Performance Evaluation of VoIP over WiMax Network

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Abstract
In recent years, there is rapid development in the field of wireless communications, to support a variety of applications that use network resources. These applications include voice over IP, multimedia services, such as video, video conferencing etc. This paper focuses on study of Performance Evaluation of Voip over WIMAX Network by using the OPNET simulation programming for different scenarios to study the jitter and End to End Delay parameters to evaluate the QOS in WIMAX network. The results show that the best jitter when the power is 5 watt, and when the power increase the delay increase.

Keywords: VoIP, WiMax, QoS, OPNET.

1. Introduction
Worldwide Interoperability for Microwave Access (WiMAX) is a standard for wireless communication which supports large number of users with higher data rates, coverage and availability. This technology is based on IEEE 801.16 standards and the most relevant versions are the Fixed WiMAX, based on IEEE 801.16d, and the mobile Wimax, defined by IEEE 802.16e [1]. IEEE 802.16 uses multiple channels for a single transmission and supply bandwidth up to 100 Mbps. The use of orthogonal frequency-division multiplexing (OFDM) increases the bandwidth and data capacity by spacing channels very close to each other and avoids interference by orthogonal channels [2] The elements of network equipment can be used from different provider, it is necessary to define the WiMAX network architecture that is common to all WiMAX networks. The WiMAX network architecture defines the system after the antenna interface to enable a full end to end network to be accomplished [3]. The WiMAX network architecture comprises three major elements:

• Remote or Mobile Stations:
These are user equipments that may be mobile or fixed and may be in the premises of the user.

• Access Service Network, ASN:
This comprises one or more base stations and one or more ASN gateways that form the radio access network at the edge.

• Gateways Connectivity Service Network, CSN:
This provides IP connectivity and all the IP core network functions [4].

In recent years, there is a growing trend in real-time voice communication using Internet protocol (IP). VOIP is an acronym for Voice over Internet Protocol, or in more common terms phone service over the Internet. Voice over Internet Protocol is a category of hardware and software that allows people to use the Internet as the transmission medium for telephone calls. It works by conversion of voice signals into digital format using IP rather than by traditional circuit transmissions of the PSTN. Therefore, VoIP provides a solution that merges both data and voice which gains benefits include cost savings, high quality and value added services. Today, VoIP is becoming one of the most widely used technologies today, more and more people and organisations are using VoIP systems worldwide [5].

The related work in this area is discussed below; authors in [1] stated that quality of voice in wimax network is satisfying with excellent...
jitter and good latency with 4.0 for mos scale.

His work also show that bandwidth does not influence the jitter in the network. His findings also show that both jitter and latency values for wimax were low as compared to broadband network. Work in [6] also evaluates the performance of different VoIP codecs in a fixed best effort WiMAX network for varying number of VoIP flows in [7], the authors measured the capacity of WiMAX link using BE and the performance of mixed traffic. In this study, the authors did not evaluate the VoIP performance regarding RTP jitter and delay.

2. Descriptive Analysis

We have used OPNET Modeler, in our simulation; and designed 4 scenarios for voice conference and measure the performance of End to End delay and Jitter in voice packet according to the Codec’s: G711, as well as meet the goal to analysis the quality voice over the internet protocol in wimax networks. We designed two scenario for cells including 1,3,5,7 and 9 cells, and tow scenarios for power which varies from 0.5,1,5,10 with 15 node in each scenario. Then we evaluated the results to improve the QoS to support in voip performance in 4G network for successful transmission.

3. Mathematical Model

(A) Mathematical equation of End to End Delay

\[ D_{EED} = N [D_{trans} + D_{prop} + D_{proc}] \] (1)

Where

- \( D_{EED} \) = End to end delay.
- \( D_{trans} \) = Transmission delay.
- \( D_{prop} \) = Propagation delay.
- \( D_{proc} \) = Processing delay.
- \( N \) = Scalar number.

(B) Mathematical Equation of Jitter

\[ Jitter = \frac{1}{N} \sum_{i=1}^{N} [PacketArrival_{i} - PacketStart_{i}] \] (2)

4. Computer Model

![Figure 1: Number of Cell Model]
Figure 2: Power Mode

No of client = 15
No of cell = 3
Size = 100mx100m

Create WIMAX network
Power = 0.5

Power >= 10

Calculate delay
Calculate jitter

View result

END

Power = 0.5, 1, 5, 10
5. Simulation Environment

The simulation of VoIP application over the WiMAX Network with the OPNET Software was completed under the following WiMAX Network parameters

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Network</td>
<td>WIMAX</td>
</tr>
<tr>
<td>Area</td>
<td>50 KM</td>
</tr>
<tr>
<td>Number of nodes</td>
<td>15</td>
</tr>
<tr>
<td>Number of cell</td>
<td>1, 3, 5, 7, and 9</td>
</tr>
<tr>
<td>Cell radius</td>
<td>2Km</td>
</tr>
<tr>
<td>Power</td>
<td>0.5, 1, 5, 10</td>
</tr>
<tr>
<td>Bandwidth</td>
<td>900GHZ</td>
</tr>
<tr>
<td>Simulation time</td>
<td>1 min</td>
</tr>
<tr>
<td>Voice coder</td>
<td>G.711</td>
</tr>
</tbody>
</table>

Simulation:

OPNET software program used to simulate and evaluate the performance of VoIP over fixed and mobile WiMAX network, as shown:

6. Results

After execution of simulation code we get the result in form of tables and graph as follows:

<table>
<thead>
<tr>
<th>Number of cell</th>
<th>Delay</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>0.0728</td>
</tr>
<tr>
<td>3</td>
<td>0.0750</td>
</tr>
<tr>
<td>5</td>
<td>0.00010</td>
</tr>
<tr>
<td>7</td>
<td>0.07433</td>
</tr>
<tr>
<td>9</td>
<td>0.07447</td>
</tr>
</tbody>
</table>
Average (delay) = 0.0593

Figure 4: A plot of delay Vs number of cell

Table 3: Jitter vs. Number of cell

<table>
<thead>
<tr>
<th>Number of cell</th>
<th>Jitter</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>-0.00125</td>
</tr>
<tr>
<td>3</td>
<td>-0.00016</td>
</tr>
<tr>
<td>5</td>
<td>0.07197</td>
</tr>
<tr>
<td>7</td>
<td>-6.1301</td>
</tr>
<tr>
<td>9</td>
<td>-0.000567</td>
</tr>
</tbody>
</table>

Average (jitter) = -1.2120

Figure 5: A plot of jitter Vs number of cell

Table 4: Delay Vs Power

<table>
<thead>
<tr>
<th>Power</th>
<th>Delay</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.5</td>
<td>0.07500</td>
</tr>
<tr>
<td>1</td>
<td>0.07248</td>
</tr>
<tr>
<td>5</td>
<td>0.07334</td>
</tr>
<tr>
<td>10</td>
<td>0.07615</td>
</tr>
</tbody>
</table>
Average (delay) = 0.0742

![Figure 6: A plot of Delay time Vs Power](image)

Average (jitter) = -4.8461

![Figure 7: A plot of Jitter time Vs power](image)

7. Result Discussion

From table () and Figure(6-1) shown that the no of cell from 1 to 3 the delay is fixed, from 3 to 5 the delay is decrees, from 5 to 7 the delay is increase and from 7 to 9 the value return to fixed. The average of delay is 0.0593. From table () and Figure (6-1) we observe the delay is decreasing when the power is 1 watt, and it increasing g proportionally when the power is increasing. The average of delay is 0.0742.

8. Conclusion

The performance analyses of VOIP over fixed and mobile WIMAX networks have been done by measuring and calculating the end to end Delay for different scenarios using OPNET software. We found that when the number of cell increase the delay and jitter are decreased and increased, and we found that the best jitter when the power is 5 watt, and when the power increases the delay increase. We observed that
the quality of voip over wimax network in best performance.

References


