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Improving Handover in WiMAX using Stand-By-Request

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Abstract:
In past few years many research works carried out towards achieving faster and more reliable handover techniques in a Mobile WiMAX (Worldwide Interoperability for Microwave Access) network. Mobile WiMAX supports two different types of handover mechanisms the hard handover and soft handover namely, the Fast Base Station Switching (FBSS) and the Micro Diversity Handover (MDHO). In which, the hard handover is the default handover mechanism whereas MDHO and FBSS are the optional schemes. Also, when it comes to dealing with the high-speed multimedia applications, FBSS and MDHO provide better performance in comparison to hard handover. In this paper we have proposed a scheme, the standby request based call or data handover mechanism for the purpose of soft handover and to reduce the call drop rate during the process of changing the cell due to the movement of the user. We have analyzed the proposed technique with an existing scheme for soft handover in WiMAX with simulation results**.**

Keywords: FBSS, Hard Handover, MDHO, Soft Handover, Standby request, WiMAX.

I. INTRODUCTION

WiMAX stands for Worldwide Interoperability for Microwave Access. The name "WiMAX" was created by the "WiMAX Forum" in June 2001 to promote interoperability of the standard and based on Institute of Electrical and Electronics Engineering (IEEE) 802.16 standards [1]. The forum describes WiMAX as "a standards-based technology enabling the delivery of last mile wireless broadband as an alternative to cable and DSL". Basically WiMAX is aimed at providing wireless data using microwaves over a long distance in a variety of ways, such as from point-to-point links to full mobile cellular type access. It is a telecommunication technology and also a wireless communications standard designed for creating Metropolitan Area Networks (MANs).

II. CALL HANDOVER IN MOBILE WIMAX

The huge and rapid growth in the area of communication give raises the concept of need of mobility during communication. The concept of mobility of a node is a requirement of great importance, which is supported by a procedure which is known as handover. Handover is also known as a key element which maintain air link to base station even when mobile node is moving with high velocity and changes its geographical position. When a mobile user travels from one cell to another with a call in progress, the call should be transferred to the new cell's base station. Otherwise, the call will be dropped or ended because of the week or poor link or signal with the current base station as the mobile recedes. This ability for transference is a design matter in mobile cellular system design is call handover. Handover action is complete when the receiving controller acknowledges assumption of control authority.

III. TYPES OF HANDOVER

Mobile WiMAX support two different types of handover mechanisms, namely, the hard handover and soft handover which further subdivided into the Fast Base Station Switching (FBSS) and the Micro-Diversity Handover (MDHO) [2].In which, the hard handover is the default handover mechanism whereas the other two are the optional schemes. Also, FBSS and MDHO provide better performance in comparison to hard handover, when it comes to dealing with the high-speed multimedia applications. However, MDHO and FBSS require a complex architecture and are very expensive to implement.

A. HARD HANDOVER

The hard handover is a procedure mainly works using a "brake-before-make" way, in other words the connection to the old BS is broken before creating a new BS connection. In this way the excess signaling traffic can be avoided during the handover process, but the time before the connection is return in normal operation can be longer. So there is a short disconnection of communication for real time application users. Thus, there is an interruption of service when the handover occurs which reducing the quality of service (QoS) [11]. Hard handover is used by the systems which use time division multiple access (TDMA) and frequency division multiple access (FDMA) such as GSM and GPRS

B. SOFT HANDOVER

In contrast to hard handover, soft handover works on "make before break". In this type of handover mechanism the connection of MS with source BS is retained until the establishment of new connection with another i.e. target BS. In this manner the MS is connected with two (or may be more) BS at a given piece of time. The time for which both the connection run in parallel may be very small but also may grow large in some conditions [6]. Soft handover is used by the code division multiple access (CDMA) systems where the cells use same frequency band using different code words.

- **Macro Diversity Handover (MDHO)**

In MDHO, the "Diversity Set" is maintained by BS and MS, which is a list of BS's involved in the handover procedure. Diversity set is defined for all of MS's in network and also

MS communicates with all BS's in the diversity set [10]. In MDHO for downlink, two or more BS's transmit data to MS such that diversity combining can be performed at the MS. For uplink, 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". There is also need for updating the Diversity set when the CISR level of the serving BS falls below a predefined level known as H_Delete threshold or any BS is added into the diversity set if it has CISR levels above H_Add threshold.

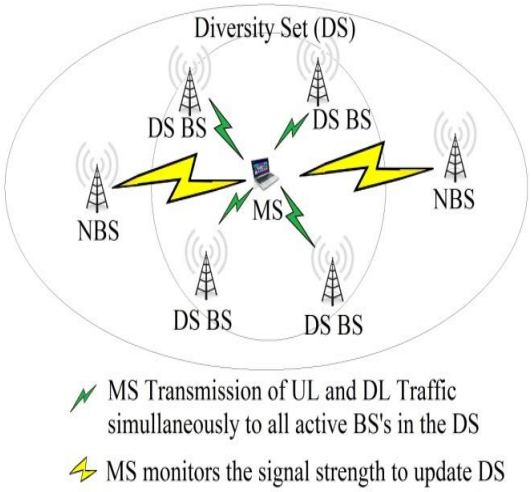

Figure .1. Macro Diversity Handover

- **Fast Base Station Switching (FBSS)**

Like MDHO, fast base station switching technique is also maintained diversity set for each mobile station. In this MS continuously monitors the base stations in the diversity set and defines an "Anchor BS" and that Anchor BS is only one base station of the diversity set that MS communicates with for all uplink and downlink traffic including management messages. This is the base station where MS is registered, synchronized, performs ranging and there is monitored downlink channel for control information. The choice of anchor BS can also be changed from frame to frame depending on the selection scheme of BS [8].

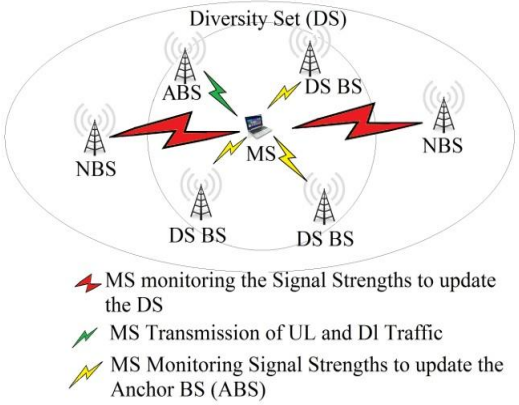

Figure.2. Fast Base Station Switching

IV. PROPOSED TECHNIQUE AND IMPLEMENTATION

The proposed technique is to define a procedure that uses the stand-by-request mechanism for the purpose of improvement in the handover procedure in the existing schemes.

1. Simulation properties acquisition.
2. Start the simulation with acquired parameter.
3. BTS will start up their system.
4. BTS becomes ready to accept requests.
5. When user (MT) request a BTS, BTS register the user and assign the communication channel i.e. BTS_A.
6. MT stays connected with BTS_A and run all communication through BTS_A.
7. MT computes the RSSI of others BTS's as well.
8. MT will maintain an RSSI table with BTS ID.
9. When RSSI of a BTS which is not active, become higher than BTS_A, MT will place a stand-by request to BTS_I.
10. BTS_I will verify the MT details and send the connection acknowledgement.
11. MT will shift its communication over BTS_I.
12. MT request leave to BTS_A.
13. New BTS_A is assigned with BTS_I.
14. The fore communication data received through previous BTS_A will be discarded.

V . SIMULATION AND RESULT

The proposed scheme is implemented in NS-2.34 simulator in Linux environment. We have modified ns-2.34 by adding mac802.16-e layer to it for supporting WiMAX.

Table.1. List of key simulation Parameters

Input / Output Parameter	Value
Number of base stations	8
Number of user nodes	1
Connectivity Mechanisms	WiMAX
Wireless Standard	802.16
Request Threshold	80/20 (Connected Cell/In-Range Cell)
Connectivity Distance (BTS and Node)	250 meters
Request type	Standby Request

Transmission Delay (End-to-End Delay): The end-to-end delay is the time from the generation of a packet by the source up to the destination reception i.e. the time that a packet takes to go across the network. Once the traffic gets stable, the transmission delay remains at the 0.03 seconds for the proposed mode and 0.09 seconds for the existing model.

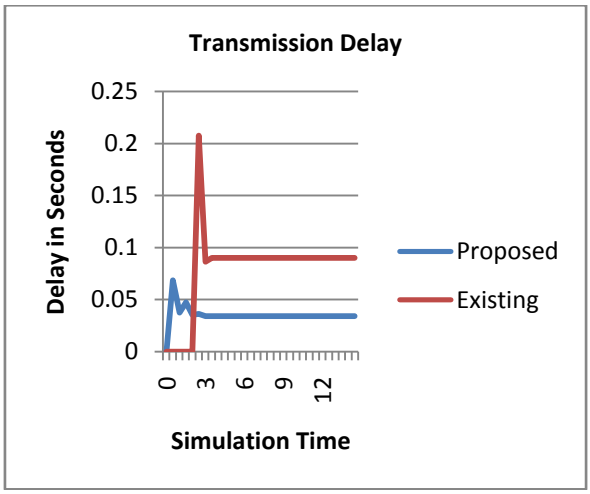

Figure.3. Comparison of Transmission Delay in soft handover and soft handover using stand by request

Packet Delivery Ratio: The packet delivery ratio is the total percentage of the data delivered successfully on the other end. The graphical representation of the packet delivery ratio clearly shows the effectiveness of the proposed model against the existing model. The proposed model has been recorded with the maximum packet delivery ratio at 82 percent and 30 percent for the existing model.

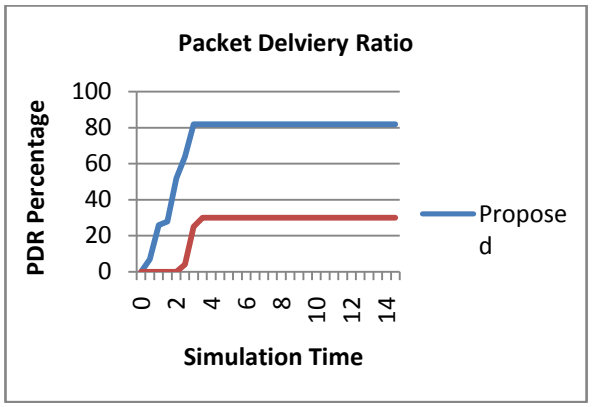

Figure.4. Comparison of packet delivery in soft handover and soft handover using stand by request

Network Load: The network load is the parameter to find the data per time interval on each node for processing. The low amount of easily process able data indicates the robust performance of the proposed model according to the following graph

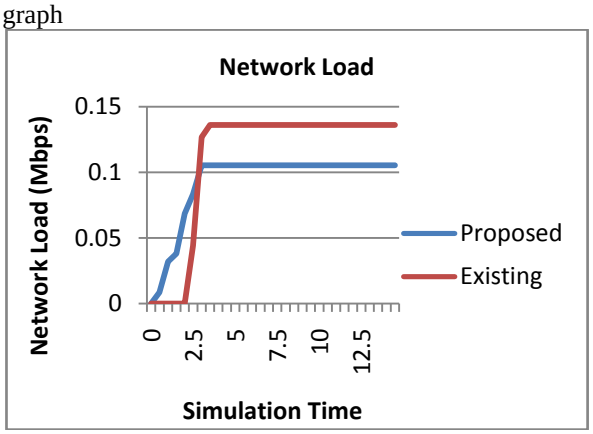

Figure.6. Comparison of network load in soft handover and soft handover using stand by request

Throughput: Throughput is the parameters indicate the successfully processed or transferred data between all of the nodes within the network. The higher throughput adds the robustness to the proposed model over the existing model after the analysis of the handoff models simulation.

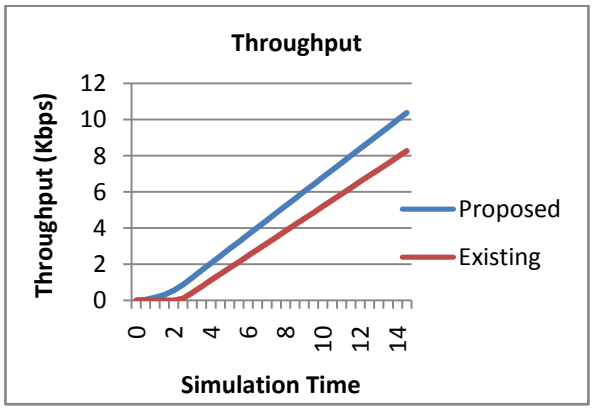

Figure.7. Comparison of throughput in soft handover and soft handover using stand by request

VI. CONCLUSION

The proposed model simulation has been designed for the purpose of soft handover in the WiMAX networks. The WiMAX networks are popular for the high-speed network connectivity in many forms of networks**.** The proposed model has been designed for the purpose of soft handover with minimizing the probability of the connection loss while changing the coverage cell. The proposed work has been equipped with the stand-by request based mechanism. The proposed mechanism enables the WiMAX users to stay connected while changing the cells in the WiMAX network. The WiMAX network nodes connect themselves with the other base station in the vital reach in order to keep it connected while keeping all of the data or voice connections intact in the given WiMAX network while changing its positions from one cell to another cell. The proposed model proposes the use of standby request for the purpose of improvement in the handover procedure in the existing schemes. The simulation results have been obtained in the form of network performance parameters of network load, packet loss, throughput, packet delivery ratio and transmission delay. The experimental results have shown in the effectiveness of the proposed model in comparison with the existing models. In the future, the proposed model can be improved for the more balanced and accurate handover model for the better connectivity. The proposed model performance can be also evaluated and compared with the existing models of handover for the WiMAX networks.

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