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Optimization and Improving Throughput on WiMAX Mobility

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Abstract*—The demand for broadband services is growing sharply today. The traditional solutions to provide high-speed broadband access is to use wireless access technologies, like most data communications, WiMAX (Worldwide Interoperability For Microwave Access) relies on a process consisting of a session setup and authentication. The Radio Link Control (RLC) manages and monitors the quality of the service flow. With WiMAX, this process is a series of exchanges Download and Upload (DL and UL) between the Base Station (BS) and Subscriber Station (SS). In this paper we discussed a method to improving the throughput in mobile subscribers moving within the coverage. The IEEE 802.16 standard is introduced and especially Hand Over (HO) procedure. This paper shows that the IEEE 802.16 system has the capability to fulfill the requirements regarding the mobility management of future communication systems.

***Index Terms*— BS, HO, RLC, WiMAX.**

I. INTRODUCTION

WiMAX is one of the most popular BWA technologies today, which aims to provide high-speed broadband wireless access for Wireless Metropolitan Area Networks (WMANs). The air interface standard, IEEE 802.16, commonly referred to as WiMAX, is a specification for broadband wireless communication standards developed for WMANs, which supports fixed, nomadic, portable, and mobile broadband accesses and enables interoperability and coexistence of BWA systems from different manufacturers in a cost-effective way. Compared to the complicated wired network, a WiMAX system only consists of two parts: the WiMAX BS and WiMAX (SS) [3]. Similar to the different cellular and broadband technologies, global mobility related research in WiMAX is mostly focused on two main areas of concern: location management and handover management [1]. The IEEE 802.16e BWA defines several steps of HO [2]. Before HO initiation, network topology acquisition including network topology advertisement, neighboring BS scanning, and the target BS association are carried out helped by backbone network. Then, cell reselection, HO decision, HO initiation, downlink synchronization with the target BS, initial ranging, termination service with the serving BS, authorization, and registration are performed during the actual HO. Unnecessary neighboring BS scanning and association are conducted before and during HO process. Once HO process is initiated, data transmission is paused until the establishment of the new connection. It causes service disruption for some time. Thus, the IEEE 802.16e provides neighboring BS scanning opportunity before HO initiation. Since it is done before the actual HO, data transmission is not paused but interleaved with neighboring BS scanning. However, system throughput is degraded because they share the same wireless resources [4]. It is evident that determining the duration and frequency of channel scanning will have a direct impact on the application traffic and the resulting quality of service supported. A long scanning interval increases the packet jitter and the end-to-end delay, thus imposing large buffer sizes. On the other hand, a short scanning interval requires multiple iterations, thus increasing the overall scanning duration [5], With OPNET 14.5 modeler simulator, scenarios (1,2,3) are presented to clarify the relation between Signal to Noise Ratio (SNR) and throughput and the coverage area for each BS.

II. SCENARIO 1

The objective of this scenario is to show the normal operation of mobility and HO presented. Consider a MS visiting several BS with specific speed, and study different parameters that effect on the design of the system and discuss methods for enhancement. As shown in Fig. 1 , MS moving with speed 120 km/h along trajectory and visiting four BS (0,1,2,3) , all base stations are connected to IP-backbone and this connected to application server to ensure HO operations.

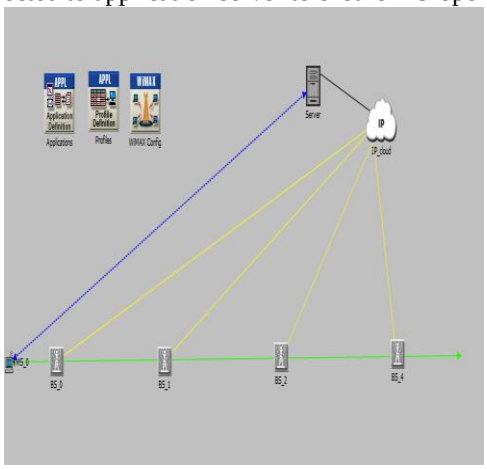

Fig. 1. Mobility on WiMAX

Orthogonal Frequency Division Multiplexing (OFDM) profile: base frequency is 3.5 GH and bandwidth is 20 MHz, same data rate for DL and UL. Scanning threshold dB is 54 and interleaving interval is 140f. Simulation time is 900 sec.

RESULTS

As shown in Fig. 2 scanning interval activity almost continuing along the simulation time because SNR is less than the SNR threshold declared, since the decision for MS to switch from one BS to another BS taken when detected SNR

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become greater than the current BS, no need to keep scanning activity running all the time, if we reduce SNR threshold that will cause reducing scanning activity and increase throughput. But first, it is very important to determine the minimum SNR enough to guarantee services to be working at acceptable rates and that led to scenario 2.

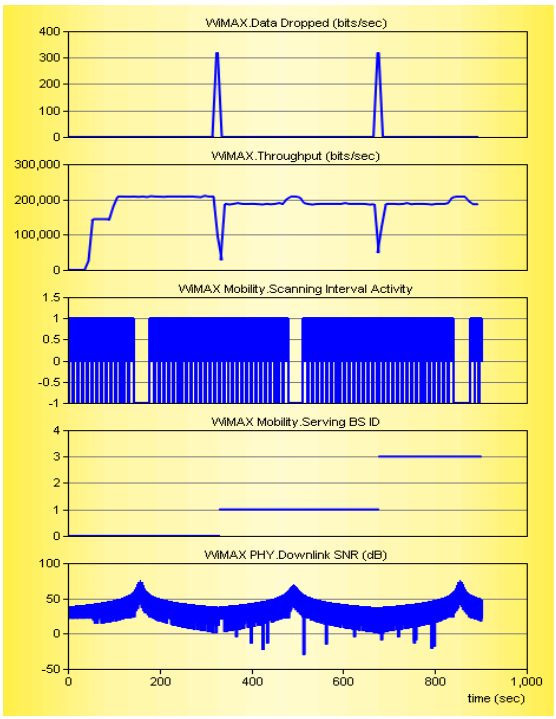

Fig. 2. Data Drop, Throughput, Scanning intervals, Serving BS, SNR

III. SCENARIO 2

The objective of this scenario is to determine the minimum value of SNR attribute enough to guarantee throughput and ensure services delivered with acceptable rates. Fig. 3 shows MS traveling along trajectory moving away from BS, for first state MS connected initially to BS and the services are delivered ideally, in conjunction with estrangement MS and BS the throughput will decreases till degraded and become not acceptable, the setting is similar to simulation 1 and simulation time is 20 min .

Results:

As shown in Fig.4 It's clear that the throughput starts normally with accepted rates and gradually it reduced and then degraded at second 600 and SNR is 28-30 dB at this time, which mean that the minimum SNR needed to preserve throughout and keep it with an accepted rates is approximately 30dB and the distance away from BS needed to degraded services is approximately 13 Kilometer ,according to this the distance between two BS 's is approximately 25 kilometer at straight line, in the next scenario SNR thresholds will be limited to 30dB and re-arrange the BS 's positions with new distances between them and see what happens

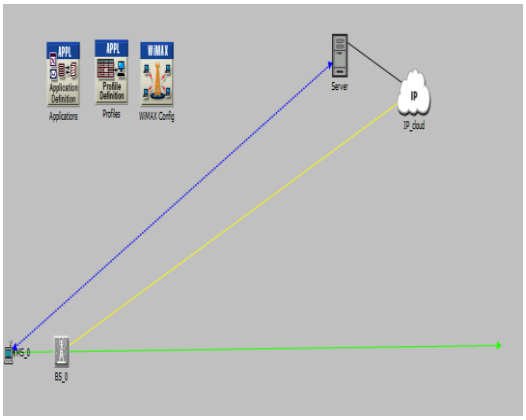

Fig. 3. MS moving away from BS

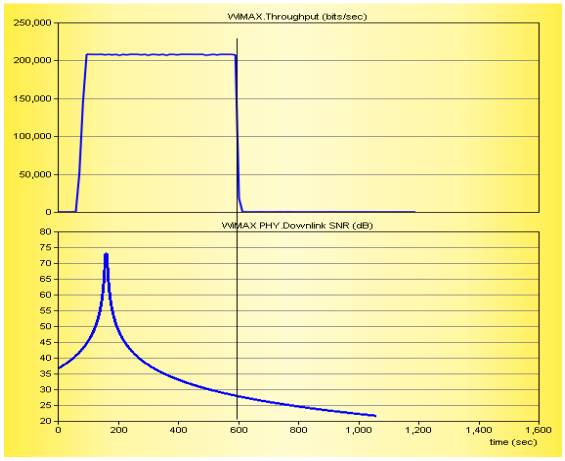

Fig. 4. Throughput against SNR

IV. SCENARIO 3

The objective of this scenario is examine the same network in scenario 1 with the new SNR threshold from 54 dB to 30db and new distances between BS's which mean 25 Km between two BS's as shown in Fig. 5 .The OFDM profile similar to scenario 1.

Results:

As shown in Fig. 6 and comparing with Fig. 2. The scanning activity reduced to the lower limit, of course throughput increased and number of BS's reduced.

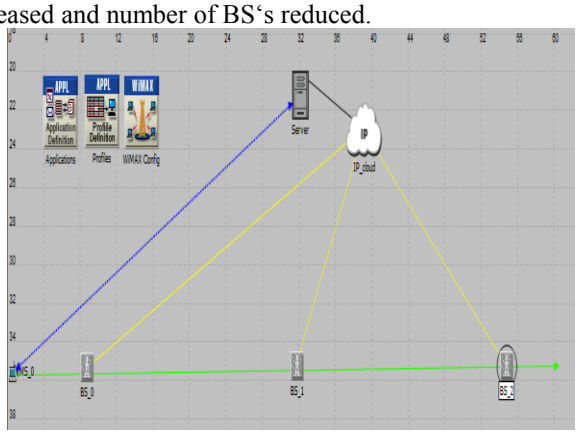

Fig. 5. MS Moving with SNR Threshold 30dBb and 25 Km apart

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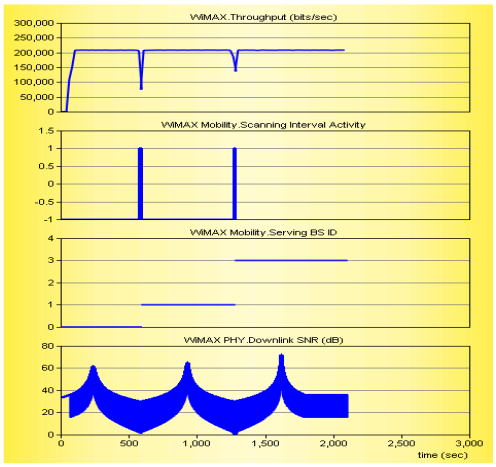

Fig. 6. Throughput, Scanning Interval, HO, SNR

V. CONCLUSION

Neighboring BS scanning opportunity provided before HO initiation. Since it is done before the actual HO, data transmission is not paused but interleaved with neighboring BS scanning. However, system throughput is degraded because they share the same wireless resources. It is evident that determining the duration and frequency of channel scanning will have a direct impact on the application traffic and the resulting quality of service supported. In this article, we addressed the design issues of a WiMAX network to better performance. We proposed a set of design guidelines for the WiMAX networks. Within the proposed framework, we further discussed the effects of SNR threshold on the throughout and the distance between BS's. For each OFDM profile different coverage distance and throughput which differs from the other profiles.

- In order to obtain the highest throughput in WiMAX wireless resources for specific OFDM profile, scanning activity must be reduced to the lowest limit, i.e. scanning activity activated only if there is a need to it.
- Throughput degraded at specific SNR value, this SNR value can be used to determine the exact value of SNR threshold needed to reduce the period of scanning activity and ensure throughput from being degraded.
- Coverage area for each BS can be determine accurately, in other hand that will cause increasing in power dissipated, and throughput increased with reducing scanning activity.

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AUTHOR'S PROFILE

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