COST EFFECTIVELY DEPLOYING OF RELAY STATIONS (RS) IN IEEE 802.16M

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***Abstract*— The relay stations are broadly employed in major wireless technologies i.e. WiMAX (Worldwide Interoperability for Microwave Access) and LTE (Long term evolution) which offer cost efficient service to the operators and end subscribers. It is quite challenging to offer guaranteed Quality of Service (QoS) in WiMAX networks in cost efficient way. The primary aim is to reduce the total deployment cost in relay stations and use the existing spectral resources as effectively as possible to reduce the delay and increase throughput for end users with high demanding applications i.e. voice and video. Having in mind the cost and the increasingly more demanding applications with ever growing number of users, primary consideration of this paper have adjust the parameters and contribute to the techniques in cost efficient manner to enhance QoS. Within the pool of scheduling algorithms and for the aim of attaining effective link adaptation methods, radio resource management, cell sectoring, AMC scheme and directional antenna have been studied. Some of the IEEE802.16m standard parameters are not supported in current version of OPNET 16.0 because of new amendment and evolution of new techniques employed on WiMAX2.**

Keywords: AMC, LTE, QoS, OPNET, WiMAX, RS

I. Introduction to WiMAX and WiMAX2

or cable connections are very generally utilized by average internet subscribers because they are fast, affordable, and reliable. WiMAX has the possibility to permit the broadband service suppliers to offer reliable and fast wireless broadband. WiMAX was demonstrated as a Standard for WLANs (wireless Metropolitan Area Networks) by IEEE. The first WiMAX protocol was formulated for static wireless broadband access and later on approved by IEEE in 2005 with mobility support and called as IEEE 802.16e [2]. The first WiMAX work in the range of 10-66 GHz and lower band function in frequency range from 2-11 GHz. WiMAX technique depends on point to multi point technology. IEEE 802.16m or WiMAX2 is the improved version of WiMAX which depends on its previous version IEEE 802.16e with extra features i.e. it provides support to 300 Mbps data rates with mobility while 802.16.2-2004 provides support to data rate of 100 Mbps. Thus, IEEE 802.11 can enhance VoIP capability with low latency to fulfill the need of 4G (International telecommunication union). WiMAX2 utilizes OFDM (orthogonal frequency division multiplex) and other advance antenna technology i.e. MIMO (multiple inputs and multiple outputs) for best performance. The primary aim of IEEE 802.16m WiMAX standard is to enhance spectral efficiency, enhance VoIP capacity, speed coverage range and handover. The IEEE 802.16m functions within the radio frequency range from 2 to 6 GHz and it also provides support to scalable bandwidth of range 5 to 20MHz.

The important characteristics of WiMAX2 are :

- The highest and channel spectral efficiency has been enhanced which helps and offers better spectral efficiency for the subscribers at the cell edge.
- The total VoIP capacity has also raised with the support of user plane latency, also the handover limitation also reduced. The existing channel bandwidth in WiMAX2 is scalable to 40MHz.
- Throughput assumes to be at least three times more than the available mobile WiMAX or IEEE 802.16e.
- Mobility support should expand to 350 km/h
- Single user and multi user MIMO for throughput improvement
- New and improve RS which offers better throughput ability with MIMO
- It supports broadcast and multi cast services
- Improved energy efficiency enabled for power savings
- It provides support to femtocells which are low power base station (BS) to increase the coverage.

II. Relay Station in WiMAX

Relay stations increase the throughput, capacity and coverage region of BS (Base station) in the techniques i.e. LTE and WiMAX and LTE. At early stages, relay stations were utilized to function as repeaters, and their main objective was to rise the signals obtained from BS. However, the booster did not have the ability to eliminate errors, enhance throughput for long distance interaction and also lead inter cell interference. But, after the introduction of IEEE 802.16j which is the first standard for relay station, several new characteristics are added in RS to improve the functionality of the relay stations

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building them much more intelligent devices to function well with BS (Base Station) and offer better performance to end subscribers. The RS is able of rising the signal and also it has some added characteristics i.e. error correction, compression and decompression, and DF (decode and forward). In WiMAX relay stations are either distributed at the cell edge to increased coverage area or they are distributed within the cell to relay the BS signal into coverage holes. Relay stations offer a low coverage, cost effective and easy to install solution for coverage region extension and to remove coverage holes. Multi-hop wireless networks utilize two or more relays to offer services to the users which are not in the range of BS. Rather than installing multiple BS, utilization of multiple relay stations is a very cost efficient solution. Relay stations are very much useful to assure QoS in WiMAX as they enhance coverage region, remove coverage holes, enhance capacity and throughput of the network. The fig above depicts the operation of relay stations in a WiMAX network. Here RS of NTR-RS (non transparent relay station) is employed to expand the coverage region as it installed at the edge of the cell and relay stations of TR-RS (transparent relay station) are utilized to remove the coverage hole as they are deployed within the cells where signal are blocked, possibly by mountains or tall building or base signal signals are not strong enough to interact.

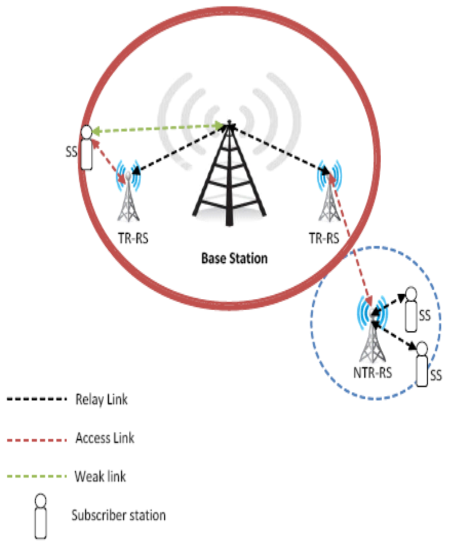

Fig.1 Operation of relay stations in a WiMAX network

The link from BS to Rs known as relay link and from SS (subscriber station) to RS known as access link.

III. Simulation Environment

OPNET is a powerful tool, which offers an excellent graphical user interface (GUI) facility to subscriber. Following are the steps needed to generate the WiMAX network in OPNET Version 16.

- generating the initial Topology
- generating WiMAX deployment scenario
- Adding Traffic to the WiMAX Network Model
- Configuring, BS, SS and WiMAX Parameters
- Simulating and examining results

In order to run the simulation, the efficiency mode, service class and some other parameters required to be specified. To do the analysis of the WiMAX and WLAN network model, the statics can be gathered globally and individually.

To generate WiMAX topology various instructions required to be followed. The first step is to make the subnet with mobile subnet and link both with IP cloud. In subnet network, the server with router required to be positioned which later link with backbone by router. In subnet, where two video and voice servers linked with router in order to obtain the results depending on video and voice profile. The profile, application definition and WiMAX tower tabs are also positioned to adjust the parameters depending on voice and video applications. After designing application process, the configuration based on cost has been deployed utilizing wireless network topology deployment where three cell topology draw and random set of SS nodes chosen with three BS and the whole BS are linked to core network's router utilizing IP backbone while PPP_Sonet cable is utilized for connectivity. Ethernet cable is utilized to link router from server holding video and voice application.

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IV. Results and Analysis

There are various scenarios and deployment possibilities with RS to manage the total network capabilities as well as user satisfaction. The primary concentration depends on two different contribution scenarios which depend on cost effective solution for RS deployment where total cost can be decreased and keep QoS standard. The second scenario where delay and throughput parameters considered to evaluate the performance of RS with various deployment environments.

4.1 Cost Scenario: Throughput Analysis

The throughput evaluated below is based on various RS deployment scenarios which are as follows.

4.1.1 Throughput Using Directional Antenna

The directional antenna beam can be useful for throughput improvement and link budget as it conducts its main lobe towards one direction and small side lobes to other directions to cover the cell region.

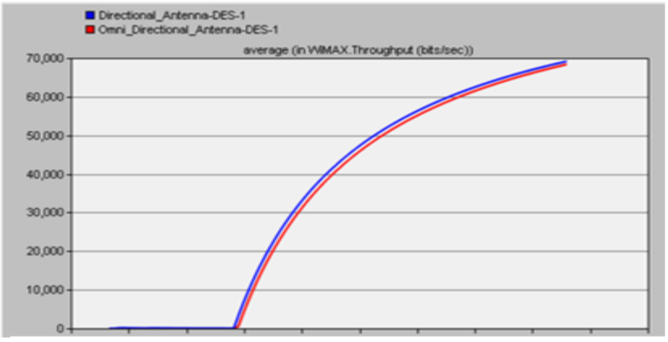

Figure 4.1 Results of throughput with Omni and directional Antenna

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The mean throughput with Omni and directional antenna are depicted in figure 4.1

4.1.2 Throughput Comparison with Three and Four RS

The throughput evaluation of three and four RS is depicted in figure 4.2. However, when four RS deployed in the same configuration then the throughput enhanced as the distance reduced from RS to EN.

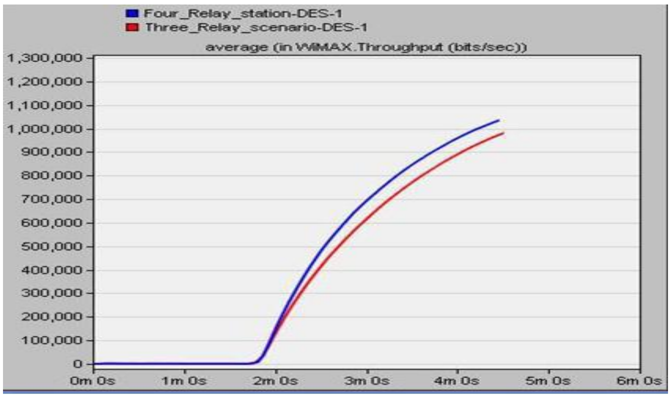

Figure 4.2 Throughput comparisons with four and three RS

4.1.3 Throughput measurement of End nodes

The result in figure 4.3 indicates the mean throughput of three nodes positioned at different angles. The node two is near RS and have high throughput in comparison of node five and node six.

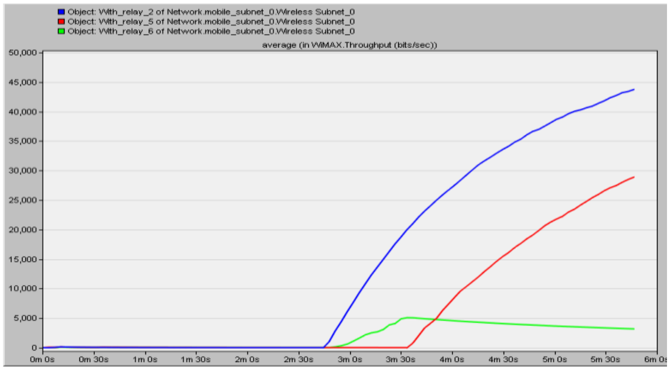

Figure 4.3 The average throughput of three nodes placed at different angles

4.2 Cost Scenario: Delay and Load

To examine the cost effective RS deployment analysis of load and delay is conducted.

4.2.1 Comparison of Load with Three and Four RS

The total load will increase when three RS are utilized as the number of subscriber arbitrarily divided up with three relay stations. However, the load can be reduced by effective utilization of resources. Figure 4.4 indicates the average effect of load in three and four RS scenarios.

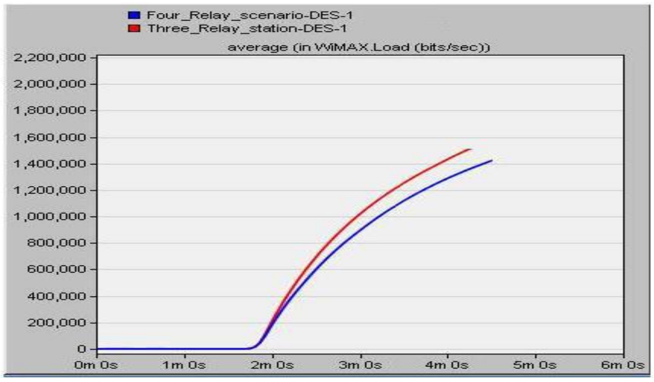

Figure 4.4 Average load using three and four RS

4.2.2 Comparison of Delay in Four and Three RS

Figure 4.5 indicates the average delay utilizing three and four RS. The average delay with three RS is enhancing because of high total load on the network.

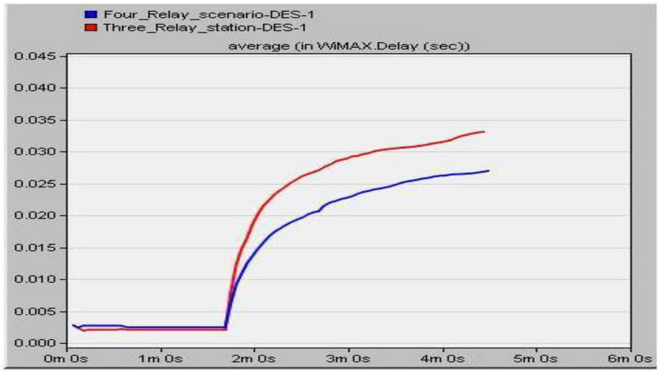

Figure 4.5 Average delay three and four RS

4.3 QoS Classes Comparison

The comparison of QoS provides in detail understanding of every class and its matrices i.e. delay, throughput, packet loss, traffic obtained and traffic sent with bandwidth request possibility.

4.3.1 Throughput with QoS classes

The figure 4.6 indicates throughput for various QoS classes, amongst all other classes where UGS class has higher throughput as packet lost possibility is low,

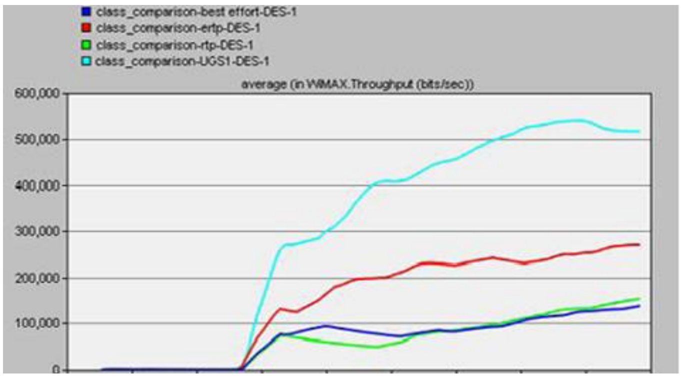

Figure 4.6 Throughput with QoS class's comparison

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4.3.2 Load with QoS classes

The effect of load on all the service classes is nearly same as throughput. The figure 4.7 indicates the effect of load on UGS class which is higher or the same as UGS.

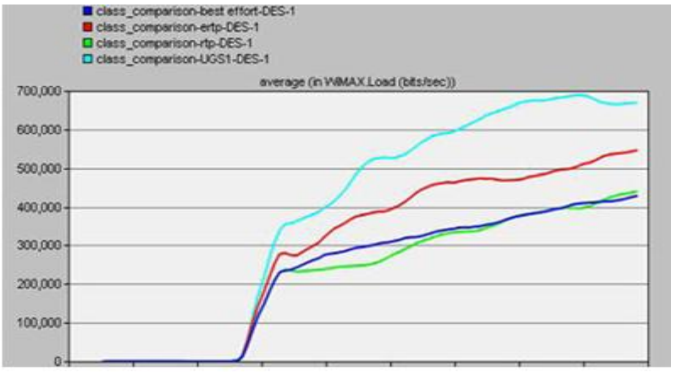

Figure 4.7 Average load with QoS classes' comparison

4.3.3 Traffic Sent with QoS Classes

The traffic sent parameter has been selected to find the number of packets sent successfully utilizing each class.

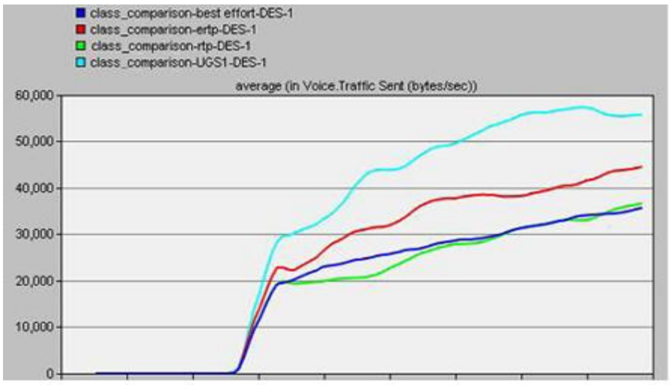

Figure 4.8 Average Traffic sent with QoS Classes comparison

Conclusion

The work done in this paper evaluate the effect of QoS and cost effective placement in WiMAX network. The QoS can be evaluated and compared with various QoS parameters. . In our simulation results, we have compared various scenarios and models for a WiMAX network depending on different environment within the configuration. After simulating the results, we determined the important factors which influences the network performance can be distance from RS to MS and from BS to RS, cell size, the LOS and NLOS communication as it can lead propagation delay etc. In this paper, we studied two views of RS

- Based on cost effective deployment of RS
- Based on QoS in RS.

Firstly, three RS deployed to deal with the territory of the BS and also compared the simulated results with four RS topology. There were a small difference in throughput and SNR but compared with cost, we can conclude that the total performance may be little bit reduce but we are presering cost for entire network. Secondly, The QoS parameters have been taken into consideration for better RS performance. The performance factor of any wireless technology depends on various aspects i.e. cell size, cell planning, scheduling types, antenna type applied to reduce the delay and enhance the performance.

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