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# An Optimized Parametric Approach for Improving Handover in WiMax

**Naveen Kumar, Parmender Balyan, Poonam Yadav**

***Abstract: WiMAX network is one of the high speed networks that provide the high level security and reliability over the network. One of the common problems in WiMax network is the handover mechanism. Most of the chances of data loss and intrusion are during the handover process. To get the better efficiency and throughput an efficient handover mechanism is required. This paper proposes an optimized handover scheme for mobile WiMAX networks that tries to minimize packet loss during handover. With the help of simulation we will show that this scheme is more efficient then traditional handover. The proposed approach is the parametric approach where some parameters are used as the decision factor to elect the nearby base station.***

***Key Words: WiMAX, VoIP, Handover, Efficient, Parametric***

## I. INTRODUCTION

WLAN, WMAN has a larger coverage area up to a city, and it has a higher data rate up to 70Mb/s. The IEEE 802.16 standard, also known as WiMAX, is being supported and promoted by a group of leading vendors of wireless access equipments and telecommunications components. The current 802.16 standard is IEEE 802.16-2004, which only addresses fixed systems. Using the 2-11GHz frequencies which can penetrate walls and other dense objects, 802.16-2004 provides transmission to stationary devices and replaces prior 802.16 and 802.16a specifications. While 802.16e is an extension of 802.16-2004 for mobile use in the 2-6GHz band. It allows people to communicate while walking or riding in cars. In Europe, ETSI developed a similar standard HIPERMAN, which is used mainly within European countries.

IEEE 802.16e clearly defined the mobility techniques in WiMAX network or handoff. Handoff means a mobile station (MS) can maintain continuous connectivity if it travels from a coverage area of one base station to the coverage area of another base station. Three types of handoffs are defined by the IEEE 802.16e, Hard handoff (HHO), Macro Diversity Handoff (MDHO) and Fast Base Station Switching (FBSS). Out of these three handoff types, HHO is mandatory and the other two are optional.

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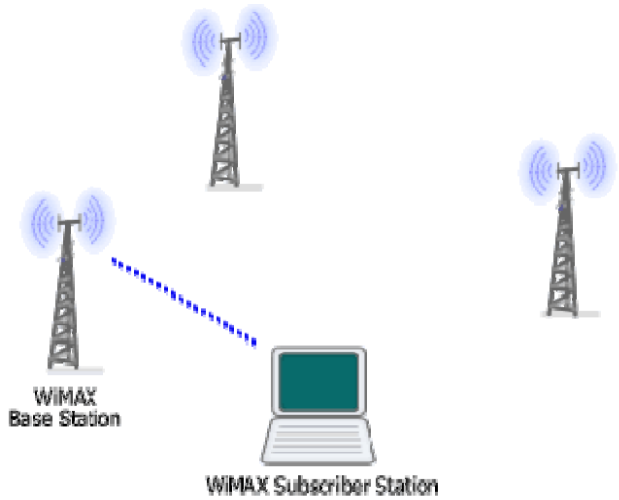


**Figure 1 : Wimax Handover**

This Figure 1 hows the hard handoff mechanism of WiMAX where subscriber station connected with one base station. During the movement, if it gets the stronger signal from the other base station, it will first break the connection with the currently connected base station and will connect with the new base station.

**Macro Diversity Handover**: In figure 2 MDHO is similar to a soft handover in nature where within a diversity set, MS maintains communication with multiple BS. A set of BS which are treated as diversity set are responsible for handoff procedure. In case of downlink within MDHO, a mobile station receives data from several base stations; as

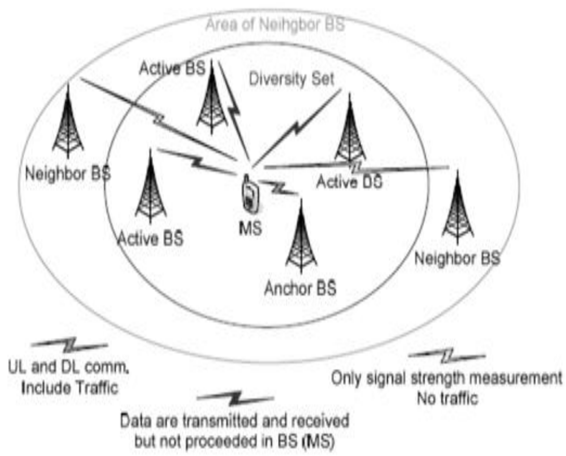


**Figure 2 : Macro Density Handover**

a result diversity could be combined within the mobile station. In uplink, MS transmits signal to several BS.



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The Selection diversity process takes place in these BS's. Neighboring BS are those which communicates with the MS and other base station with weaker signal.

**Fast Base Station Switching**: In Figure 3 FBSS, mobile station monitors all BS and selects one BS as

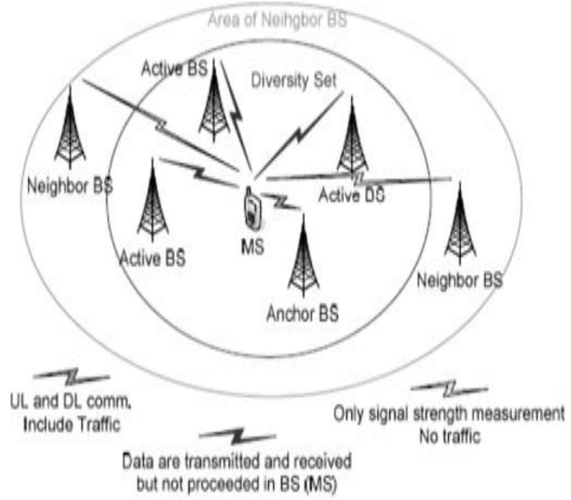


**Figure 3: Fast Base Station Handover**

an Anchor BS where it registered and passing all the uplink and downlink data. Synchronization and monitoring control information also performing through this base station.

Power control is important for system efficiency and successful communication, so it should be manage properly. Power control algorithm is implemented in the base station which regulates the power level of all subscriber station for increasing the system performance, reducing the power consumption and minimizes the interference with other BS. Power control algorithm follows different approach for LOS and NLOS communication. For LOS communication power control depends on the distance between the WiMAX tower and the customer premise equipment and for NLOS it depends on the obstacles. For fading environment, CPE should be send adequate amount of power to maintain the effective communication. Power control also depends on the modulation method, channel condition and propagation attribute.

## II LITERATURE SURVEY

S. Kim et al.[1] Explained "The Design and Implementation of tiny-WiMAX Connection Manager (t-WCM) for Specific Purposed Devices" In this paper, we propose a design and implementation technique called tiny-WiMAX Connection Manager (t-WCM) for non-PC/SC WCM to provide WiMAX services to special purpose devices. The t-WCM is composed mainly of three units; WiMAX module Control Unit (WCU), Data Surveillance Unit (DSU), and External device Program Unit (EPU). J. Martin,et al.[2] explained "The WiMAX Performance at 4.9 GHz" In this paper, we present the results from a performance analysis we have conducted of the WiMAX network. To the best of our knowledge the work reported in this paper is the first academic study of an operational 4.9 GHz WiMAX in which controlled experiments could be conducted. I-Kang Fu, et al. [3] explained The "Multicarrier Technology for 4G WiMAX System" The most efficient solution to achieve this challenging objective is to utilize wider channel bandwidth. Multicarrier is the technology to utilize wider bandwidth for parallel data transmission across multiple RF carriers, which is well agreed as one of the key technologies to satisfy ITU-R IMT Advanced requirements. It is anticipated that 4G communication systems can provide much higher transmission rates to satisfy the service requirements for the next decade. This article provides an overview of the physical and MAC layer supports for multicarrier technology specified in the IEEE 802.16m draft standard, which covers basic operation principles as well as some functional details. KUO et al[5] explained the "Adaptive Resource Allocation For Layer-Encoded IPTV Multicasting in IEEE 802.16 WiMAX Wireless Networks". The objective is to maximize the total utility (i.e., all users' satisfaction) and the system resource utilization, subject to users' channel conditions, the popularity of a video program, and the total available radio resource. We design a polynomial-time solution to this problem, and show that the difference in the performance of our proposed mechanism and the optimal solution is tightly bounded. Our mechanism supports both unicast and multicast, and both single layer and multi-layer environments. In this paper, we have proposed a utility-based resource allocation scheme, called UE-LEM, for layer-encoded multicast streaming service in WiMAX networks. This scheme can run in polynomial time and the difference of its performance and that of the optimal solution is within a small value. The performance of the proposed scheme is evaluated by simulations. We show that under the same conditions, layer-encoded programs have higher total utility than single-layer programs, making the former more suitable in WiMAX environment. K. Kulat et al [7] Explained the "Novel Approach: Codec Design for WiMaxSystem" In particular a Novel Approach which uses a concatenation of RS (ReedSolomon) and Turbo Codes for the Codec design in The WiMax Communication System is presented. The paper also discusses use of OQPSK Modulation Technique in place of the conventional QPSK system, for performance improvement. The comparative simulation results of existing WiMax System and the system using the novel approach are also provided.

## III PROBLEM DEFINATION

To provide stable HO, the IEEE 802.16e BWA defines several steps. Before HO initiation, network topology acquisition, network topology advertisement, neighboring base station (BS) scanning, and the target BS association are carried. 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. However some steps of HO process are still ambiguous and are not clearly defined [5].

Furthermore, 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. The disruption time (DT) of HO is still too long to overcome the maximum delay time of real-time services and this cause's packet loss [6].

The 802.16 standard defines the receive signal strength indicator (RSSI) or carrier-to-interference plus noise ratio (CINR) as HO trigger factor [7]. But WiMAX can serve the best average signal-noise-ratio (SNR) in the coverage area. So the probability of drop link caused by the abrupt fall of the signal quality is very low. However, the drop of the link quality caused by the congestion is more because of the support for many multimedia data services. Thus the signal strength should not be the only trigger factor. We propose in this paper to take capacity as additional trigger factor for HO.

## IV PROPOSED SYSTEM

Efficiency and the Integrity are always the major requirement for any network and when we talk about some wireless network the problem is more critical. We are proposing one of such a target cell selection scheme in case of handover in wimax network. The proposed handover scheme will evaluate the maximum effiective capacity and the idle capacity of the base station for any point of time in the network. The the triggering will be performed based on some decisison factor. Base station having the more effective capacity will be elected for the next base station after handover. The proposed system will provide a reliable and energy efficient hand over. The steps involved in the algorithm are given here

1. Let the communication is being performed between 2 nodes present in coverage area of two different base stations or they can be in same base station called Nodei and Nodej
2. During the data transmission Nodei start moving to some indefinite direction.
3. As it moving there can be the requirement of hand over. Now the following steps are performed.
   A) Find the capacity of each base station. For this we need to calculate the number of OFDM(Orthogonal Frequency Division Multiplexing) symbols and the overhead symbols in WiMAX MAC frame. For this calculaton the the Time Division Duplexing is being used in this work. According to TDD every frame is further divided in two sub frames called DL To calculate total number of OFDM symbols transmitted per frame, first we have to calculate OFDM symbol duration which is given as: $D_{OFDM}$ = useful symbol time + guard time $TD_{OFDM}$ = useful symbol time + G * useful symbol time

$$\mathbf{TD_{OFDM} = [1 / (f_s / N_{FTT})] * (1 + G)} \qquad - (1)$$

Where $N_{FTT}$ is total number of subcarrier for OFDM PHY which is 256. G is Cyclic Prefix (CP) ratio=1/4.

fs is Sampling factor = (Bandwidth * 144/125). Here we have taken 5MHz channel bandwidth. This gives $TD_{OFDM}$ = 55.5 µs. We can compute total number of symbols as

$$\mathbf{N_{symbol} = T_{frame} / TD_{OFDM}} \qquad - (2)$$

Where $T_{frame}$ is the frame duration and if assumed 20 ms gives $N_{symbol}$ =360.

In the original WiMAX HO triggering is based only on RSSI or CINR .This scheme is still valid here but works in parallel with additional trigger based on BS idle capacity. The trigger policy is expressed using a probabilistic variable $P_{trigger}$. In this proposed work we defined the triffering on the basis of effective Capasity of the base Stations. Let we have N of base Stations that are the eligible to perform the handover and to take charge of the mobile node. In this case we will find the effective capacity of each node called C1,C2,C3….Cn l base stations BS1, BS2…BSn.

Now we have to elect the base station such that

Min(C(i)) where i>=1 and i<=n

Here also exist a veriable p probabilistic variable globally controlling the HO frequency to avoid ping-pong effect. This means that the trigger will take place with the probability p when the condition is reached. When the condition is not reached nothing happens. A greater p implies more frequent cell switch. A cell with heavy traffic load will be relieved quickly but congestion in the target cell might be produced due to massive cell switch; whereas a smaller p implies less frequent cell switch therefore less HO cost, but the traffic load will be balanced more slowly. And µ is the assurance factor in order to avoid useless scanning. By choosing a greater µ, MS will be assured to switch only to another WiMAX cell with sustainable idle resources.

In our decision algorithm the decision factor for each candidate BS depends on both factors: idle capacity and signal strength. We have combined the two factors into a weighted target cell decision function.

**Table 1: Simulation Parameters**

| PARAMETER | VALUE |
|---|---|
| Frequency Band | 5 MHz OFDM |
| Modulation Scheme | 1/2 BPSK |
| No of BS | 5 |
| No of MS | 50 |
| No of active MS under each BS | 5 |
| Simulation duration | 20 s |
| Requested data rate | 50 kbps |
| BS coverage | 1000 m |
| Frame duration | 20 ms |
| Sampling factor | 144/125 |
| Propagation model | Two ray ground |
| Antenna Model | Omni directional |
| MS Speed | 20 m/s |

The simulation is done using NS2 simulator [12] with National Institute of Standards and Technology (NIST) module [13] to support for WiMAX. The simulation scenario consists of a test area covered by 5 WiMAX BS, and 50 MSs which are randomly dispersed in the test area with overlapped contiguous areas.

The position of each MS is random but there are ten MS served by each BS. The traffic model that each MS requests is a non real time Polling Service (nrtPS) at 50 kbps. Table 1 lists the main parameters of the simulation scenario.

In order to evaluate the performance thoroughly we measure packet loss during HO when a particular MS moves to particular destination with some speed. Using the same conditions for both traditional and optimized HO packet loss of the moving node is recorded in the trace files of simulator. Then a graph is plotted using X-graph to show packet loss variations of the two HO algorithms. Fig. 2 shows the packet loss at different times in both the schemes.

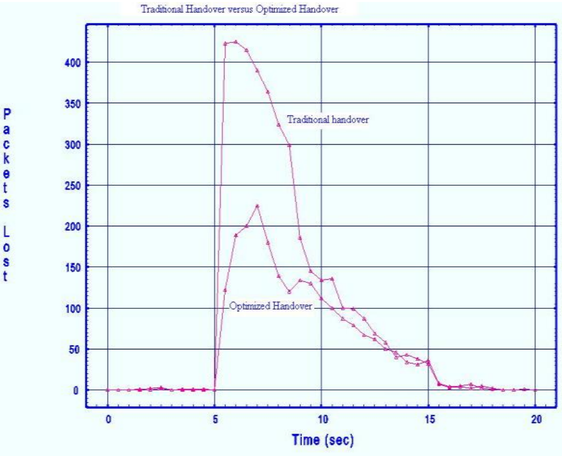


**Fig. 2 Graph showing packet loss variations for two schemes**

From the graph this is very much obvious that the optimized handover scheme has drastically reduced the packet loss at different times. Thus the optimized algorithm has well adjusted the handover procedure to solve the network congestion.

## V CONCLUSION

The paper introduced an optimized handover scheme for WiMAX network. The method is based on effective capacity estimation of a BS and advertising idle capacity information through neighbor advertisement messages as per the IEEE 802.16 specifications. A detailed analysis is done to estimate maximum capacity of OFDM PHY layer. A conditional handover trigger for target cell selection decision based on RSSI and idle capacity is being proposed that minimized data loss rate and ping-pong effect. The simulation result shows that for a multi-cell coverage area, this method could significantly enhance the system performance in terms of overall throughput and can avoid the congestion problem.

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