THROUGHPUT PERFORMANCE IMPROVEMENT FOR VOIP APPLICATIONS IN FIXED WIMAX NETWORK USING CLIENT-SERVER MODEL

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ABSTRACT*- The Quality of Service (QoS) is a major concern for real time application such as voice and video telephony. In order to fulfill the users' demand, it is necessary to improve the QoS. In this paper, a throughput performance improvement for Voice over IP (VoIP) applications in the fixed WiMAX network using a distributed Client-Server model is developed to improve the services that are provided to the end user. The new distributed Client-Server model is simulated in the OPNET modeler 16.0 with multiple Base Stations (BSs), Subscribers Stations (SSs) and some Server BSs selected by the Nearest Neighborhood Algorithm using Orthogonal Frequency Division Multiplexing (OFDM) techniques. The proposed method is compared with the existing Centralized model that uses Frequency Division Multiplexing (FDM) techniques. The results obtained for the VoIP throughput of the proposed Client-Server model show an improvement in the network performance.*

Keywords— WiMAX, QoS, Throughput, VoIP, OFDM, Base Station, Subscriber Station and OPNET Modeler 16.0

I. INTRODUCTION

Day by day communication through technological means has become more popular over the past decade due to the numerous developments in the area of wireless technologies. During the past decades the evolution of these wireless technologies has enabled the development to better achieve users' satisfaction [1]. At present, with increasing number of demand driven applications, different types of services are available to fulfill the expectation of users. Against this backdrop, efficient Quality of Service (QoS) method is required to sustain and improve the quality of the multifarious services aspiring to satisfy users' satisfaction [2].

QoS refers to the collective effects of services perceived by the end users. QoS also refers to requirements such as application response time, throughput, packet error rate, delay, and jitters, etc. The wireless network support a various type of applications for instance, voice, data, video, and multimedia [3]. Throughput is one of the important QoS parameters that measure QoS performance in WiMAX Network [4].

This research is motivated by the fact that user expectations in wireless networks have increased with regard to a large variety of services and applications with deferent QoS requirements. In this research a throughput performance improvement for Voice over IP (VoIP) applications in the fixed WiMAX network will be developed using a distributed Client-Server model. The aim is to improve the services that are provided to the end user.

Rest of the paper is organized as follows: The background and the work done so far in the literature are discussed in Section II. Section III presents the proposed model configuration in the OPNET Modeler 16.0. In Section IV, simulation and results are discussed and finally the paper is concluded in Section V.

II. BACKGROUND AND RELATED WORK

The success of WiMAX in wireless technologies depends on the users' satisfaction and affordability for different types of services such as interactive communications, web surfing, entertainments and so on. Implementation of QoS in the fixed WiMAX network has a great role in order to improve the network performances.

The Quality of Service (QoS) in WiMAX network is useful in order to provide the two major types of WiMAX, the fixed and Mobile with multimedia applications service for the reliability and efficient use of network resources as described in Figure 1 [10].

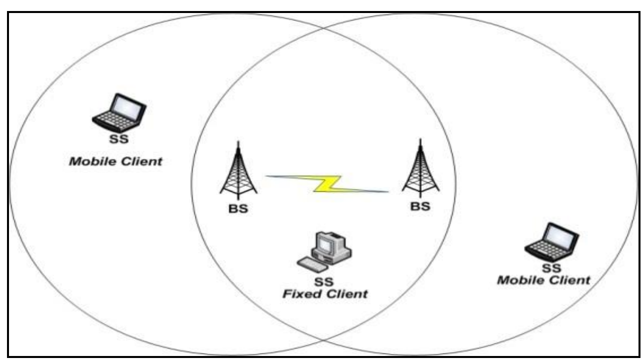

Figure 1: Fixed and Mobile WiMAX Newark architecture

Some related research works have been done in the same area. Sen, Arunachalam and Basu presented a framework for QoS management for 3G wireless networks. They explained a number of unique characteristics of the radio links and showed the required flexibility of resource management techniques for guaranteed QoS over the wireless Network. They also proposed a framework for wireless QoS agent [5]. Du, Tso and Jia proposed architecture for video transmission from the wireless sensor network to UMTS networks, which enables an adhoc public switched network to interact with circuit switched network [6].

Voice over Internet Protocol, known as (VoIP/IP Telephony/Internet telephony/ Digital Phone) is the routing of voice over the IP network and the voice data travels through packet-switched network [7]. Our home phone is based on an analogue system, while VoIP has digital one. In VoIP enabled phone, voice is converted into packets; compressed for efficiency and then transferred to the connection. The process is reversed on the other side of the connection. Protocols carry voice signals over the IP networks are referred to as VoIP protocols. VoIP traffic can be deployed on any IP network instead of private building wide Local Area Network (LAN) that lacks an internet connection [8].

In one of the Telecommunications Industry Association (TIA) report says that residential VoIP consumers have more than tripled in 2005 and predicted an annual growth of more than 40% during 2009 [12]. This would report more than 18 million VoIP connections. This shows that VoIP is not only growing rapidly, also it is here to stay. The adoption of VoIP in small to large businesses has also been great. Traditional communication systems are being replaced at a rapid pace by enterprise business communication tools that offer feature rich and cheaper way of communicating with your contacts [9].

III. PROPOSED DISTRIBUTED MODEL

As discussed by Lawal et al. [11], the client server BSs is selected at the MAC layer of the central server using Nearest Neighborhood Algorithm. The new distributed model was simulated in OPNET modeler 16.0 with multiple BSs, SSs and some Server BSs using OFDM techniques. In the model, Server BSs is selected using Nearest Neighborhood Algorithm to provide network information from a central server to the nearest Client BSs using OFDM techniques. This selection takes place in the MAC layer of the central server. The communication between the central server and Server BSs uses a Client-Server algorithm to provide network information; communication between Server BSs and Client BSs uses Client-Server communication algorithm to provide network information from Server BS to Client BS.

The WiMAX configuration attributes of the Centralized model in which the MAC service class definitions, FDM PHY profile and SC PHY profile in the fixed WiMAX network were configured as illustrated in Figure 2.

Also the WiMAX configuration attributes for the distributed model in which the MAC service class definitions, OFDM PHY profile and SC PHY profile in the fixed WiMAX network were configured as shown in the Figure 3.

Attribute	Value
name	WiMAX Config
AMC Profile Sets Definitions	(...)
Contention Parameters	(...)
Number of Retries	uniform_int (1, 10)
Efficiency Mode	Efficiency Enabled
MAC Service Class Definitions	(...)
FDM PHY Profiles	(...)
Number of Rows	1
Row 0	
Profile Name	Wireless FDM 20 MHz
Frame Duration (milliseconds)	5
Symbol Duration (microseconds)	102.86 (n=28/25, delta_f = 10.94 kHz, ...
Number of Subcarriers	(...)
Frame Structure	(...)
Duplexing Technique	TDD
TC Sublayer Overhead Factor	0
Frequency Band	(...)
Frequency Division	(...)
SC PHY Profiles	(...)
Number of Rows	1
Row 0	...

Figure 2: WiMAX configuration attributes for the Existing model

Attribute	Value
name	WiMAX Config
AMC Profile Sets Definitions	(...)
Contention Parameters	(...)
Number of Retries	uniform_int (1, 10)
Efficiency Mode	Efficiency Enabled
MAC Service Class Definitions	(...)
FDM PHY Profiles	(...)
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Number of Subcarriers	(...)
Frame Structure	(...)
Duplexing Technique	TDD
TC Sublayer Overhead Factor	0
Frequency Band	(...)
Frequency Division	(...)
SC PHY Profiles	(...)
Number of Rows	1
Row 0	...

Figure 3: WiMAX configuration attributes in the Client-Server model

IV. SIMULATION SETUP & RESULTS

A detailed explanation of the distributed Client-Server model simulation together with the configuration of the network traffic is given below.

A. Scenarios for the Existing Model

In the scenario 1 of the existing model, 4 WiMAX Base Stations were used to design the network with 80 SSs, out of which 20 SSs are situated around each one BS. While in scenario 2 of model 7 WiMAX BSs were developed with 140 SSs and also with 20 SSs surrounding each BS without any selected Server BSs as shown in Figure 4.

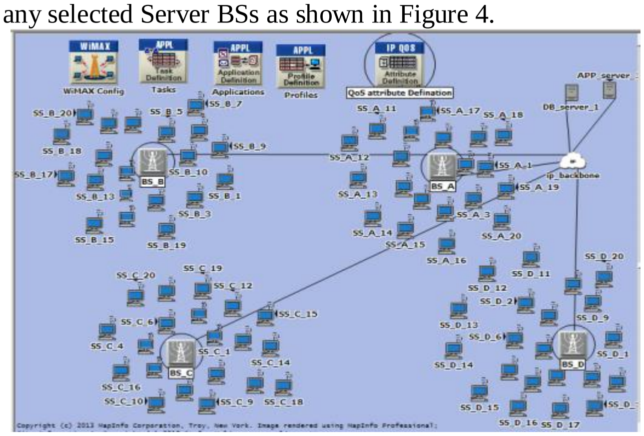

Figure4: Scenario_1 of the Existing Model

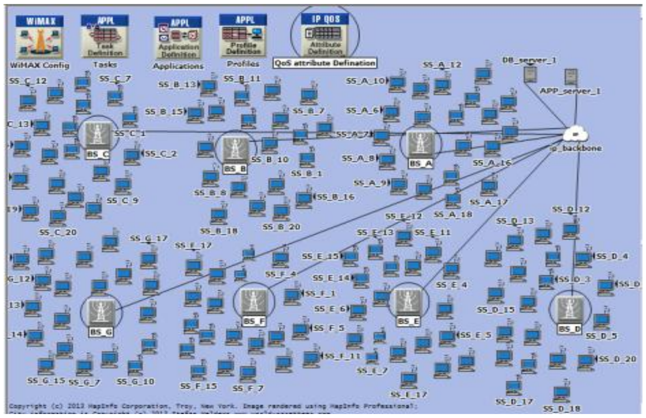

Figure 5: Scenario_2 of the Existing Model

In the scenario 2 of the existing Centralized model, there are eight (8) WiMAX Base Stations with eighty (80) Subscriber Stations. Ten (10) SSs around each BS and also all nodes are configured as in scenario 1of the existing model as described in Figure 5.

B. Scenarios for New Distributed Client-Server Model

The proposed model scenario 1 also comprises of 4 WiMAX Base Stations with 80 SSs, 20 SSs around each BS. Also, all nodes are configured in order to simulate using OPNET software. In this scenario Base Station A and D selected as Server BSs as illustrated in Figure 6.

The scenario_2 of the Client-Server model comprises seven (7) WiMAX BSs with 140 SSs out of which 20 SSs situated around each BS with BSs A, B and F as Servers selected by the Nearest Neighborhood Algorithms as shows in Figure 7.

C. RESULT AND ANALYSIS

In this Section, the results of the VoIP throughput for the existing Centralized and the Distributed Client-Server models were discussed.

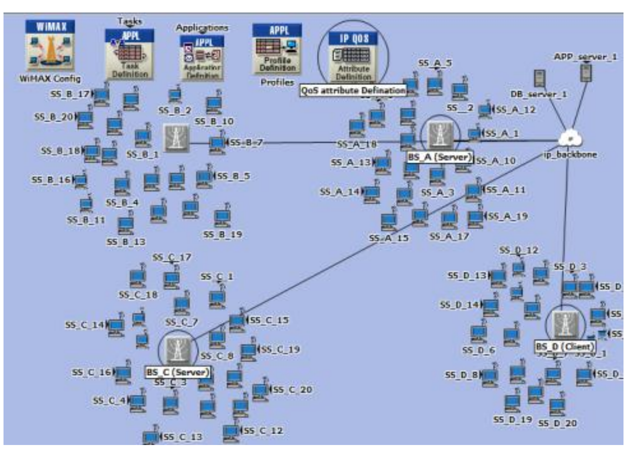

Figure6: Scenario_1 of the Distributed Client-Server Model

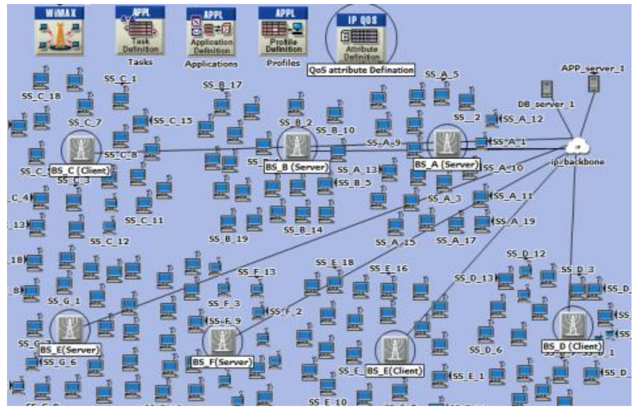

Figure7: Scenario_2 of the Distributed Client-Server Model

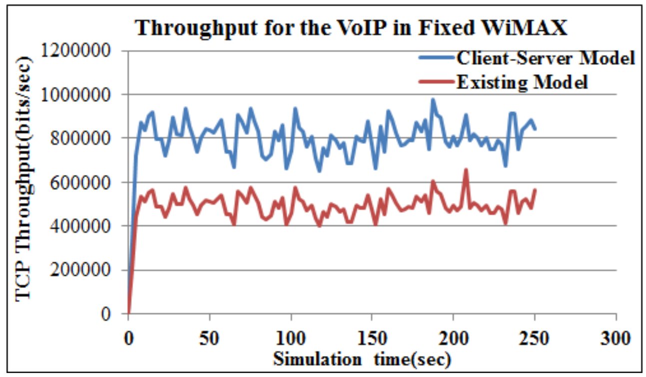

Figure 8: Scenario_1 of the Existing and the Client-Server models throughput for VoIP Results

The VoIP throughput of the existing and the Distributed Client-Server models in scenario 1 and scenario 2 is shown in Figure 8 and Figure 9 respectively.

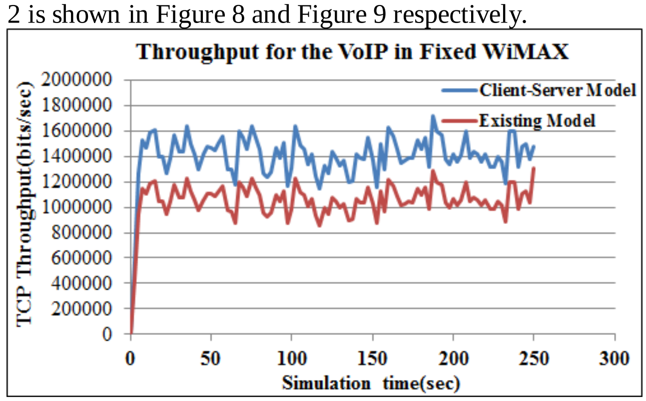

Figure 9: Scenario_2 of the Existing and the Client-Server models throughput for VoIP Results

The throughput for the VoIP in fixed WiMAX Network is represented in (bits/sec) and time in (sec) during the OPNET modeler 16.0 simulations for scenario 1 of the two models. The X axis of the scenarios of the two models represents the simulation time in seconds, while the Y axis represents the throughput for the VoIP in bits/sec. With the bandwidth of 20 MHz, the received maximum VoIP throughputs for the downlink and the uplink are observed and the maximum VoIP throughputs for two models are approximately 658088bits/sec and 979634bits/sec at time t= 207sec and t=187sec respectively. While in the scenario 2 of the two models the throughput for VoIP was increased. The maximum VoIP throughputs for the Centralized and new distributed Client-Server models in scenario 2 are approximately 1307724bits/sec and 1718656bits/sec at time t= 189sec and t=250sec. This is because of the introduction of Client-Server BSs and OFDM techniques for network transmission in the new distributed model. The Centralized Model has no client-server BSs and used only FDM techniques.

V. CONCLUSION

Quality of Services is considered to be the main issue in VoIP systems. A VoIP application requires a higher throughput, less packet loss, and a higher fairness index over the network. The VoIP throughput was designed to deliver seamless and reliable end-to-end data transfer across networks. In this regard, a throughput performance improvement model for VoIP applications in the fixed WiMAX network was developed using distributed Client-Server in order to provide the end user with improved network. The evaluation of the proposed and the existing model was conducted using the OPNET simulator. The maximum VoIP throughputs for the Centralized and new distributed Client-Server models are approximately 658088 bps and 979634 bps at time t= 207 sec and t=187 sec in scenario 1. While in scenario 2 of the two models, the VoIP throughput of the two models are approximately 1307724 bps and 1718656 bps at time t= 189 sec and t=250 sec. The results obtained for the throughput for the VoIP of the proposed Client-Server model showed an improvement in network performance over the existing Centralized model.

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