Handover Schemes in the Mobile WiMAX

[1]Tanu Arora, [2]Rakesh Gill

[1,2]Asst. Prof., GITM, Gurgaon
Email: [1]arora.tanu12@gmail.com, [2]gill.rmd@gmail.com

Now days, new data services are demanding for a high data rate speeds in access systems. The emerging technology, which allows high speed broadband wireless access, is WiMAX. This technology is based on the IEEE 802.16 family of standards. There exist several versions. This paper is focused on the description of full mobile WiMAX and presents an overview of the handover schemes and the procedures used during movement of users.

I. INTRODUCTION

Mobile WiMAX (Worldwide Interoperability Microwave Access) is a wireless system based on the IEEE 802.16e standard [3]. This standard, was published in 2005, is innovating previous version IEEE 802.16- 2004 [1], which was published in October 2004.

In the 802.16-2004 implemented support of handover between cells was not implemented. This version allows only fixed and nomadic access [4]. The handover mechanism is implemented in the newest version 802.16e- 2005.That introduced tremendous support of soft and hard handovers.

Rest of the paper is organized subsequently. Next section describes the access used in mobile WiMAX. The third section describes types of WiMAX handover. Further section is focused on updating procedures which are used during movement of the mobile stations. In the last section main differences between handovers are summarized.

II. WIMAX ACCESS

In older version i.e. IEEE 802.16-2004, only fixed and nomadic access was defined.

Fixed access allows no movement. The user device is assumed to be fixed or stationary in a single geographic location for the duration of the network subscription.

Nomadic access provides movement among the cells, but there is no handover support. It means that moving user must establish a new network connection after each cell boarder overrun.

IEEE 802.16e specifies handovers for portability, and mobility. Here, mobility refers two types i.e. simple mobility and full mobility between users.

Portability and simple mobility fall into a hard handover group. The moving speed is in the range of walking speed for portability and low vehicular speed for mobility.

Full mobility comes under the group of a soft handover. Maximal supported speed matches high vehicular speed (about 190 km/h [2]). Handover between BS's provide service continuity for all applications. The comparison of access types, maximal speed and handovers support in both versions of 802.16 are summarized in Table.1

Table 1. Comparison of 802.16-2004 and 802.16e-2005

Access	Speed	Handover	802.16-2004	802.16e-2005
Fixed access	Stationary	No	Yes	Yes
Nomadic access	Stationary	No	Yes	Yes
Portability	Walking speed	Hard	No	Yes
Simple mobility	Low vehicular speed	Hard	No	Yes
Full mobility	High vehicular speed	Soft	No	Yes

III. HANDOVER TYPE

The basic mean of WiMAX handover is to provide the continuous connection, means without any break in the call. When a Mobile Station (MS) moves from an air-interface of one BS to another air-interface provided by another BS.

In the IEEE 802.16e three types of handovers are defined[5]: Hard handover, Macro Diversity Handover (MDHO) and Fast Base Station Switching (FBSS). Hard handover is mandatory in WiMAX systems. Other two types of handover are optional.

3.1. Hard Handover

During hard handover the MS (Mobile Station) communicates with only one BS (Base Station) in each time. Connection with the old BS is broken before the new connection is established, but the continuous connection is essential. Handover is executed after the signal strength from neighbor's cell is exceeding the signal strength from the current cell (in which the cell is originated). This situation is shown in Fig.1.

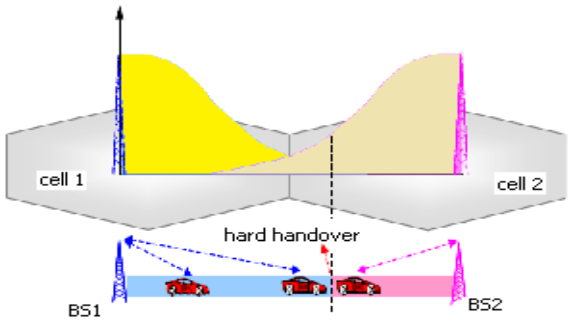

Figure 1. Hard handover realization

3.2. Macro Diversity Handover

When MDHO is supported by MS and by BS, the "Diversity Set" is maintained by MS and BS. Diversity set is a faction of the BS's, which are involved in the handover procedure. Diversity set is defined for each of MS's in network. MS communicates with all BS's in the diversity set (see Fig. 2.). For downlink in MDHO, two or more BS's transmit data to MS such that diversity combining can be performed at the MS. For uplink in MDHO, MS transmission is received by multiple BS's where selection diversity of the received information is performed. The BS, which can receive communication among MS's and other BS's, but the level of signal strength is not sufficient is noted as "Neighbor BS".

3.3 Fast Base Station Switching

In FBSS, the MS and BS diversity set is maintained similar as in MDHO. MS continuously monitors the base stations in the diversity set and defines an "Anchor BS". Anchor BS is only one base station of the diversity set that MS communicates with

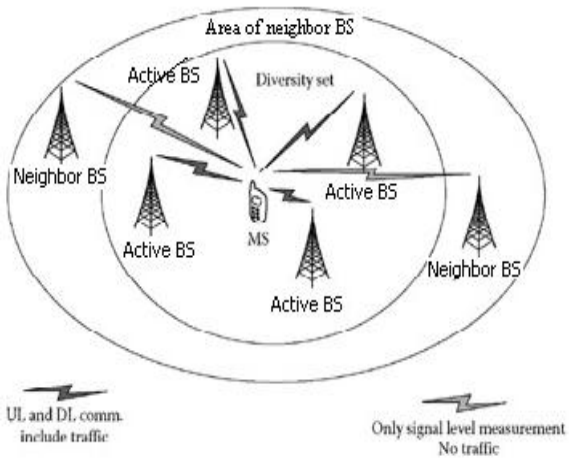

Figure 2 Macro Diversity Handover

for all uplink and downlink traffic including management messages (see Fig. 3.). This is the BS where MS is registered, synchronized, performs ranging and there downlink channel is monitored for control information. The anchor BS can be changed from frame to frame depending on BS selection scheme. This means every frame can be sent via different BS in diversity set.

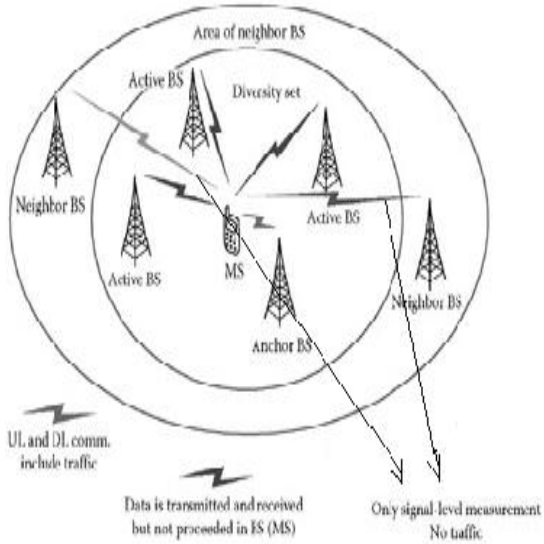

Figure 3. Fast Base Station Switching

IV. UPDATING PROCEDURES

4.1. Updating of Diversity Set

Update of diversity set is depending on the threshold contained in Downlink Channel Descriptor (DCD) [3]. There are defined two thresholds: H_Delete Threshold and H_Add Threshold. There can come two situations. The first is dropping of the serving BS from diversity set. BS is dropped from diversity set if long- term CINR of serving BS is less then H_Delete Threshold. The second case is adding neighbor BS into the diversity set. Neighbor BS is added to diversity set if long-term CINR of neighbor BS is higher then H_Add Threshold. Updating of the diversity set is same in the case of MDHO and FBSS.

4.2. Updating of Anchor BS

There exist two mechanisms for updating of the Anchor BS. The first mechanism, noted as "Handover MAC Management Method", uses exchange of five types of MAC management massages [3]. The second, called "Fast Anchor BS Selection Mechanism", uses Fast Feedback channel [3] for exchanging anchor BS selection information. The selection of new anchor BS is based on signal strength measurement reported by MS. New anchor BS shall be included in the current diversity set.

V. CONCLUSION

This paper analyzes the current handover situation in WiMAX networks. In the first version of WiMAX standards, the mobility was not supported at all. By the time became a need of user mobility. Because of this reason several types of handover in WiMAX technology were introduced.

Hard handover allows only low speed mobility (portability or simple mobility). For higher speed mobility (portability, simple mobility or full mobility) were FBSS and MDHO implemented.

MDHO and FBSS belong to the group of the soft handovers. In booth handover types the diversity set is maintained. The main difference between MDHO and FBSS is, that in MDHO is applied the selection diversity and diversity combining in uplink and downlink, respectively. In FBSS all data traffic is processed only in the anchor BS.

REFERENCES:

[1] IEEE 802.16-2004: Air Interface for Fixed Broadband Wireless Access Systems, October 2004

[2] WiMAX Forum: Can WiMAX Address Your Applications? October 2005

[3] IEEE P802.16e/D11: Amendment for Physical and Medium Access Control Layers for Combined Fixed and Mobile Operation in Licensed Bands, September 2005

[4] WiMAX Forum: Fixed, nomadic, portable and mobile applications for 802.16-2004 and 802.16e WiMAX networks, November 2005

[5] WiMAX Forum: Mobile WiMAX – Part I: A Technical Overview and Performance Evaluation, February 2006

[6] Becvar, Z., Zelenka, J., Bestak, R.: Comparison of Handovers in UMTS and WiMAX, Elektro2006, Zilina 2006, ISBN: 80-8070-544-5

[7] WiMAX Forum, www.wimaxforum.org