PERFORMANCE EVALUATION OF QUALITY OF SERVICE IN HETEROGENEOUS NETWORKS USING OPNET MODELLER

Vijay Verma¹, Silki Baghla²

¹Research Scholar, JCD Department, JCDM College of Engineering, Sirsa, INDIA
²Asst. Prof., JCD Department, JCDM College of Engineering, Sirsa, INDIA

ABSTRACT

The aim of next generation wireless network (NGWN) is to integrate different wireless access technologies such as WLAN, WiMAX, UMTS etc., each with its own characteristics, into a common IP-based core network to provide mobile user with seamless connectivity. One of the major issues for the converged heterogeneous networks is to provide seamless connectivity with QoS support. In this paper we simulated various wireless networks (WLAN, WiMAX and UMTS) for various applications and evaluated their performance as individual as well as in integrated mode.

Keywords: WLAN, WiMAX, UMTS, QoS, NGWN.

INTRODUCTION

Now a days telecommunication services such as video on demand, music down- load, video streaming, video conferencing and VoIP are becoming part of user’s daily activities. These applications demand high quality service, particularly for voice and real time sessions. So it is very important to increase the quality of data for telecommunication [2]. In wireless technologies such as 3G, WLAN, WiMAX etc. offer variety of services. They are developed with different standards and provide different area of coverage and data rates [3]. VoIP applications are being widely used in today's networks challenging their capabilities to provide a good quality of experience level to the users [4]. Now days the heterogeneous networks are widely used in telecommunication. The mobility in heterogeneous networks for any mobile device requires seamless connectivity using vertical handover [6]. But the mobility management is the main issue in heterogeneous networks that supports the roaming of users from one system to another [7]. The vertical handover involves procedures of registration, binding, route optimization, and bi-directional tunnelling mode so that transition between heterogeneous access technologies is transparent to user [5]. Consequently, many wireless technologies, such as 3rd Generation (3G), Worldwide Interoperability for Microwave
Access (WiMAX), Wireless LAN (WLAN), Universal Mobile Telecommunications System (UMTS) are emerging to satisfy the users’ growing requirements to provide anytime and anywhere access to the Internet.

Even though, the wired network has benefits like less packet loss, more security and less delay, it has its main drawback as immobility which makes the wireless network to be prominent since it supports mobility. Nowadays, the voice and video transmission is widespread among the mobile users. In this case, the effective quality of speech at the destination side is more essential. The quality of speech in any network is determined by using Mean Opinion Score (MOS) value, delay, jitter [1] while quality of service of any network can be determined in terms of load, delay and throughput as well. In this paper we have integrated three wireless technologies (WLAN, WIMAX and UMTS) in a network and analyzed its performance for voice application. The analysis is done on the basis of MOS value, delay, jitter, load, throughput and mobility. As the mobile terminal moves in such an integrated network its point of connectivity to access point may shift from one access point to another. This process of change of access point is known as handover. In WLAN network handover can be found through its AP connectivity while in Wimax handovers can be found by its mobility. In UMTS, handovers can be found as active cell count in UMTS handover.

INTEGRATION OF VARIOUS WIRELESS NETWORKS

In this paper implementation of three wireless technologies WLAN, WIMAX and UMTS have been implemented on OPNET Modeller. The simulation is done in 2 parts having seven scenarios:

1) Network implementation using same wireless technology
   - Implementation of WLAN network in 7-cell structure
   - Implementation of WiMAX network in 7-cell structure
   - Implementation of UMTS network in 7-cell structure

2) Network implementation using different wireless technologies
   - Integration of WLAN- WiMAX
   - Integration of WLAN-UMTS
   - Integration of WiMAX-UMTS
   - Integration of WLAN-WiMAX-UMTS

In scenarios of first part the simulation is performed with three applications Voice, Video and FTP while for scenarios in second part voice application is used for performance application.

SIMULATION RESULTS FOR INDIVIDUAL NETWORKS

Fig. 1, 2 and 3 shows WLAN, WiMAX and UMTS network structure used in this work in 7-cell structure. In WLAN each cell has four mobile workstations connected with one base station while in WiMAX network each cell has 5 mobile workstations with one access point. UMTS network 7 cell structure shown in figure 2. Each cell can have 1 or more NODE B.
Figure 1: Implementation of WLAN

Figure 2: Implementation of WiMAX

Figure 3: Implementation of UMTS
Voice jitter for WLAN, WiMAX and UMTS is shown in figure 4 and voice MOS value for WLAN, WiMAX and UMTS is shown in figure 5. The value for voice jitter should be low and voice MOS value should be high. MOS value is in between 1 to 5. MOS value five is excellent and 1 is poor.
SIMULATION RESULTS FOR HETEROGENEOUS NETWORKS

In scenarios 4, 5, 6 and 7 the simulation is done by using voice application.

In this integrated network, the users can get signal from WiMAX or WLAN (depends on signal strength).

![Figure 6: Implementation of WLAN-WiMAX](image)

In this scenario, four UMTS architectures are integrated with the WLAN architecture. So the users can utilize either UMTS or WLAN which depends on the signal strength.

![Figure 7: Implementation of WLAN-UMTS](image)

In this scenario user equipment can use UMTS or WiMAX, which depends on the signal strength.

![Figure 8: Implementation of WiMAX-UMTS](image)
Figure 9: Voice jitter in WLAN-WiMAX, WLAN-UMTS, WiMAX-UMTS

Figure 10: MOS value in WLAN-WiMAX, WLAN-UMTS, WiMAX-UMTS

Table no. 2

<table>
<thead>
<tr>
<th>Parameters</th>
<th>WLAN-WiMAX</th>
<th>WLAN-UMTS</th>
<th>WiMAX-UMTS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Voice Jitter</td>
<td>0 sec</td>
<td>0 sec</td>
<td>0.09 sec</td>
</tr>
<tr>
<td>MOS value</td>
<td>3.6</td>
<td>Max-3.1</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Min-1.5</td>
<td></td>
</tr>
</tbody>
</table>
A combination of all three networks WLAN, WiMAX and UMTS is shown in the figure.

**Figure 11:** WLAN-WiMAX-UMTS implementation

**Figure 12:** Voice jitter and MOS value for WLAN-WiMAX-UMTS

**Figure 13:** Load in WLAN-WiMAX-UMTS
Table no. 3

<table>
<thead>
<tr>
<th>Parameters</th>
<th>WLAN-WiMAX-UMTS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Voice Jitter</td>
<td>Max-0.0036 sec</td>
</tr>
<tr>
<td></td>
<td>Min-0.0001 sec</td>
</tr>
<tr>
<td>Voice MOS value</td>
<td>3.4</td>
</tr>
<tr>
<td>Load</td>
<td>130 bps (WiMAX)</td>
</tr>
<tr>
<td></td>
<td>68,000 bps (WLAN)</td>
</tr>
</tbody>
</table>

CONCLUSION AND FUTURE WORK

In this paper, we present a performance analysis of various types of wireless networks with many applications using OPNET simulator. The simulation results show that the WiMAX performance is good as compared with WLAN and UMTS for voice application and in heterogeneous networks, WLAN-WiMAX network gives the best results among all heterogeneous networks with 0 sec of jitter and maximum value of MOS. For future work number of networks in a structure can be increased and simulated with different applications. The simulation time can also be increased for performance evaluation.

REFERENCES

6. Iyad Alkhayat, Anup Kumar, Salim Hariri, “End-to-End Mobility Solution for Vertical Handoff between Heterogeneous Wireless Networks” Institute of Electrical and Electronics Engineers (IEEE), 2009.