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Review Paper on Study of Velocity Adaptive Handover Scheme for Mobile Wimax

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Abstract - WiMAX stands for Worldwide Interoperability for Microwave Access. It is a technology that is based on IEEE802.16 standard for broadband wireless access (BWA). The Mobile WiMAX or the 802.16e-2005 launch the incredible latest feature, mobility to support for handoffs, that is essential for mobile communication system. Hard handoff is mandatory in Mobile WiMAX and the two optional soft handoff methods are known as Macro Diversity Handover and Fast Base Station Switching. During hard handover, the data transmission should be suspend and makes handover delay in mobile communication. Due to handover delay, there is severe degradation in system performance when implemented in real-time applications like VoIP. The existing standard considers only the received signal strength that decides when handover occur. Though, there is velocity factor that has an important influence on handover initiation as well and cannot be neglected. To handle these types of issues, this article suggests a velocity-adaptive handover scheme. This scheme adopts dynamic handover threshold according to different velocity to avoid some unnecessary handover stages, shrink handover delay and enhances the network resource utilization.

Keywords – WiMAX; Handover; Delay; Velocity; VoIP.

I. INTRODUCTION

WiMAX acronym for Worldwide Interoperability for Microwave Access. IEEE802.16 standard introduce the air interface for fixed Broadband Wireless Access (BWA) systems that is to be used in Wireless Metropolitan Area Networks, which is known as WiMAX (Worldwide Interoperability for Microwave Access). IEEE 802.16 standard does not provide mobility, In order to avoid this limitation IEEE launched a new standard named as IEEE 802.16e.It is also known as Mobile WiMAX. Mobile WiMAX permits the user to move freely throughout data transmission. In mobile WiMAX, there should be no data loss when the user is in moving state switches from one base station to another i.e. during handover. WiMax can gives the broadband wireless access up to 30 miles (50 km) for fixed stations, and 3 - 10 miles (5 -15 km) for mobile stations[5]. The WiMAX technology offers about 72 Mbps without any need of the cable infrastructure [6]. Since the support of mobility management frameworks in the IEEE 802.16e standard, WiMAX is now in the competition with the existing and forthcoming generations of wireless technologies for providing ubiquitous computing solutions. WiMAX is a second-generation protocol that permits efficient bandwidth use, interference avoidance, and is planned to permit higher data rates over longer distances [7].

1.2 Features of WiMAX

WiMAX is an innovatory wireless technology which has many technological improvements as compare to the other broadband access technology. Following is the lists of WiMAX feature which are mentioned below:

1.1.1. High data rate: the data rate limit of Wimax is very high. It can support up to 75 Mbps.
1.1.2. OFDM based physical layer: Wimax technology is based on orthogonal frequency division multiplexing. OFDM provides multipath resistance and NLOS communication to Wimax.
1.1.3. Flexible architecture: Wimax architecture is very flexible which can support point to point and point to multipoint connection according to its requirement in network. It supports IP-based architecture that is simply meeting with other networks and takes advantage of application development from the accessible IP based application.
1.1.4. Quality of service: Wimax MAC layer is responsible for QoS. Wimax MAC layer can support different type of attributes like actual time, non real time and best effort data traffic. Its high data rate, flexible scheduling and sub-channelization improve the QoS.
1.1.5. FDD and TDD support: Wimax works in both time division duplex (TDD) and frequency division duplex (FDD) which helps in spectrum management, transceiver design and low cost system development.
1.1.6. Adaptive modulation and coding: Using Adaptive modulation and coding scheme can connect more users at a time in same network. This technique is used to maximize throughput and capable to setup connection in a low signal strength and noisy environment.
1.1.7. Scalability: Wimax offer scalable network architecture that support user roaming in different WAN networks. It improves the broadband access capability as well.
1.1.8. Strong Security: Wimax support extensible security feature for reliable data exchange. It uses Advanced Encryption Standard (AES) encryption for secure transmission of data. It utilizes data authentication mechanism for data integrity [5].

II. MOBILE WIMAX HANDOVER

The mobility techniques are introduced by IEEE which defines as 802.16e in Wimax network or handover. Mobility technique provides requirement for a mobile device is the ability to change the serving BS if there exists another BS with in network, which provide better link quality in the reach of the mobile station. Handover define as a mobile station can maintain continuous connectivity if it travels from a coverage area of one base station to the coverage area of another base station with zero data loss or disconcerting the existing connection(s) [8].

2.1. Why Handover Occur

There are certain reasons why a handover might be conducted:
2.1.1. As the mobile station is moving away from the serving area of one cell and entering in the area served by another cell, then the call is handover to the second cell to avoid call termination when the phone gets outside the range of the first cell.
2.1.2. As the capacity for connecting the new calls in a given cell is exhausted and an existing or new call from a phone, which is located in an area over lied by another cell, is relocated to that cell in order to ease up some capacity in the first cell for rest of users, who can only be connected to that cell [4].

2.2. Handover Types

Wimax is basically used to provide the continuous connection when user migrated from of one BS to another BS. According to IEEE 802.16e standard defined three types of handover. Hard Handover is mandatory in wiMax systems and other two types of handover are optional.

2.2.1. Hard handover

In hard handover the Mobile station communicates with only just one base station at a time. It follows"Break before make" strategy that is it breaks the connection with current serving base station before making the new connection. When the signal strength of neighbor cell is stronger than current

serving base station of mobile user, Handover occurred. This state depicts in Fig. 2.2.1 Black thick line at the boarder of the cells represents the place where the hard handover is happened [3].

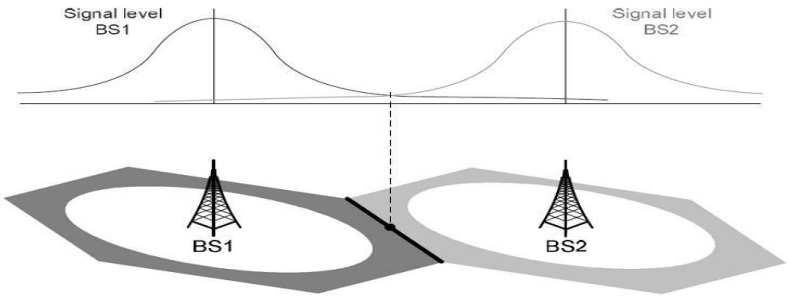

Figure 2.2.1 - Hard Handoff Realization [3]

2.2.2. Macro Diversity Handover

In MDHO , the "Diversity Set" is maintained by BS and MS. Diversity set contain the list of the BS's, that are engaged in the handover process. Diversity set is defined for all mobile stations in current network. In the Diversity Set, Mobile station communicates with all BS's. During downlink process in MDHO, combining of diversity can be performed at the mobile station when two or more BS's transmit data to mobile station. During uplink process in MDHO, when mobile station transmission is received by several BS's then selection diversity of the received information is achieved. The BS which can receive communication from MS's and other BS's yet the level of signal is not sufficient is termed as neighbor BS [10].

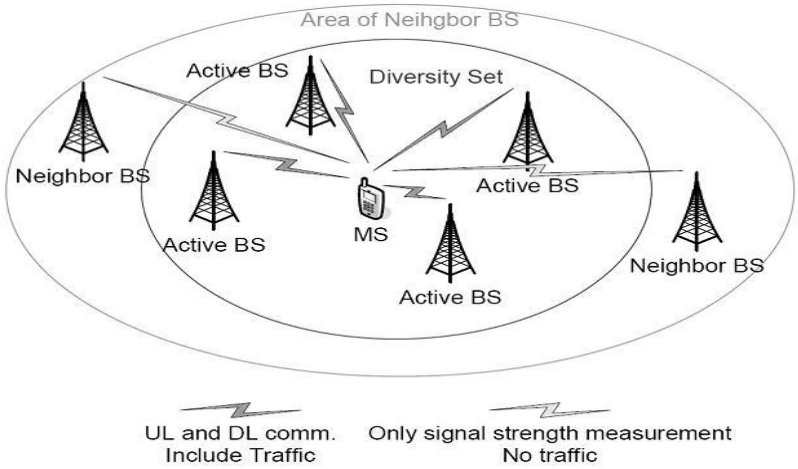

Figure 2.2.2. Macro Diversity Handover [10]

2.2.3. Fast Base Station Switching

In fast base station switching, diversity set is sustain same as in MDHO. In FBSS, the mobile station and BS diversity set is maintained in the same way as in MDHO. Mobile station continuously keeps an eye on the base stations in the diversity set and identify an "Anchor BS". Anchor BS is merely one of the base station present in the diversity set that mobile station communicates with for all uplink and downlink traffic as well as management messages .Anchor base station is the BS wherein mobile station is registered, synchronized then carry out ranging and there is checked downlink channel for control

information. Anchor BS can be vary from frame to frame depend lying on BS selection method. Which means every frame can be sent by different BS in diversity set [3].

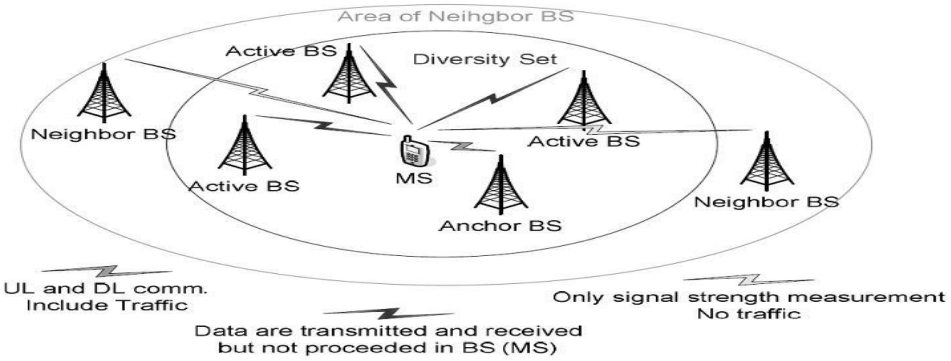

Figure 2.2.3. Fast Base Station Switching Handover [3]

III. HANDOVER PROCEDURE

For a handover process, the Serving BS broadcasts information message, typically using MOB NBR-ADV that contains information of neighbor BSs. The mobile station examined its neighbor base stations time to time and choose the target BS, based on the quality of signal strength and others appropriate parameters and send a request for handover message to serving base station (with current cell) .The Serving BS then come into action and exchanges the handover messages with the target BSs candidates and chooses a target BS. BS sends the handover response message to the mobile station. when the mobile station received the message , first it break the connection with the serving base station then make the connection with target base station and performed network re-entry process. The serving BS sends the security information to the target base station. After network re-entry process the mobile station can send or received traffic. The network re-entry process contains synchronization with new downlink, ranging and synchronization with uplink, re- registration and reauthorization procedures**.** When the mobile station break the connection with current serving BS. To obtain new downlink and uplink transmission parameters, the mobile station coordinate with new downlink of target base station. The mobile station carry out ranging process to obtain correct timing offset and power adjustments. In order for ranging process, Target BS uses fast-ranging IE to serve a non- contention based ranging opportunity to mobile station. If the fast ranging IE message is not received by mobile station then it performs contention based ranging process by transmitting the CDMA codes. During handover process, if the target base station received all security and MAC state information by backbone network from the serving base station, then mobile station may skip reauthorization and re-registration process. Though, the target base station, for transmitting the CID update information, has to send unsolicited REG-RSPmessage.[1]

V. VELOCITY-ADAPTIVE HANDOVER SCHEME

In this paper, we suggest the velocity-adaptive hand-over scheme. The Mobile WiMAX specification defines the procedures throughout the HO, but does not contain the HO decision. Mobile station makes the HO decision according to signal quality that can be calculated by the RSSI. Figure 3 . 1 shows a simple case involving two BSs and an mobile station moving away from base station A (serving BS) toward base station B (target BS). The $Th_{handover}$ represents the HO threshold and Th_{drop} is the point below which the quality of the link becomes intolerable, and will lead to too much packet loss and the session being dropped. The hysteresis value (ΔH) is used to eliminate thrashing effect. The scheme is that the mobile station choose those BSs that have high RSSI value which results in a better link-level

communication with the target BS and a lower bit error rate. However, HO procedures are initiated when the RSSI drops below the $Th_{handover}$ (1). Also, HO is executed only if there is another BS for which the RSSI is at least ΔH higher than Th_{drop} (2). These can be described as follows:

$RSSI_{cur} < Th_{handover}$ eq. (1)
$RSSI_{candidate} > Th_{drop} + \Delta H$ eq. (2)

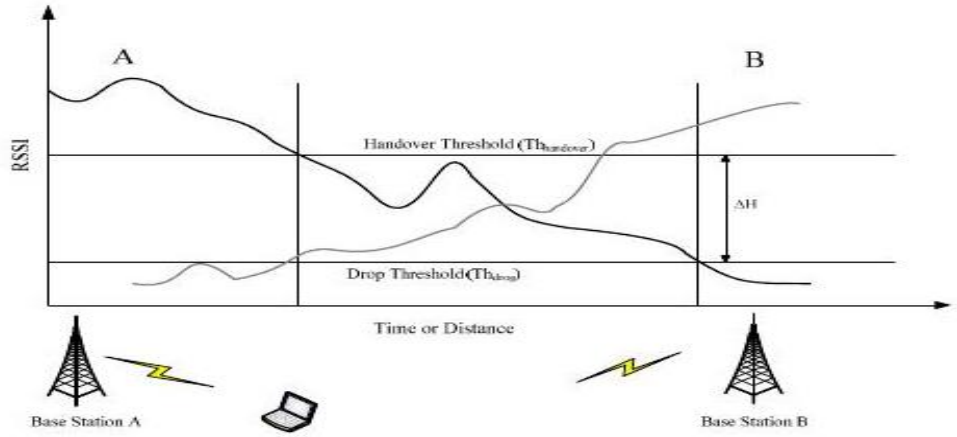

Figure 3.1 Handover decision based on RSSI

When the mobile station moves in a high velocity, the network channel information will vary frequently, so that some unnecessary stages must be performed, this makes severe degradation in system performance like network resource waste and HO delay. Form Equation (1) and (2), it can be known that if the $Th_{handover}$ is set higher, the frequency of HO initiated will be higher, thus the network channel information can be acquired quickly .Which means that the probability of pre-obtained information used in the HO process (cell reselection and synchronization to target BS downlink) will be improved. So it can decrease the HO delay. However, the frequently performing HO causes a great wireless network resource waste. If the $Th_{handover}$ is set lower, the HO frequency becomes lower. Since the pre-obtained information do not update with the changes of channel condition, the neighboring BSs scanning and contention-based ranging operation must be performed. Therefore, the HO delay will be longer, but the wireless channel resource is consumed less. If the $Th_{handover}$ maintains a stable value regardless of the velocity, for a high $Th_{handover}$, the wireless channel resource waste will increase in the low velocity condition, and for a low $Th_{handover}$, the HO delay will increase in the high velocity condition. To keep the balance of the two cope and facets with HO delay and wireless channel resource waste problems, we propose the velocity-adaptive handover scheme. The scheme changes the HO threshold by dynamically adapting the $Th_{handover}$ value based on velocity. When the mobile station moves in a higher velocity, the $Th_{handover}$ is set higher, and as a result the HO delay is reduced. When the mobile station moves in a low velocity, the $Th_{handover}$ is set lower. Since the unnecessary HO is reduced and the wireless channel resource waste becomes little [2].

V. CONCLUSION

This paper examines the present handover situation in WiMAX networks. The mobility was not supported by the earlier version of WiMAX standards. With the passage of time became a need of user mobility. Due of this reason numerous types of handover in WiMAX technology were introduced. Whereas hard handover is mandatory and soft handover is optional. The velocity-adaptive handover

scheme is presented in this paper. HO initiation must execute if the RSSI of the current serving base station is lower than the threshold. Yet, it does not think about the velocity's influence on the HO process, and the HO threshold is set as a constant. So the velocity has a bad effect on the HO performance. To cope with this problem, our scheme is proposed, the HO threshold is set variably according to the mobile station mobility. This velocity-adaptive handover scheme can offer seamless communication for Mobile WiMAX in delay-sensitive and high velocity applications.

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