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Research Article

Performance Evaluation of a WiMAX Mobile Networks using Omnidirectional antennas

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Abstract

One of the most promising global telecommunication technologies capable in boosting the capacity & requirements of present & future wireless systems. One such standard,IEEE 802.16 (WiMAX) for wireless metropolitan area networks. It supports wide coverage area and high data rate compared to cellular and Wi-Fi network. In recent times by adding Omni directional antenna tends to bring the new functionalities in the advancement of WiMAX technology .This paper investigates the potential of Omni directional antennas in context to mobile WiMAX network. The performance evaluation based on wide variety of simulation scenarios were built in WiMAX networks. The proposed technique has been designed and simulated using the QualNet 6.1 network simulator.

Keywords: *WiMAX, Omni directional antenna, Qualnet 6.1*

1. Introduction

IEEE 802.16 based WiMAX network offers one of the best quality of service for mobile data service users. WiMAX is a wireless technology that provides the broadband access services that supports the low cost mobile Internet applications over large distances than the standard Wi-Fi. In the past years, the problem faced by the wired backhaul networks and the deployment if ISPs are being eliminated usually by a fast emerging broadband access technology i.e. WiMAX which tends to provide high data rate coverage over the large coverage region. Mobile WiMAX is based on IP core network that provides the good quality of service and easy deployment within wireless networks thus it tends to enhance the security features in the WiMAX networks.WiMAXis basically a wireless technology which operates at a frequency band if 2– 66Ghz and provides broadband connections with data rates up to 75 Mb/s over long distances It is highly adopted as a backbone for wireless local area and cellular networks .WiMAX Forum promoted the new broadband access technology that is WiMAX based on the 802.16 standards.

In order to extend the scope of applications beyond the requirements of the service providers forum generated e2e based specifications based on network architecture & protocol. Fig. 1 shows an example of WiMAX network architecture that involves a collection of subscriber stations connected to base stations. The communication between all the mobile operators i.e. SS & BS are managed by ASN (access service network) .ASN provides the collection of functional bodies that represented by different classes of services in the WiMAX network. To manage connectivity between subscriber stations is provided by CSN (connectivity service network).It provides a group of networks which tends to achieve the IP connectivity & provides services to the WiMAX subscribers. The WiMAX network is deployed in terms of different topologies i.e. hierarchical, flat or mesh topology based. The base stations either connected to a single gateway or both are connected to separate gateways depending upon the traffic load on the network. TheWiMAX architecture incorporates both mobility and handoff in network. When mobile station moves from one cell to another cell , handoff will be executed between the base stations.MIP presents at the core network contains home agents(HA) which allows the handoff to occur in order to transfer the user from one coverage region to another region, such that it tends to support dynamic channel assignment strategies.

WiMAX can be the attractive solution inurban and suburban areas where problem arises in using wired based technologies such as digital subscriber line (DSL) and cable because of the need to satisfy rural areas requirements at lower cost and higher speed of deployment. Moreover, even in large cities, WiMAX can be used to extend services to any area efficiently.

Recently the world has adopted different evaluations of many multimedia applications in different fields as per the increasing demand of user. A variety of initiative , such as terrestrial/satellite – DMB (T/ S- DMB) , media forward link only,multimedia broadcast/multicast service (MBMS) which provided one to many distribution of mobile users.

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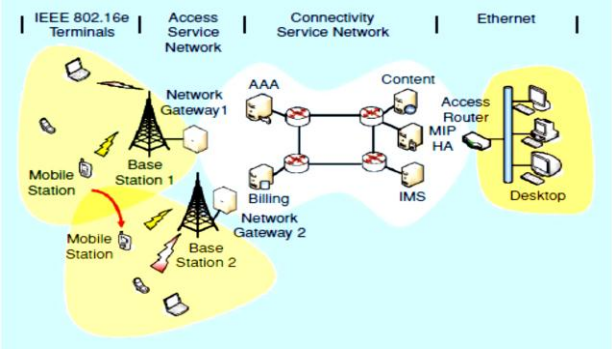

Fig 1:IP- Based WiMAX Network Architecture

2. Research Methodology

In this paper mobile WiMAX network is simulated by using the basic topologies according to it two scenarios are being designed and their performance are evaluated .Omni directional antennas were installed on the WiMAX nodes such that it tends to highlight the manner through which coverage and capacity of the network will be improved. An omnidirectional antenna which tends to receive or radiates in all the directions without favoring the particular direction. It tends to offer highest gain of 8 dB in order to improve range of wireless network. Omni directional antenna provides 360 degrees of coverage in all the directions by which the capacity to occupy more of the wireless region increases. The following scenarios are being created in order to evaluate the performance of mobile WiMAX networks.

Scenario 1:- It consists of single BS and MS topology in which MS communicates with the BS through a single WiMAX link. Both station equipped with WiMAX nodes having an Omni directional antenna placed at each nodes.MS generates packets stream of about 2 MBPS to the fixed server and mobile station moves along the trajectory with the speed of 10m/sec. This scenario is preferable for small coverage regions.Figure 2 shows the snapshot of scenario 1.

Scenario 2:- It consists of three WiMAX BS and single mobile station i.e. external node. Four servers are connected to one external node. MS moves around the BS by using the flag mobility, in order to provide the signals to all servers for external use.MS communicates to the server and MS generates packets stream of about 2 MBPS to the fixed server. It is mesh topology based network in which speed of the mobile station remains same with the variation of time varied with the deviation of 70 seconds. Figure 3 shows the snapshot of scenario 2.

3. Simulation Set up

The overall purpose of this simulation study is to determine the performance of mobile WIMAX environment. The simulation has been performed using QualNet 6.1 version. The IEEE 802.16 is used as a MAC layer communication protocol. In the application layer, the nodes communicate using Constant Bit Rate (CBR) traffic generators over UDP with random source/destination pairs.

CBR applications are used for data traffic which keeps the bit rate same throughout the process.The parameters set for the WiMAX networks are: Frequency spacing of 10.94 kHz, bandwidth set at 20MHz, FFT size 2048.Both scenarios nodes are equipped with Omni directional antennas. The antenna gain set at the base station is 15 db and receiver sensitivity of -100 db.After network set up completed the subscriber station tends to move after 8 seconds by using flag mobility. Table 1 illustrates the simulation parameters related to the discussed work.

Table 1 Simulated parameters

Parameter	Value
Simulator	QualNet 6.1
Scenario Dimensions	1500m x 1500m
Simulation Time	600 seconds
Number of Nodes	S1- 2 , S2- 11
Traffic Type	CBR
Antenna Type	Omni directional
FFT Size	2048
Radio Type	802.16
Channel Frequency	2.4GHz
Flag Mobility	800s,630s,560s,490s,420s,350s, 280s,210s,140s,70s,0s
Topology	Mesh Topology
Mobility	Random Waypoint

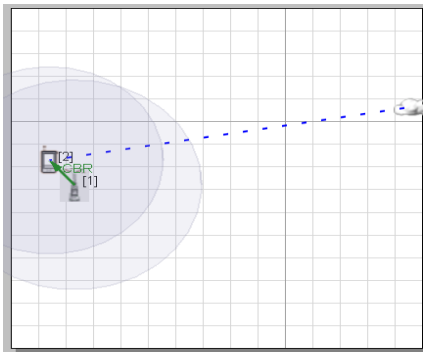

Fig.2. Snapshot of Simulated scenario 1

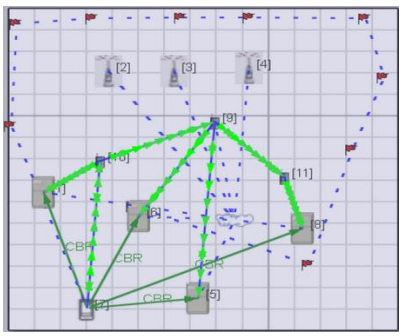

Fig 3. Snapshot of Simulated scenario 2

4. Result

The different types of scenarios are shown in this paper and their results are discussed on the performance metrics

such as Average jitter, End to End delay and Average Throughput. After running the scenarios through simulation tool number of times gets the following results,

Analyzing the performance of scenario 1 and scenario 2:-

Throughput: -Average rate of successful delivery of packets over the communication channel. In fig 4, node 1 shows good throughput because as the scenario 1 is for smaller coverage area so packets loss less while fig 5 shows the result for wider coverage area in which throughput is decreasing from node 1, 5, 6, 8.

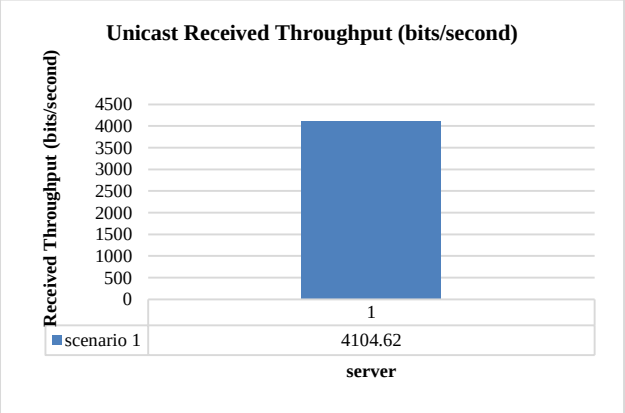

Fig 4. Received Average throughput in scenario 1

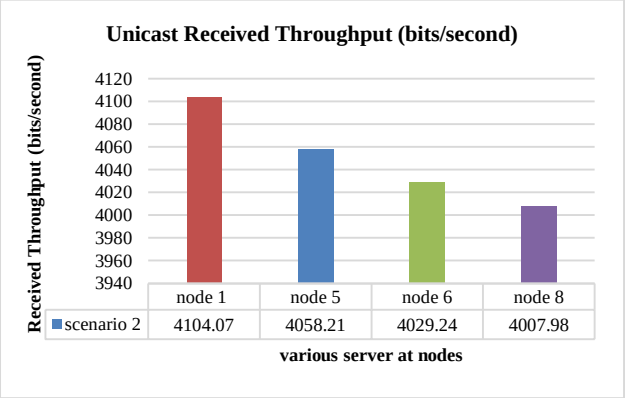

Fig 5. Received Average throughput in scenario 1

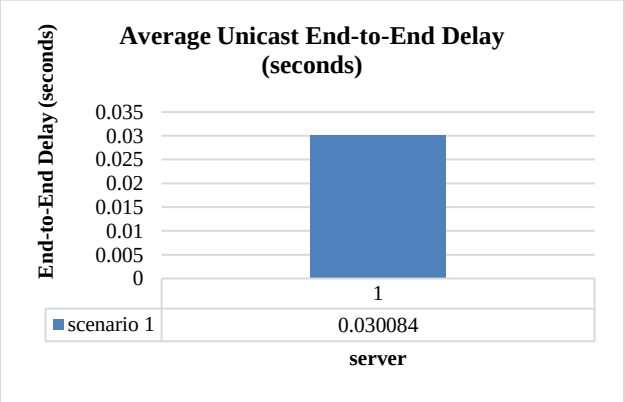

Fig 6. Received Average End-to-End Delay in scenario1

End-to-End Delay: - Average delay between the time when the data packet reaches from source node to the destination node. Lesser will be the delay better will be the performance of the network. In fig 6 end to end delay will be better but in tends to increase for larger area so less packets will be received at node 8.

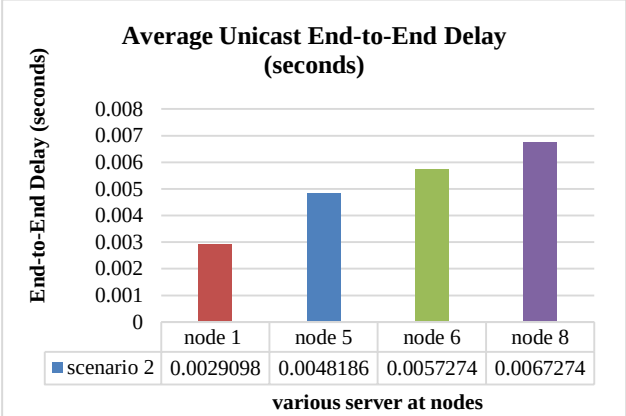

Fig 7. Received Average End-to-End Delay in scenario2

Average jitter: - Jitter refers to the rapid variations in a waveform resulting due to rapid fluctuations in the voltages or due to sources in the network.

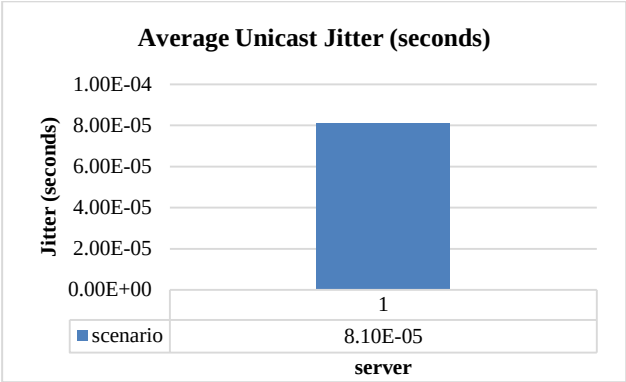

Fig 8. Average unicast jitter in scenario 1

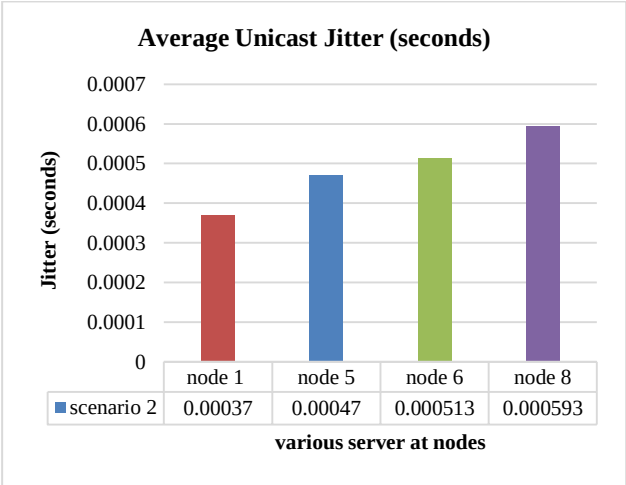

Fig 9. Average unicast jitter in scenario 2

Conclusions

In this paper performance evaluationof two scenarios in Mobile WiMAX environment has been discussed using Qualnet Simulator. It has been concluded that scenario1 can be used externally only for specific purposes hence it performsbetter. While in scenario 2 different external nodes can be used for connecting different backhaul networks and coverage area can be controlled by either increasing or decreasing the power of the BS antenna. In future, analysis can be done on the basis of different topologies and also by increasing number of servers in the network.

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