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SIMULATION BASED ANALYSIS OF VARIOUS QUEUING POLICIES IN LINKS BETWEEN ACCESS POINTS AND BACKBONE NETWORK IN MESH NETWORKS

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***Abstract*: -** WiMAX is a new technology that offers high data rate and high reliability. There are many factors and challenges that need to be taken care of and that affects the quality of services of WiMAX based networks. One factor is type of applications that are deployed or configured by using the services of 802.16 based wireless networks. Day by day, as the new applications are getting designed, the performance evaluation of WiMAX based networks to measure the quality of services of networks is required again and again. In the given work, various networks are designed by using WiMAX based wireless nodes by using a discrete event simulator 'OPNET'. To generate data in the networks, three different client-server architecture based applications generating high load FTP, high load HTTP and heavy Email data. To manage the data in the networks, priority queues are configured between access point and backbone network. For congestion control in the queues, Random Early detection (RED) algorithm has used with optimized configuration parameters. Various performance evaluation metrics are used to evaluate the performance of the designed network to rate the quality of services. After running intensive simulations, it has concluded that, WiMax shows high quality of service rates, when the networks are used to transfer HTTP based data and the performance of the networks degrades, when the network is used to upload or download the data i.e. if the networks use FTP based application.

Introduction:

WiMAX stands for Worldwide Interoperability for Microwave Access. WiMAX technology provides wireless broadband service for fixed and/or mobile users, and became a reality in 2006 when Korea Telecom started the deployment of a 2.3 GHz version of mobile WiMAX service called WiBRO The first version of the IEEE Standard 802.16-2001 Alexander Sayenko, limo Hamalainen [1] was completed in October 2001 and published on 8 April 2002 which defined the Wireless MAN™ air interface specification for wireless metropolitan area networks (MANs). The intention behind the first release of the standard was to define a technology for broadband wireless access (BWA) for fixed users, as an alternative to cabled access networks, such as a digital subscriber line (DSL) links.

Most researchers are familiar with the technical features of Wimax technology but the evolution that WiMAX went through, in terms of standardization and certification, is missing and unknown to most people. Knowledge of this historical process would however aid to understand how WiMAX has become the widespread technology that it is today. Therefore, Daan Amina Al-Sawaai, Irfan Awan and Frewell [4] presents a survey on all relevant activities that took place within three important organizations: the 802.16 Working Group of the IEEE (Institute of Electrical and Electronics Engineers) for technology development and standardization, the WiMAX Forum for product certification and the ITU (International Telecommunication Union) for international recognition.

In addition to this standard, some methodologies and paths for controlling and evaluating of IEEE802.16 standard are given by Xudong Wang a, Azman O. Lim [13]. Their main focus is on classifying and evaluating some basic subjects and topics in IEEE802.16 , based on WiMAX technology. A. Bacioccola, C. Cicconetti [1], first presented a historical overview of the IEEE 802.16 standard from the first version released in 2001 to the current version. Then, they have provided a detailed technical analysis of the PHY, MAC layer, and other relevant aspects of the new standard, including a detailed description of its relay architecture and support for self organizing networks and Femto cells. The IEEE 802.16 is a standard for broadband wireless communication in Metropolitan Area Networks (MAN). To meet the QoS requirements of multimedia applications, the IEEE 802.16 standard provides four different scheduling services: Unsolicited Grant Service (UGS), real-time Polling Service (rtPS), non-real-time Polling Service (nrtPS), and Best Effort (BE). Verification of effectiveness of these four different scheduling

services wad done by Claudio Cicconetti, Amina Al-Sawaai, Irfan Awan and Fretwell [3][11] in managing traffic generated by data and multimedia sources. Performance is assessed for an IEEE 802.16 wireless system working in Point-to-Multipoint (PMP) mode, with Frequency Division Duplex (FDD), and with full-duplex Subscriber Stations (SSs). To ensure meeting the QoS requirements, the 802.16 base station must run some algorithm to allocate slots between connections. A simple and an efficient solution that is capable of allocating slots based on the QoS requirements, bandwidth request sizes, and the 802.16 network parameters is proposed by Yunxia Feng [2] [12]. To test the proposed solution, 802.16 MAC and PHY layers are implemented in the NS-2 simulator. According to the simulation results, the proposed scheduling solution ensures the QoS requirements of all 802.16 service classes.

***Objectives*:** Various objectives of the proposed work are:

1. To study about the working, deployment and applications of wireless mesh networks.
2. To study various queuing mechanism used to avoid congestion and data drop for wireless mesh networks.
3. Various factors required to identify an efficient queue management policy will be determined.
4. To choose various performance evaluation metrics to evaluate the deployed queuing policies efficiently.
5. New high traffic load data applications will be designed for wireless mesh networks to generate intensive data in the networks.
6. To find out the best queue management policy for wireless mesh networks under highly congested networks.

Network Design And Implementation

WiMax Network and Configuration Parameters

To meet the defined objectives, various networks are designed as shown in figure1. Each network consists of 15 hexagonal shape cells. In each cell, there are 20 WiMAX based mobile nodes using OFDMA at physical layer. To make the inter cell communication possible, each cell consist of an access point and all the access the points are connected through a backbone network by using fiber optics based point-to-point links. To generate the data in the network and to evaluate the quality of services of the network, three different client-server architecture based applications, such as FTP, Email and HTTP are configured by using application definition utility and profiles of all the defined applications are defined by using profile definition utility.

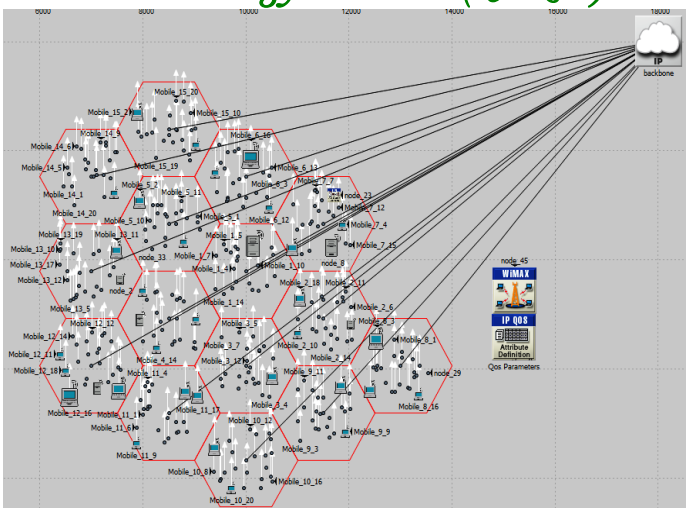

Figure 1. Sample network scenario

To manage data flow in the network, weighted fair queue (WFQ) mechanism has been used and to control the occurrence of congestion in the queues, Random Early Detection (RED) algorithm has used configured by using optimized parameters table 1. For working of any network, routing protocols are also required. In the given networks, an ad hoc network routing protocol, AODV has used at node level with optimized configuration of parameters table 1 and at access point level, Border Gateway Protocol (BGP) has used with default values.

General Configuration Parameters

Table 1 lists all the important general parameters and values that are used to simulate the networks. All these parameters are common to all the networks designed for simulations. All the research is carried out by using a discrete event simulator known as OPNET (Optimized Network Engineering Tool) version 14.0. It is one of the most widely used commercial simulators based on Microsoft Windows platform and incorporates more data management queue parameters as compared to other commercial simulators available.

S. No	Parameters	Values
1.	Data Rate	2Mbps
2.	Simulation Area	1000x1000 Meters
3.	Route Cache	50 Routes
4.	Node Mobility	Vector
5.	Nodes	300
6.	Size of Data Packets	1024
7.	Packet Interval	1 sec

8.	Routing Protocol	AODV
9.	PHY Profile Type	OFDM
10.	Ranging Power Setup	.25mW
11.	Contention Ranging Retries	16
12.	Simulation Time	1800 sec

Table 1 General Parameters

PHY profile type attribute defines the class of the PHY profiles. PHY profiles are grouped into two main classes such as Single Carrier (SC, SC-a) and Orthogonal Frequency Division Multiplexing (OFDM, OFDMA). A BS node and its associated SS nodes should be configured with the same PHY profile type. Ranging power setup attribute sets the power step used by the MS in initial ranging, before a response is heard back from the BS. According to section 6.3.9.5.1 of 802.16e-2005, "if the SS does not receive a response, the SS shall send a new CDMA code at the next appropriate Initial Ranging transmission opportunity and adjust its power level." The power step used in this adjustment is specified by this attribute. Contention Ranging Retries is the number of retries to send contention ranging requests. As 802.16-2004, the number of retries is no less than 16. A retry to send a ranging requests (message or CDMA code) happens when T3 seconds elapse since the last try, without a response arriving to the BS in this T3 seconds interval.

WiMAX Layer In this table Maximum Transmission Power refers to the total transmission power that this transmission can output on the entire channel bandwidth. The Ranging Power Setup attribute sets the power setup used by MS in initial ranging before a response is heard back from BS. The Contention Ranging Retries sends the requests. The Multiple Path Channel mode is defined on the SS and it applies to the channel between this SS's transmitter and BS receiver. The Timer attribute is used to group linear settings that are relevant to the operation of MS.

Results and Analysis Various performance evaluation metrics have used to measure the quality of services of *WiMAX* nodes under different types of client-server architecture based applications. All the results of various metrics in graphical and tabular form are presented in this . In the last conclusion has drawn and future scope has proposed.

Performance Evaluation Metrics All the evaluation metrics that are used to evaluate the networks are as follows:

Load:Represents the total load (in bits/sec) submitted to WiMAX layers by all higher layers in all WiMAX nodes of the network.

Throughput:This statistic represents the average number of bits successfully received or transmitted by the receiver or transmitter channel per unit time, in bits per second.

Queuing Delay:This statistic represents instantaneous measurements of packet waiting times in the transmitter channel's queue. Measurements are taken from the time a packet enters the transmitter channel queue to the time the last bit of the packet is transmitted.

Delay: Represents the total load (in bits/sec) submitted to WiMAX layers by all higher layers in all WiMAX nodes of the network.

Results and discussions :

After the intensive simulation, all the results that are generated are given below.

Utilization

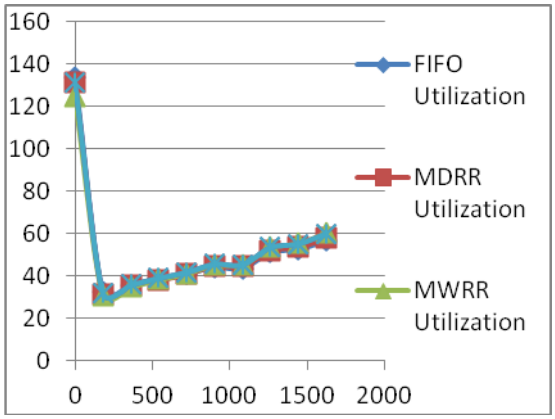

Figure 2 Utilization

WiMAX has shown maximum, utilization for http application because of the large size of the objects configured for the web pages and in each web pages, It has seen that the load is minimum for ftp protocol because ftp uses two different port to send data such that for uploading, ftp uses port number 20 and for download the files, it uses port number 21. Due to the involvement of two different ports, there are always high chances to find the channel busy and nodes have to wait to place the data over the carrier than other applications. But due to the high bandwidth, WiMAX shows its good sustainability.

Queuing Delay

Figure 3 has shown delay for all kind of data traffic flowing in the configured networks. WiMAX has shown almost same delay for all type of data packets. But it has seen that WiMAX has shown less delay for http based data traffic and shown maximum delay for ftp based data traffic because of the busy carrier and nodes have to wait to place the data over the channels. Also ftp protocol has also more prone to data drop than the other applications such that email and http.

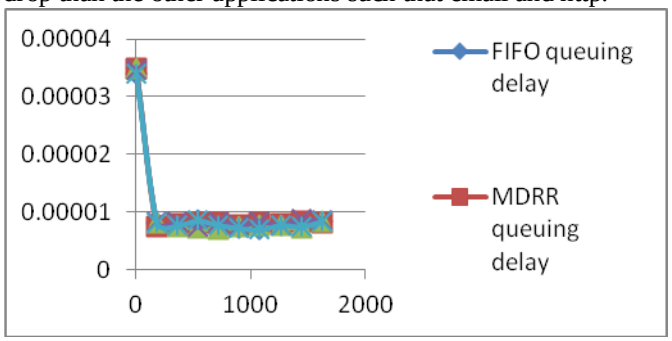

Figure 3 Queuing Delay

Throughput (bits/sec)

From the literature survey, it has seen that throughput always considered as a main factor to measure the quality of services of a network. Throughput of all wimax based networks under different type of applications are given in figure 4. From the graph, it has clearly shown that the rate of quality of services for http data is high in comparison to other types of data because http application posses minimum delay and maximum load than other applications such as FTP and Email.

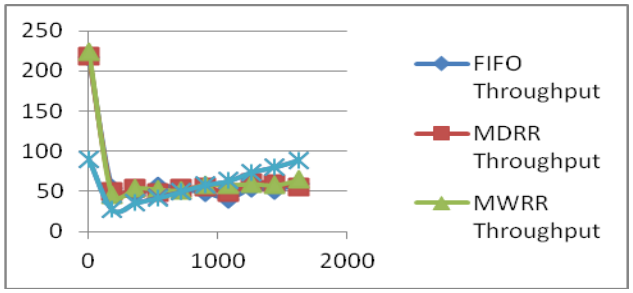

Figure 4 Throughput (bits/sec)

Conclusion

In the given work, various WiMAX based wireless networks are designed and each network consists of 15 hexagonal shaped cells with 20 WiMAX based node in each cell. To generate the data in the networks, three different applications, such that high load FTP, high load HTTP and heavy Email generating different types of data are configured. After the intensive simulation, the results are gathered in graphical and tabular form. From all the graphs, it has concluded that under the given conditions and given configurations, WiMAX shows high quality of service rates, when the networks are used to transfer HTTP based data and the performance of the networks degrades, when the network is used to upload or download the data i.e. if the networks use FTP based application.

Future Scope There will be always scope to improve the work that has done in this study. The results could be improved by choosing other configuration parameter and by running simulations for longer period. In this work only client-server architecture based applications are used. So it is also required to evaluate the quality of services of WiMAX based networks under peer-to-peer architecture based applications. Other performance evaluation metrics need to use to make the concluded results more justified.

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