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Mobile Wimax Handover in Similar Wireless Network

Er. Himanshu Sharma[1], Er. Ajay Kumar Verma[2], Shalendra Sharma[3]
[1]*Assistant Professor, Department of Computer Science & Engineering, Translam Institute of Technology and Management, Meerut Uttar Pradesh, India*
[2]*Department of Computer Science & Engineering (Research Scholar), Swami Vivekanand Subharti University, Meerut Uttar Pradesh, India*
[3]*Department of Computer Science & Engineering (Research Scholar), Translam Institute of Technology and Management, Meerut Uttar Pradesh, India*

Abstract: The most challenging research issue of investigating broadband wireless access (BWA) technologies is how to support mobility in WiMAX networks smoothly and seamlessly. It is essential that providing continuous services of multimedia streaming data when a mobile station (MS) is across a boundary of a serving area to another one. Although the IEEE 802.16e standard is proposed to tackle this difficult problem. Handover is the main theme of mobile WiMAX technology and it makes interoperability between different network technologies and provides mobility. However there are some problems during handover and the problem in our focus will be handover delay. Handover delay if longer than expected makes the communication faulty and introduces errors and packet loss which in turns degrade QoS in mobile WiMax.

To deal with this problem, this thesis proposes a mechanism for supporting fast handover in mobile WiMAX networks. This goal is achieved by changing the process in standard handover algorithm. The implementation of proposed scheme has been done on QualNET5.0 networks simulator software. Simulation results show that the proposed scheme of handover can achieve less handover delay and proved better QoS then the standard algorithm used in mobile WiMAX. The proposed mechanism is fully compatible with the IEEE 802.16e standard.

I. INTRODUCTION

One of the most compelling aspects of broadband wireless access (BWA) technology is that networks can be created in just weeks by deploying a small number of base stations (BSs) on buildings or poles to create high-capacity wireless access systems. The Institute of Electrical and Electronics Engineers (IEEE) decided to make BWA more available and standardized by developing the IEEE 802.16 standard. Worldwide Interoperability of Microwave Access), also known as the IEEE 802.16 protocol, is the latest standard for wireless networks. It was established in 1999 to prepare specifications for broadband wireless metropolitan area networks. The first 802.16 standard [31, 32, and 10] was approved in December 2001 and was followed by three amendments: 802.16a, 802.16b and 802.16c. In 2004 the 802.16-2004 standard (IEEE-SA, 2006) was released and the earlier 802.16 documents including the a/b/c amendments were 2004 standard (IEEE-SA, 2006) was released and the earlier 802.16 documents including the a/b/c amendments were withdrawn. An amendment to 802.16-2004, IEEE 802.16e-2005 (formerly known as IEEE 802.16e), addressing mobility, was concluded in 2005. This implemented a number of enhancements to 802.16-2004, including better support for Quality of Service, Security and the use of Scalable OFDMA, and is sometimes called “Mobile WiMAX”, after the WIMAX forum currently active WiMAX amendments are: 802.16e- 2005- Mobile 802.16; 802.16f-2005- Management Information Base; 802.16g-2007- Management Plane Procedures and Services; 802.16k-2007- Bridging of 802.16 (an amendment to 802.1D).

There are several amendments under development: 802.16h- Improved Coexistence Mechanisms for License Exempt Operation; 802.16i- Mobile Management Information Base; 802.16j- Multihop Relay Specification; 802.16Rev2- Consolidate 802.16-2004, 802.16e, 802.16f, 802.16g and possibly 802.16i into a new document. IEEE 802.16 Task Group m (TGm) is working on new amendment: 802.16m- Advanced Air Interface. Proposed work plan would allow completion of the standard by December 2009 for approval by March 2010.

II. PROCESS OF HANDOVER

Some details of handover process in 802.16e WiMAX as show in figure 5.4 are already discussed. Further involved steps in handover process are discussed in following section for the better understanding. When network acquisition is done which includes Advertisement, Scanning and Association procedures, now we are going to discuss the rest of the process which are: handover decision, Initiation, and ranging, Authorization and Registration procedures.

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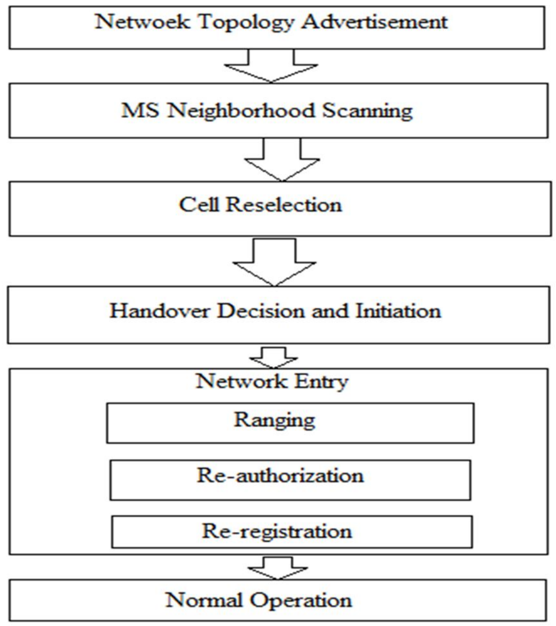

A. MAC Layer Handover Procedure

The handover procedure in IEEE 802.16e-2005 is divided into MAC and PHY layer handover. Looking at the MAC-layer handover procedure, it is divided into the network topology acquisition phase and the handover process phase according to its performing sequence.

In the network topology acquisition phase, three functions are performed, namely network topology advertisement, MS scanning for neighboring BSs, and association procedure. After receiving a neighbor advertisement message broadcast from the serving BS, the MS gets all the neighboring BSs of its current serving BS. The MS can then perform synchronization with each neighboring BS, and then continue to the handover process phase.

During the handover procedure, the process includes handover decision, handover initiation, and ranging procedures, followed by authorization and registration procedures. These procedures include cell reselection, handover decision and handover initiation, synchronization with new DL, acquisition of UL parameters, ranging, MS reauthorization, re-registration, and termination with the serving BS. When the MS migrates from its serving BS to its target BS, the following process is executed. First, the MS conducts cell reselection based on the information obtained from the network topology acquisition stage. The handover decision and the handover initiation can be originated by both MS and BS using the MOB_MSHO-REQ/ MOB_BSHO-REQ message. When the target BS is decided, the MS sends a MOB_HO-IND message to the serving BS and the actual handover process begins as illustrated in Figure5.6 [44].

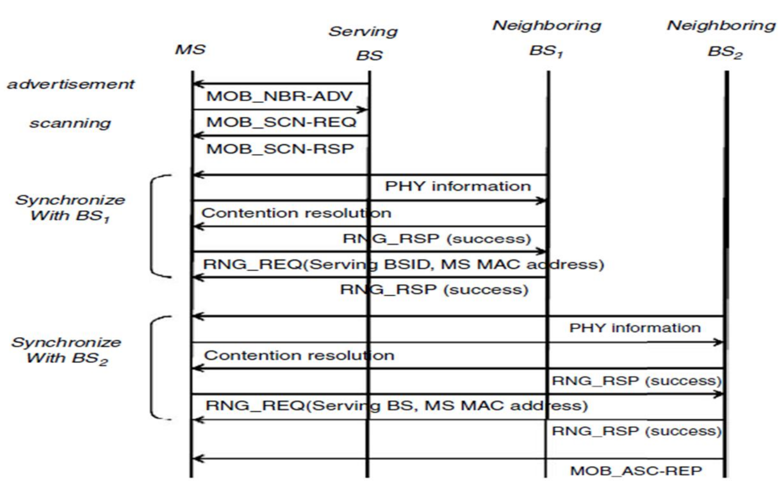

Figure3.1: Network topology acquisition phase for handover.

In the ranging process, the MS can synchronize to the DL of the target BS and obtain DL and UL parameters using the DCD/UCD message. Then RNG_REG/ RNG_RSP messages are exchanged to complete the initial ranging process. It may be done in a contention-based or non contention-based manner.

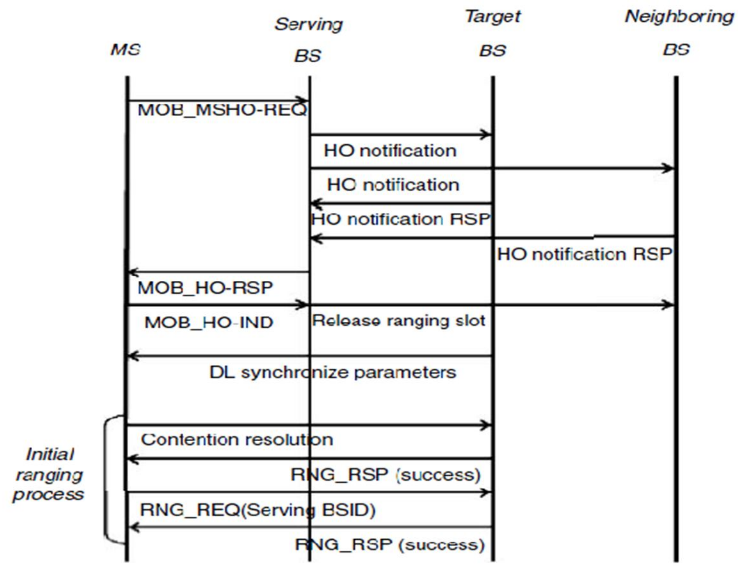

Figure3.2: Handover decision, handover initiation, and ranging procedures.

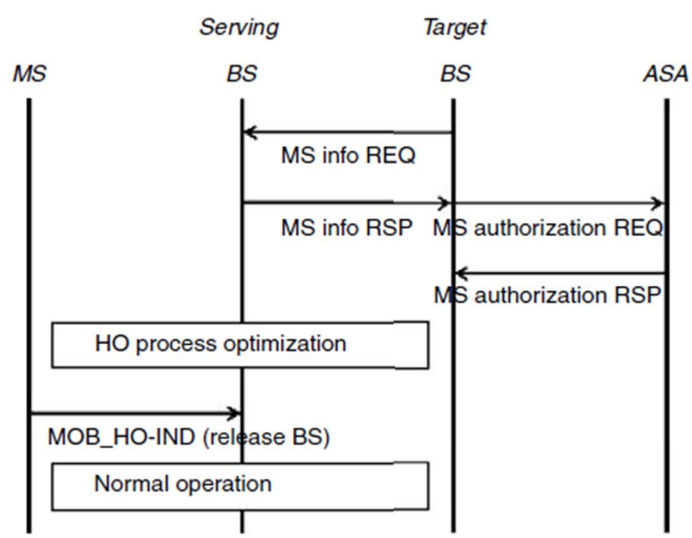

Figure3.3: Authorization and registration procedure.

If the RNG_REG contains the serving BSID, the target BS can obtain the MS information from the serving BS through the backbone network. If the MS is already associated with the target BS at the previous stage, some steps may be omitted. Therefore, the neighboring BS scanning and association should be done right after the handover initiation by utilizing pre-obtained information before the channel condition changes. If all physical parameter adjustments are done successfully, the network re-entry process is initiated. Figure 8 shows this procedure. It includes MS authorization and new BS registration. The target BS requests MS authorization information via its backbone network. The new BS registration is performed by REG_REQ and REG_RSP messages. This includes capabilities negotiation, MS authorization, key exchange, and registration. After successful registration with the target BS, the MS can send a MOB_HO-IND message to the serving BS to indicate that handover is completed.

III. PROPOSED SCHEME

A. Handover Topology

On moving out of MS from any BS like BS1 the handover becomes mandatory. The figure 6.1 shows the dissection of handover process [44].

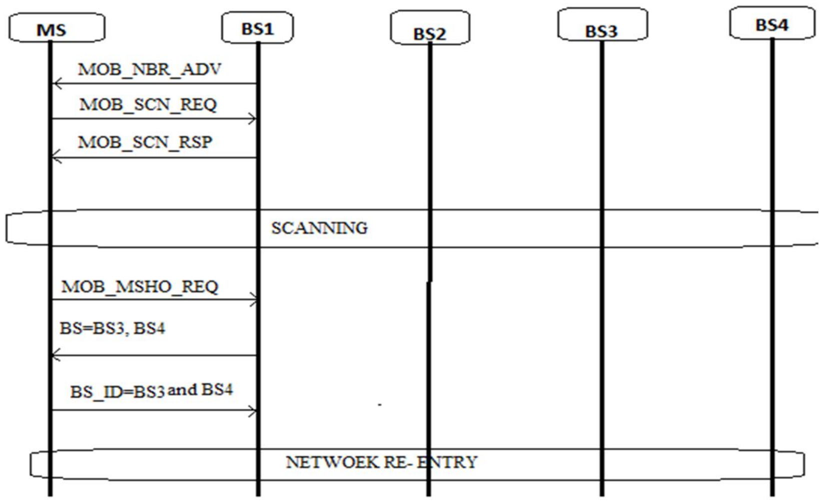

Figure 4.1: Handover Topology

Channel information about the neighbors BS's is sends by serving BS using MOB_NBR_ADV. MOB_SCN_REQ is sent by MS to the serving BS when the strength of the signal goes down whereas it receive MOB_SCN-RSP message as a result in order to get the scanning time interval. The target BS's are selected by MS depending on the signal strength as well as response time calculated during scanning. MS sends MOB_MSHO_REQ message to the serving BS. MOB_MSHO_RSP message is received as a result of final selection of the target BS let's assume BS3 and BS4.

The actual handover occurs after the MOB_HO_IND message is issues by MS in a result making network re-entry. The figure 6.2 shows the scanning process in the example context in detail as explained above.

As a result of MOB_SCN_REQ and MOB_SCN_RSP messages, MS receive time interval regarding scanning. After that MS scan the adjacent BSs using the process of synchronization. Incoming data is buffered in MS and BS while termination of transmission towards MS in the scanning process. Also the scanning of neighboring BSs is done sequentially in contrast to simultaneous scanning. As a result of sequential scanning the process is stretched, this further pauses the transmission of data towards MS making the system's performance down.

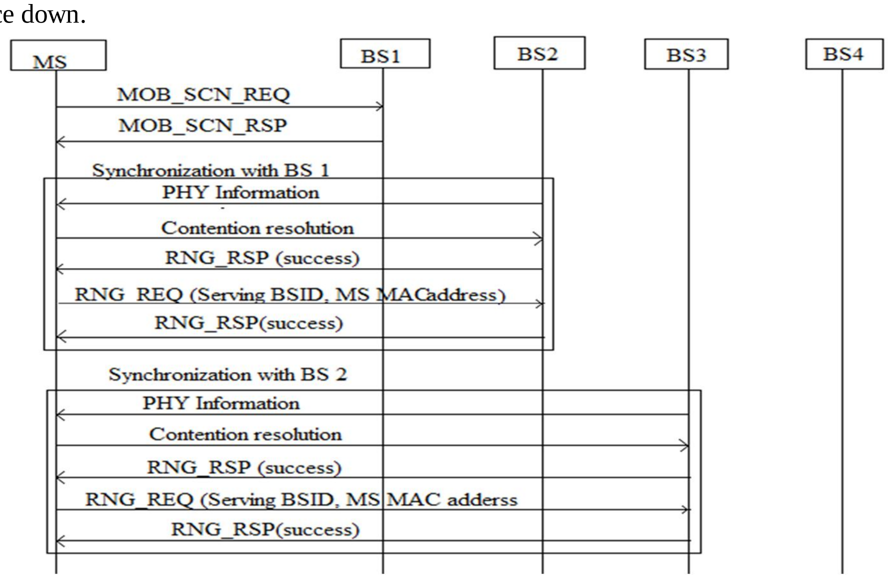

Figure 4.2: Synchronization process

Negotiation On completion of scanning MOB_MSHO_REQ message is sent by MS which consists of the list of selected target BSs and serving BS starts HO pre_notification procedure including the MS identification, bandwidth as well as QoS needed by MS in context of backbone network. HO pre_notification response is send by neighbouring BSs, which consists of validation of MS performance. These sets of activities are known as negotiation and are critical for selection of target BS finally. Following figure 6.3 shows the negotiation process.

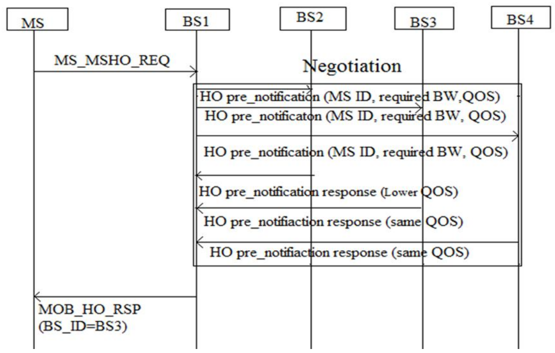

Figure 4.3: Negotiation Process

In the above figure BS is being served by BS1 whereas BS3 and BS4 constitute target list for BS. It also displays the procedure of target BS selection which in this case BS3 and BS4 are in result of negotiation done using backbone network. In the above figure BS3and BS4 are selected as a result of its capability of QoS required by MS.

B. Proposed Scheme

The point focused in proposed scheme is that target BS selection during handover process is done in two portions. That is scanning of neighbor BSs and negotiation process in IEEE 802.16e before selection of any BS as target and after negotiating target BS is selected by serving BS. Whereas in proposed scheme negotiation process is done before the scanning process. On issuance of MOB_SCN_REQ message for time interval, all the neighbouring BSs are negotiated through the backbone network by the serving BS.

The service BS sends HO pre_notificaton message to the neighbouring BSs which provide information regarding MS identification, required BW and QoS. The neighbouring BSs send back HO pre_notification response which provides information regarding performance, MS identification as well as required bandwidth along with QoS. The BSs unable to provide QoS as per MS requirement are eliminated and MOB_SCN_RSP message is sent by the serving BS. As a result only the BSs satisfying the conditions are scanned by MS and at the end of scanning the target BS is already selected. CINR checking for neighboring BS is done for single target BS estimation based on the list of QoS satisfying BSs. In other words then neighbor BS with most suitable CINR are processes only. In the proposed scheme by negotiating the neighboring BSs unwanted BSs are eliminated before scan process. Information regarding bandwidth and QoS is sent to neighboring BSs using backbone network message before MS starts scanning. The protocol calculates the MS' required performance by the response given by neighboring BSs provided the service is given by the respective BS. In this way only the BSs satisfying the demands are scanned by the MS. As a result the list of BSs to be scanned is reduced as well as the time in turn minimizing system interruptions.

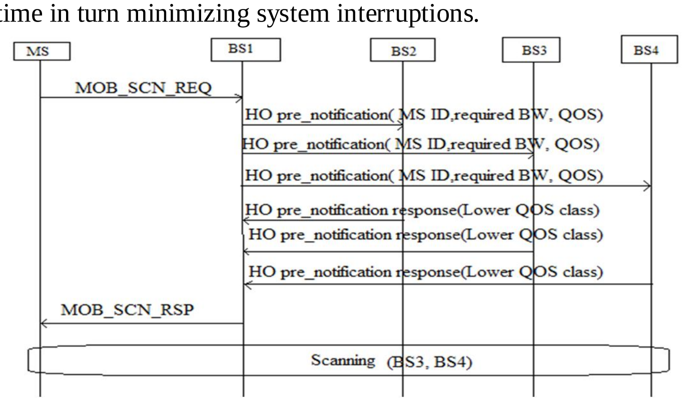

Figure 4.4: Proposed scheme

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In the context of figure 6.4 (BS2 to BS4) belong to neighboring BSs group whereas BS1 is the serving BS. Also from the list of neighboring BSs, BS2 is unable to meet the QoS requirements contrary to BS3 and BS4. Therefore while negotiation process BS2 is excluded and is out of scanning process. In short only BS3 and BS4 are included in scanning process. After receiving the MOB_SCN-REQ message, HO pre-notification is transmitted by BS1 to BS3, BS4 and BS2 in order to inform them about MS ID and other information like bandwidth and QoS requirements.

BS1 is informed by HO pre-notification response about BS3and BS4 adequacy about MS demanded QoS requirements and also inadequacy of BS2 in this regard. This information is received by MS through MOB_SCN_RSP message making it scan the filtered list containing BS4 and BS3 only. After the calculations using information provided by scanning process BS3 and BS4 is taken as target BS.

Let us suppose that,

T1: time for one neighbor BS scanning

T2: time for initiating the network re-entry

T3: time for ranging

T4: time for channel capability negotiation

T5: time for re-authentication

T6: time for re-registration

Then the overall reduction in handover delay is described as

LStandard Handover = (T1 × no of neighboring BS) + T2 + T3 +T4 + T5 +T6

LProposed Handover = (T1 × no of filtered neighboring BS after negotiation) + T2 + T3 +T4 + T5 +T6

The implementation of proposed scheme has been done on QualNET5.0 networks simulator software.

IV. RESULT

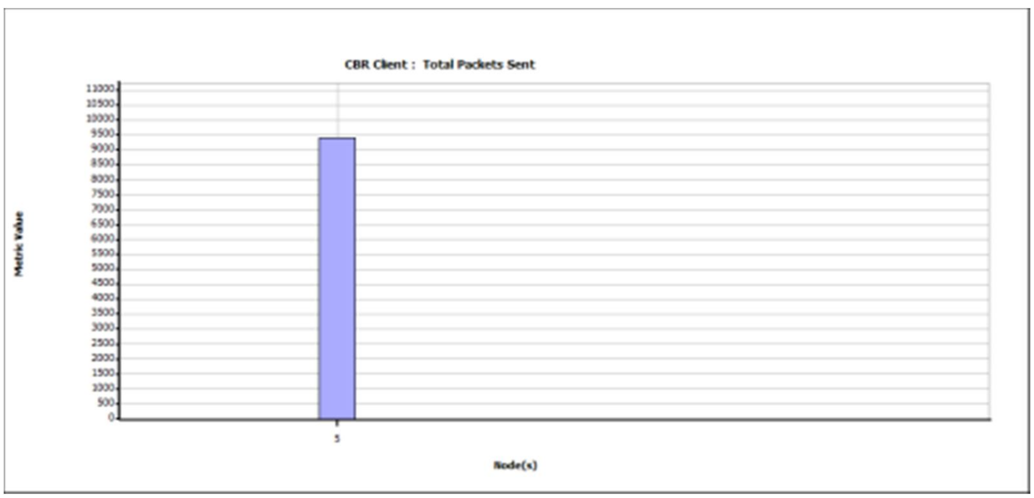

Figure5.1: Data transfer in Mobile WiMAX

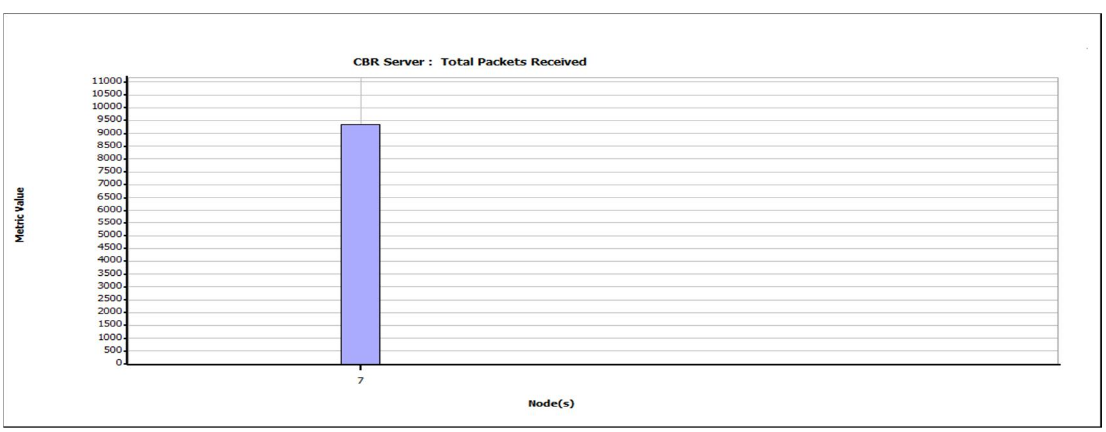

Figure5.2: Data received in Mobile WiMAX

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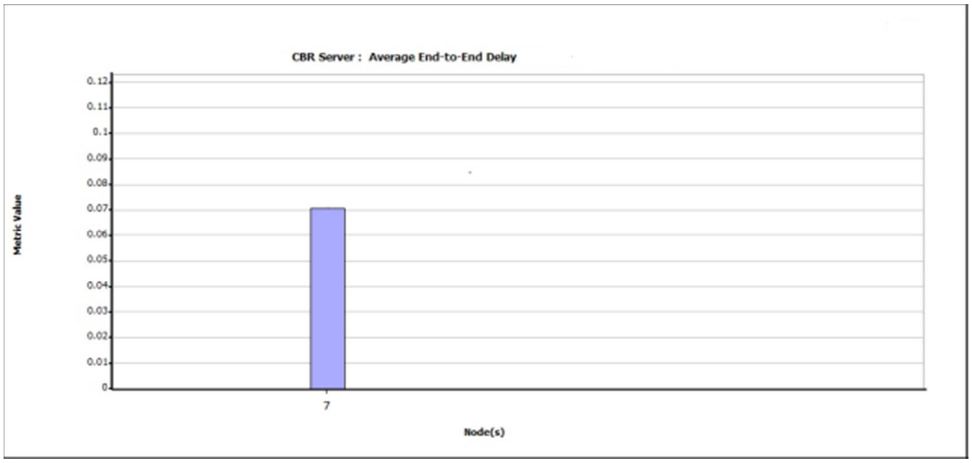

Figure5.3: Total end to end delay in Mobile WiMAX with proposed scheme.

V. CONCLUSION

Efficient support of seamless handover management activity is an important requirement for communication technologies that are intended to be universally accepted in next-generation communication systems. Although mobile WiMAX has a number of attractive features, its handover framework is not free from drawbacks and has attracted significant research attention.

In this thesis, analysis and study of IEEE802.16e handover mechanism in homogenous wireless network has been done. During the process of handover there are present some problems which make it delayed in data transfer. It is also a fact that WiMAX is still in the phase of improvement and needs special attention on the process of handover optimization.

The handover delay causes some problems in the overall quality of service and at the end to end delay, total data send and total data received are compared between proposed and without proposed scheme. This thesis work, a proposed scheme based on standard handover algorithm in mobile WiMAX has been presented. Implementation of handover process in mobile WiMAX has been done using System performance parameters like end Experimental results show that with proposed method receiver receives the data with less end to end delay. In short these schemes can improve the use of resources and hence increase efficiency and reduce handover delay.

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