Performance Analysis of VOIP over Mobile WiMAX

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Abstract: **IEEE 802.16e, Mobile WiMAX is a wireless technology which is used to offer very high data rate througout large areas to larger number of users where broadband is not available. It is an fascinating solution for offering high-speed internet access in a cost-efficient manner to people living in both densely populated urban areas as well as sparsely populated rural areas. This popularity is a solution of the low-cost, flexibility and user mobility provided by the technology. This paper examines the performance of Mobile WiMAX for small, medium and large network scenarios under HTTP, FTP, Video conferencing and VoIP traffic with changed node mobility (0~90km per hour) when handoff is enabled or not enabled through broad simulation experiments. In this paper we use OPNET simulator 15.0 to analyse the WiMAX performance.**

Keywords: **FTP, HTTP, VoIP, Videoconferencing, node mobility, Jitter, Handoff.**

I. INTRODUCTION

Global operability for Microwave Access (WiMAX) is an rising and stimulating wireless technology that can provide support to a variety of consumer and business applications, from network backhauling and interlinking with LANs and Wi-Fi, to audio, voice, data and mobility support[3]. The quick growth in the area of communication has created the requirement of mobility in communication. Mobile WiMAX may alter the way people access data, audio, e-mail and video communication services as it gives a quicker transmission speed than 3G, wider range than Wi-Fi and more mobility as compared to LAN [3]. Mobile WiMAX can supply services up to a mobile speed of 120km per hour at 3.8GHz bandwidth. By taking a scalable OFDMA and PHY architecture, mobile WiMAX is capable to support a broad range of bandwidths (1.25MHz to 20MHz) and coverage area (12~15km in LOS) [10]. This thesis work examines how is the performance of mobile WiMAX in different network conditions and how this performance vary because of handoff and traffic type node mobility. To give naturalistic results for end users, different traffic types (HTTP, FTP, Video conferencing and VoIP) that are often utilized on wireless networks and distinct node movement speeds(0~90km/h) are also applied in the experiments. The effect of the traffic type and node mobility on system performance has been examined by enhancing speed of nodes when handoff is enabled or not enabled.

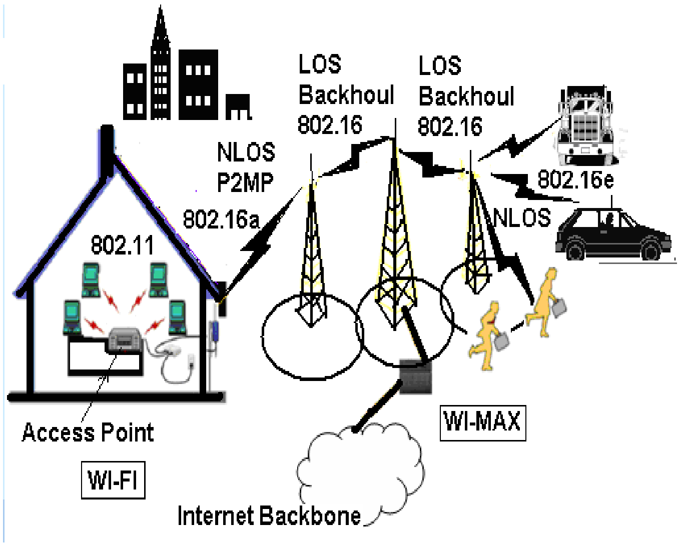

Figure: 1 Fixed and Mobile Wimax

II. LITERATURE REVIEW

In his research paper, Durantini, A [10] showed that In WiMAX network, the quality of voice is fulfilling with very good latency and jitter for MOS scale with 4.0. His work also express that bandwidth does not affect the jitter in the network. His determinations also express that both latency and jitter values for WiMAX was not high in comparison of broadband network. N.Nagarajan et al [9] deals with the problems related to the delivery of video packets in video conferencing and other multimedia application services throughout WiMAX. Multiple contending traffic sources throughout a point-to-multipoint WiMAX configuration is simulated. The performance investigation on the capability of the WiMAX appliances to manage Video and VoIP traffic flows was carried on. Parameters that show quality of service i.e. packet loss, throughput, average delay and average jitter, are examined for various types of services as described in WiMAX. Jadhav. S. et al [11] concentrate on convergence of various Radio Access Technologies (RATs) giving good Quality of Service (QoS) for applications i.e. video streaming and Voice over IP traffic (VoIP). The voice applications over IP networks are developing speedily because of their rising

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quality and cost. To fulfill the need of supplying high-quality of VoIP from anywhere and at anytime, it is required to design desirable QoS model. They have carried out the simulation study to measure the QoS performance of UMTS and WiMAX for supporting VoIP. They made simulation modules by using OPNET for UMTS and WiMAX, and carried out wide simulations to examine and measure various significant performance metrics i.e. Mean Opinion Score (MOS), jitter, end-to-end delay and packet delay variation. After the simulation results it was concluded that WiMAX outpoint the UMTS with a enough margin, and is the improved technology to support VoIP applications as compared to UMTS. Chin-Ling Chen and Cheng-Yi Pan [11] demonstrated an effective way and the supplying of Quality of Services (QoS) guarantee are the important issues in providing delay sensitive traffic, like VoIP service in WiMAX (global operability for Microwave Access). One proper-designed scheduling algorithm is required to organize QoS-concerned functional entities in WiMAX architecture. Some downlink scheduling algorithms of WiMAX which are already existed like WRR (Weighted Round-Robin) and DRR (Deficit Round-Robin) generally allow minimum rate to each kind of traffic and cannot look at the position of queue length of each connection, therefore making it not suitable for VoIP on-off traffic framework. Author suggested an effective downlink scheduling algorithm, which provide the bandwidth depending on queue-length estimation and examined the suggested scheme with WRR and DRR by estimating the system performance i.e. loss rate, average delay and throughput under various traffic scenario and system parameters value. Henriques, J. et al [12] demonstrated that the Mobile WiMAX (IEEE 802.16e) abilities to provide support to VoIP traffic under various assumptions and using discrete Quality of Service (QoS), service classes were executed. Furthermore, they described the heterogeneity access conditions inside a city, by examining both Line of Sight (LOS) and Non-Line of Sight (NLOS) considerations. After analyzing the end-user detected Quality of Experience and the network Quality of Service related parameters, the achieved results presented the effect of the correct WiMAX Quality of Service classes management on the number of well served VoIP users. Adi Chandra [13] has studied that extended real time polling service (ertps) scheduling service which support variable rate real time services in the beginning enhances performance of VoIP over WiMAX. Islam,Rashid and tariq [14] examined that VoIP over GSM full rate (GSM-fr) and GSM enhanced full rate (GSM-efr) codecs get suitable speech quality with less jitter and delay.

III. FEATURES OF MOBILE WIMAX

a) High Data Rates: The comprehension of MIMO antenna techniques by flexible sub-channelization systems, advanced modulation and coding all make capable the Mobile WiMAX technology to support maximum upload data rates up to 38 Mbps per sector and maximum Download data rates up to 63 Mbps per sector in a 10 MHz channel.

b) Quality of Service (QoS): The key assumption of IEEE 802.16 MAC architecture is Quality of Service (QoS).

c) Scalability: Inspire of growingly worldwide economy, spectrum resources for wireless broadband globally are however quite different in its allocations. Mobile WiMAX technology thus, is planned to be cable to scale to work in distinct channelization's from 1.25 to 20 MHz to follow with varied global needs as efforts continue to attain spectrum harmonization in the longer term.

d) Security: The characteristics provided for Mobile WiMAX security features are better in class with AES-CCM based authenticated encryption, EAP-based authentication, HMAC and CMAC based control message security schemes. It supports various set of user bona-fides exists including: Smart Cards, SIM/USIM cards, Digital Certificates, and Username/Password Schemes based on the applicable EAP methods for the bona-fide type.

e) Mobility: Mobile WiMAX supports optimized handover systems with response time less than 50 Milliseconds to assure real-time applications i.e. VoIP do without service changing to a lower rate. Flexible key management strategies insure that security is preserved during handover.

2.2 Hand Off

"The handoff is a process in which a mobile station (MS) migrates from air interfaces for its present Base Station (BS) to air-interfaces of next Base Station. Handoff is a significant process of mobility support in wireless network".

IV. RESEARCH METHODOLOGY

Computer simulation is most widely used as a research methodology for analyzing and simulation the performance of wired and wireless network. In our paper work we had taken OPNET 15 simulator. This simulation is performed by varying node mobility, network size, by concerning with and without handoff. Experiments are performed in a cell size of 10 km. Networks sizes of 10, 50, and 100 mobile nodes are used. In trajectory the random waypoint mobility model is used different for traffic loads that are classified into three groups: light, medium and heavy.

All the above parameters are presented in tabular form in following Table 1.

No. of Mobile nodes in the network	10,50, and 100
Cell Radius	10 km
Speed of the mobile nodes	0, 10, 30, 50, 70 and 90km/h
Simulation time	600 sec
Base Station Model	wimax_bs_ethernet4_slip4_router
Mobile Nodes Station Model	wimax_ss_wkstn
ASN Gateway Model	ethernet4_slip8_gtwy
IP Backbone Model	ip32_cloud
Voice Server Model	ppp_server
Link Model (BS-Backbone)	PPP_DS3
Link Model (ASN - Backbone)	PPP_SONET_OC1
Physical Layer Model	OFDMA 20Mhz
MAC Protocol	IEEE 802.16e

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Multipath Channel Model	ITU Vehicular A
Scheduling Type	ertPS, nrtPS
Application	FTP, Http
Voice Codec	G 723
FTP Load	High

V. RESULT AND ANALYSIS

This section reports on the combined results from the experiment scenarios 1-3 and 4-6.

5.1 Impact on Node Mobility and Handoff In Ftp

This subsection presents the relevant data and discusses changes in FTP download and uploads response times when handoff is active. There is no significant difference in download/upload times in regards to whether handoff is active or disabled When light FTP traffic is transmitted, When medium FTP traffic is active, there are no significant download/upload time differences whether handoff is active or disabled up to a 70km/h node speed. For speed above 70km/h, download/upload response times both increase by less than 0.5 second.

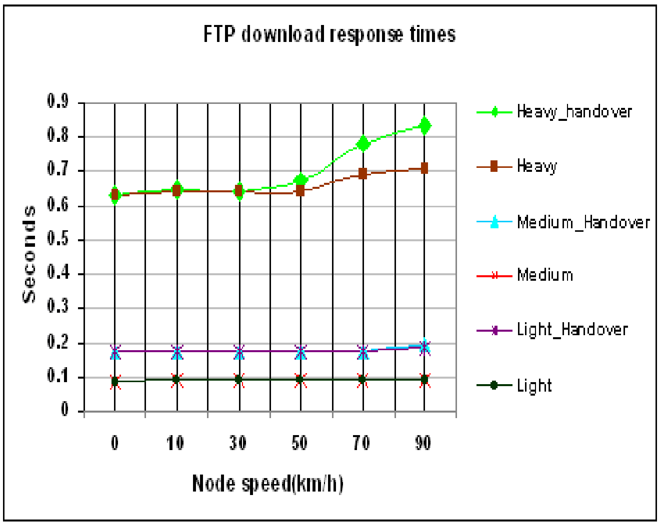

Figure 2 FTP Download response times with and without handoff

There is no significant download/upload time difference between handoff being active or disabled, up to a 50km/h node speed for heavy FTP traffic. For speeds 50km/h or higher, enabling handoff appears to have an impact on these times. Download and upload response time increase by 0.1 second and 0.3 second respectively when node speed is increased from 50km/h to 90km/h.

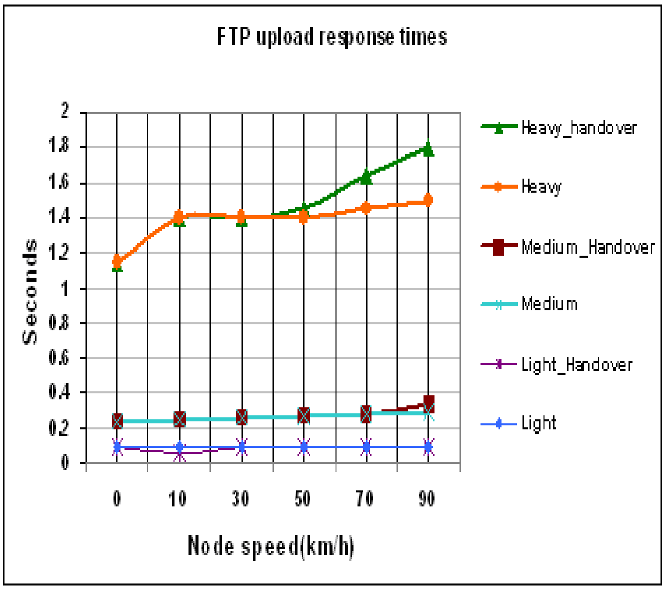

Figure 3 FTP Upload response times with and without handoff

5.2 Impact on Node Mobility and Handoff in Http

This subsection describes the simulation results for changes in HTTP object and page response times when handoff is active. There is no significant object and page response time changes when using handoff for light and medium HTTP traffic transmitted at any node speed. Download and upload response times are nearly unchanged for light HTTP traffic regardless of whether handoff is active or disabled. Object and page response times for light and medium HTTP traffic have little increase when handoff is active.

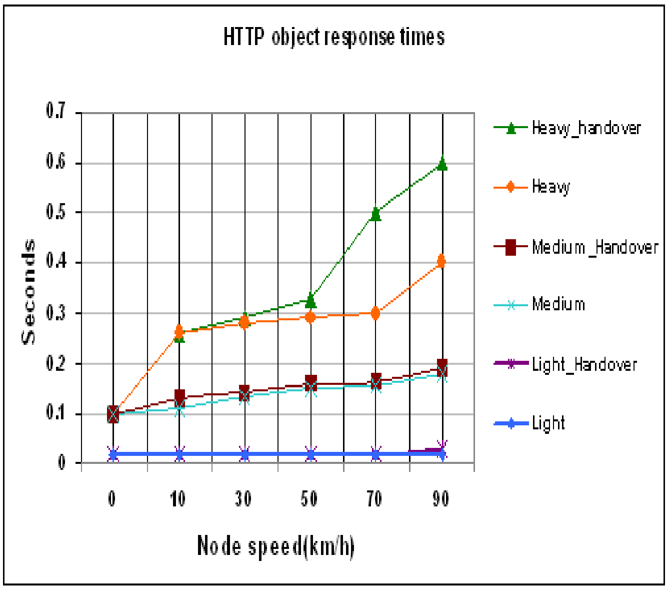

Figure 4 HTTP Object response times with and without handoff

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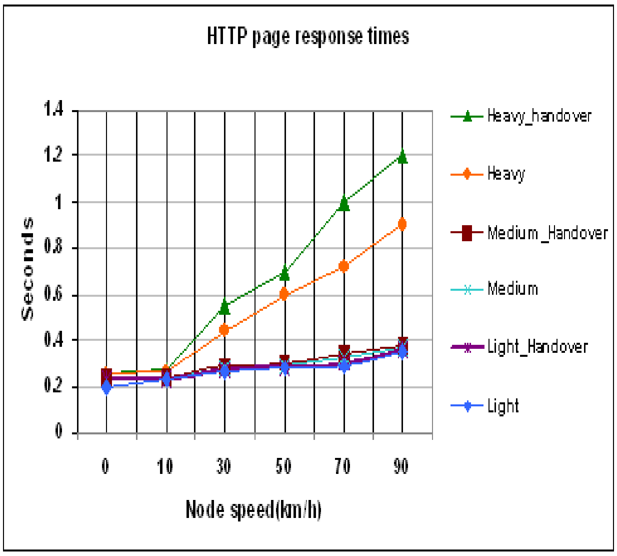

Figure 5 HTTP Page response times with and without handoff

Average object and page response times increase by 0.02seconds and 0.05seconds respectively. There is no clear evidence that handoff has influenced the HTTP page and object response time for light and medium traffic. For heavy HTTP traffic transmitted between a server and moving nodes, enabling handoff causes an increase in response time which is clearly observed for mobile node speeds 30km/h and greater. The impact of handoff becomes stronger has node speed increases. When the speed is 90km/h, page and object response times increase by 0.21seconds and 0.32seconds respectively when compared to those without handoff.

5.3 Impact on Node Mobility and Handoff in Videoconferencing

This subsection presents and discusses the simulation results of Video conferencing packet delay variation and end-to-end delay changes for video conferencing traffic when handoff is active or disabled.

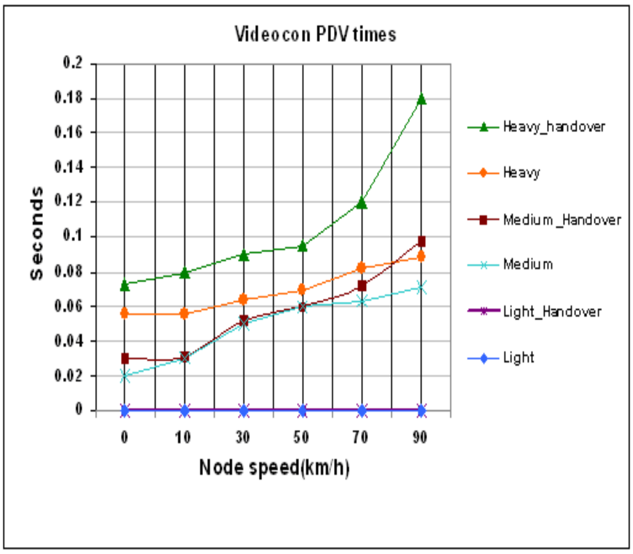

Figure 6 Video conferencing packet delay variation with and without handoff

In simulation we concern with to find out how enabling handoff impacts on packet delay variation and end-to-end delay. As shown in figure when a small amount of video conferencing traffic is transmitted between moving nodes, handoff had no significant impact of WiMAX performance for any node speed. Due to this packet delay variation and end-to-end delay increased by 0.001seconds and 0.0343seconds respectively when handoff is active.

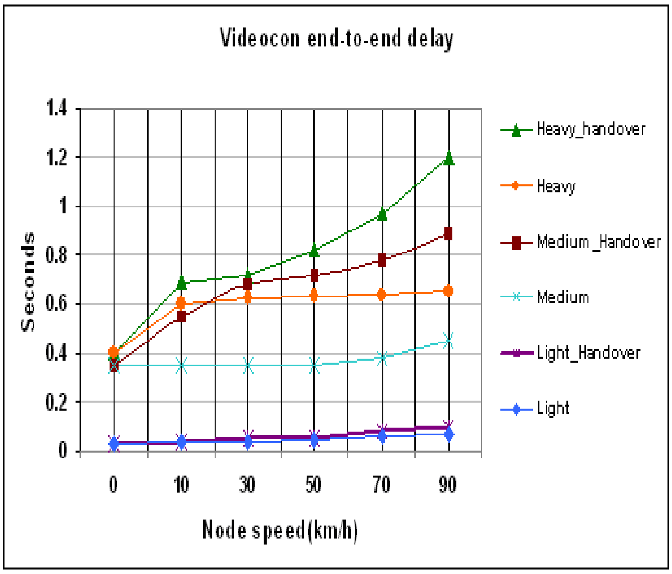

Figure 7 Video conferencing end-to-end delay with and without handoff

When handoff is active at 30km/h node speed, packet delay variation only increases by 0.002232 seconds and end-to-end delay increases by 0.3332 seconds. However, for a node speed of 90km/h speed of nodes, packet delay variation increases by 0.02372seconds and end-to-end delay increases by 0.49seconds. When handoff is active at a node speed of 30km/h, packet delay variation increases by 0.03453seconds and end-to-end delay increases by 0.0876 seconds while, for a node speed of 90km/h, packet delay variation increases by 0.1126 seconds and end-to-end delay increases by 0.6453seconds.

5.4 Impact on Node Mobility and Handoff in M-Voip

In this subsection we discuss the simulation results for m-VoIP jitter and MOS when handoff is active. whenever handoff is active, average jitter and MOS are nearly unchanged for light m-VoIP traffic at any node speed. Jitter does not exceed 1ms for any node speed. For any mobile node speed jitter is maintained at less than 1ms, MOS does not reach a fair level, 4 points at all and is about 2.5 points.

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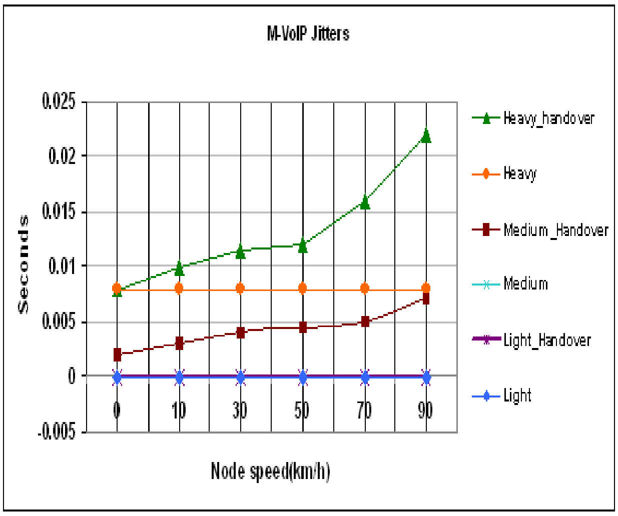

Figure 8 M-VoIP jitter with and without handoff

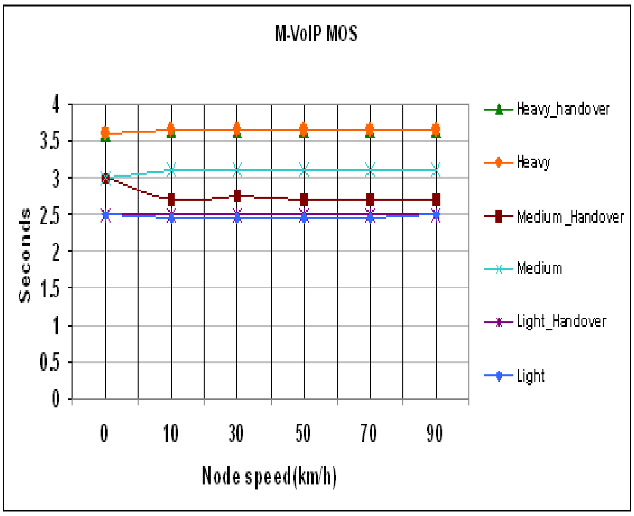

Figure 9 M-VoIP MOS for with and without handoff

Whenever handoff is active, average jitter for medium and heavy m-VoIP traffic increases linearly with an increase in mobile node speed. For a 30km/h node speed, jitter increases by 0.002 seconds and 0.003234 seconds respectively while for a 90km/h node speed, jitter increases by 0.007787seconds and 0.01343 seconds respectively. Regardless of the increasing node speed MOS remains nearly unchanged for all three amount of m-VoIP traffic. However, once handoff is active, MOS for medium m-VoIP` traffic is about 0.0903 points lower and for heavy traffic, MOS is about 0.6065 points lower than those before handoff was used.

6. CONCLUSION

In this research analyses WiMAX performance in terms of Hand off node mobility and traffic type . As a result of these simulation analyses concern with traffic type may influence the performance of Mobile WiMAX differently. The analyses result shows that traffic type differently affect the performance of Mobile WiMAX. Therefore node mobility does not importantly influence delay-tolerant traffic types (HTTP and FTP) for any node speed. Still node mobility significantly influence delay-sensitive traffic types (Videoconferencing and VoIP) .when handoff is not enabled, Packet delay is less than one second is preserved irrespective of increment in node speed. When the traffic of network volume increases, Packet loss ratios for Video Conferencing and VoIP are high and increased in an irregular manner. Other observation is that mean throughput of VoIP and video-conferencing is decreased and packet loss ratio is increased in an irregular way causing of drop of connection. When hard handoff is permitted, delays in all traffic types are increased to a small extent, packet loss ratio is reasonably decreased and mean throughput is also reasonably increased.

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