereas WiMAX uses OFDMA as an access method. The adaptation of SC-FDMA in the uplink gives edge to LTE over WiMAX because it resolves the PAPR problem of OFDMA due to its single carrier nature. We also conclude that LTE systems have less jitter and Delay as compared to WiMAX. Also LTE systems

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have greater Packet Delivery Ratio and Throughput over WiMAX. Dropping ratio is lesser in LTE compared to WiMAX So clearly LTE has advantage over WiMAX according to the given parameters.

REFERENCES

[1] Tejas Bhandare, "LTE and WiMAX Comparison", Santa Clara University, 2008, White Paper
[2] Challenges and issues in 4G – Networks Mobility Management Payaswini P, Manjaiah D.H Dept of Computer Science, Mangalore University, Karnataka, India, 2013.
[3] Jeffrey G.Andrews, Arunabha Ghosh, Rias Muhamed, Fundamentals of WiMAX, Prentice Hall Communications Engineering and Emerging Technology Series, 2007.
[4] "UMTS Long Term Evolution (LTE) Technology Introduction", Application Note 1MA111, Rohde & Schwarz Products, 2007

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