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Analysis of Soft Handover in WIMAX Ubiquitous Connectivity Using Monitoring Station

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Abstract
WiMAX stands for the Worldwide Interoperability for Microwave Access and is also known as the IEEE 802.16 wireless metropolitan area network. Along with the development of mobile communication and broadband technology, WiMAX has become a hot spot for global telecom operators and manufacturers. We have proposed a technique to select a mobile base station for potential soft handover in WIMAX. This paper develops a base station selection procedure that will optimize the soft handover such that there is no data loss; handover decision is taken quickly and thus improving overall handover performance.
Keywords: *WIMAX, Handover, Soft handover, monitoring station.*

1. Introduction

WiMAX is a rapidly growing broadband wireless access technology based on IEEE 802.16-2004 and IEEE 802.16e-2005 air-interface standards [1]. The WiMAX Forum is developing mobile WiMAX system profiles that define the mandatory and optional features of the IEEE standard that are necessary to build a mobile WiMAX compliant air interface which can be certified by the WiMAX Forum [2]. Mobile WiMAX is not the same as IEEE 802.16e-2005; rather a subset of the IEEE STD 802.16 standard features and functionalities [3].The rapid growth in demand for high-speed Internet access for residential and business customers has created a demand for "last mile" broadband access. However, providing "last mile" broadband access with fiber or coaxial cable can be very expensive. A cheaper solution to rapid requirement of internet connection for data, voice and video service is Broadband Wireless Access (BWA). BWA provides high speed network access at low cost. Other advantages of BWA are high scalability, lower maintenance and upgrade costs.

1.1 Handovers or Handoff in WIMAX

Mobile WIMAX allows the user to move freely during data transmission. The main consideration of mobile WIMAX is that there should be no data loss when the moving user switches from one base station to another i.e. during handover. Handover or handoff is procedure when a mobile station changes the serving base station. The reason for handover could be relatively low signal strength or work load of base station. [5]. Traditional or conventional handoffs also known as horizontal handoffs (HHOs) occur between the same type of access networks (WiFi-WiFi or GSM-GSM) and are fundamentally based on RSS [4]. A special requirement of a mobile device is the ability to change its serving base station if there exists another base station with better signal strength in the reach of mobile station (MS). Handover is a procedure that provides continuous connection when a MS migrates from the air-interface of one BS to another air-interface provided by another BS without disturbing the existing connections. Handovers are needed to support mobility. [1]

For a handover to occur, one needs to have at least two base stations: Serving base station(SBS) and Target base station(TBS). The handover is generally considered as change in serving base station but it does not necessarily mean that the base station must be changed.

1.2 Reasons of Handoff

There are some reasons handoff can vary. These are as:

1.When the cellular phone is moving away from the area covered by the serving BS, the device eventually

goes outside the range of the serving BS. So in order to avoid call termination, the call needs to be transferred to an area covered by another BS [1].

2.When the signal strength is not enough to maintain a proper call at the edge of a serving cell, the call needs to be transferred to another cell [6].

3.When the capacity for connecting new calls of a cell in a BS becomes full or more traffic is pending, capacity must be made available for users who can only be connected on that cell. Therefore, the existing calls or the new calls from a phone that is located in an area that is overlapped by both cells can be transferred from the first cell to the second cell [6] .

4. In non-CDMA networks several phones use different cells but the same channel. As a channel is being used by several phones, disturbing co-channel interference comes from another phone. Therefore, in order to avoid interference, the call is transferred to a different channel in the same cell or to a different channel in another cell [1].

5. In vertical handoff, a faster network is occasionally available. So the phone changes its network to the cheaper one [7].

2. Proposed Work

The proposed scheme is to define a procedure that can select the target base station for soft handover faster and efficiently:

Step 1: Maintain div set for each mobile station at Monitoring node.
Step 2: Select a base station for mobile station (MBS) for monitoring the neighboring base stations.
Step 3**:** Define a threshold level below which handover will be initiated by the mobile station, this threshold level will depend upon following parameters:-

a) Signal strength of base station
b) Traffic at base station
c) Distance of a base station from mobile station.

These are the reasons for a handover to occur and based on these parameters, the mobile station will select target base station for further services.
Step 4: The target base station is selected from diversity set by anchor base station that continuously monitors the neighboring base stations for a base station.

Step 5: As scanning procedures are already completed the mobile station will do the range selection with the target base station and when the link is properly established, then it breaks the connection with serving base station.
Steps 6: In case when serving base station fails before connecting with the target base station, monitoring station can maintain the link.

2.1 Steps for Selecting a Base Station

Table1: Steps for Selecting a Base Station

1	Initiate cell selection
2	Synchronize with DL and obtain DL and UL parameters
3	Ranging
4	Negotiate basic capabilities
5	MS authorization
6	Register with BS and establish IP connectivity
7	HO decision
8	Synchronize with new DL and obtain DL and UL parameters
9	Ranging
10	Data transmission with new base station

Initiating cell selection / reselection means scanning neighboring base stations.In the proposed technique, we are trying to modify the FBSS procedure to optimize target base station selection for soft handovers in WIMAX. We have introduced monitor base station which is selected from diversity set of mobile station. The function of monitor base station (MBS) is to communicate with mobile station and maintain the database of potential target base stations for a handover for mobile station. Another advantage of MBS is that whenever ABS fails, mobile station can start data communication with MBS without any loss of data by sending register message.

2.2 Selection for Mobile Station

When a mobile station gets registered to a base station (SBS), it sends scan_req message to SBS , it responds to this message by sending the data of its

neighboring base stations through scan_rsp message. With this data the mobile station will choose the MBS having maximum value of div parameter. That is mobile station will communicate with best suited target base station so at any point if SBS goes down, the mobile station can easily switch to MBS. As the mobile station is moving continuously the diversity set is required to updated according to current location of mobile station. If the div value of MBS goes below the threshold value. It will send the stored information to SBS and SBS will select new MBS the mobile station.

The Serving Base Station (SBS) periodically broadcasts neighbor Advertisement (NBR_ADV) message that contains network topology information or channel information of available neighboring base stations. Then the mobile station (MS) is able to synchronize with neighboring base station without listening the DCD/UCD (Downlink/Uplink channel descriptor) broadcast message. The mobile station (MS) continues the data communication with SBS. The mobile station sends (SCN_REQ) message to the serving base station to scan the neighboring base station according to the current location (div) of mobile station. The serving base station responds to SCN_REQ message by sending the information of neighboring base station as per the calculation, the base station with maximum value of div parameter is selected as monitor base station.

- The monitor station sends start monitor message to selected monitor base station (MBS).
- The mobile station now communicates with monitor base station for handover decision.

Whenever mobile Station requires a handover, it sends HO_INIT (Handover Initiation) message to monitor base station that sends the information of target base station to mobile station. The mobile station synchronizes the downlink and uplink frequencies with target base station. The mobile station can now start the data communication with target base station.

3. Results

The proposed technique is implemented in NS-2.35 Simulator in Linux environment. The hnd.tcl file is executed and it generates a .nam file which can be viewed in Network Animator tool of ns2 simulator. This simulation.nam file visualizes the soft handover procedure.

Fig. shows 3 nodes used in simulation of base station selection procedure for soft handover. Here node 1 is mobile station and all the other nodes are base stations. The simulation shows the handover procedure as mobile station changes its position.

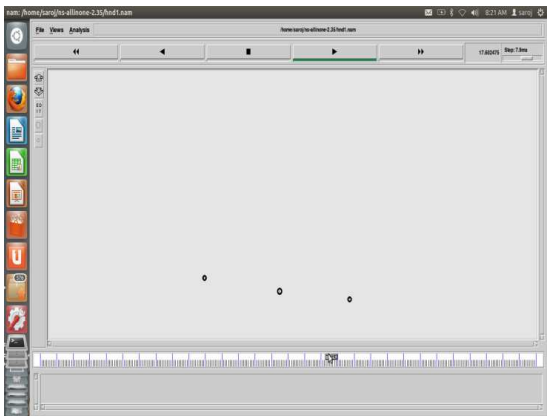

Figure 3.1: Mobile Station and Base Station in existing system

Figure shows the ranging between node 0 and node 1. The node 0 acts as serving base station for mobile station (node 1). The node 1 starts data communication with node 0. As the mobile station moves, its distance from serving base station increases and the mobile station looks for another base station for soft handover ie. Target Base Station. The below figure shows handover when the mobile station connects with target base station. Node 2 is target base station.

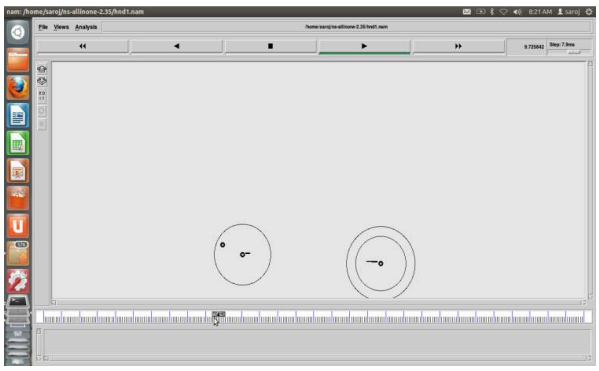

Figure3.2: Data Transfer between Mobile Station and Base Station in existing system

Figure shows 4 nodes used in simulation of base station selection procedure for soft handover. Here two nodes are base stations, 1 is mobile station and another node is monitoring stations. The simulation shows the handover procedure as mobile station changes its position.

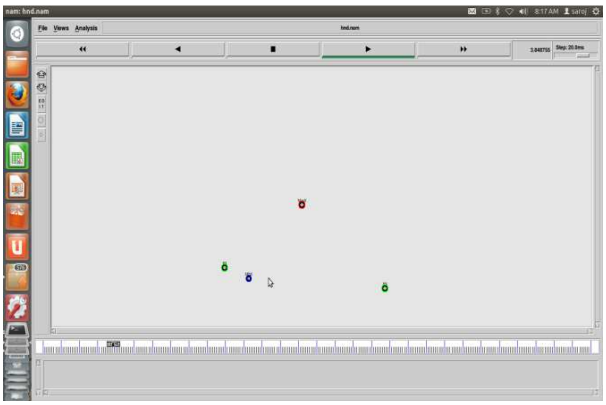

Figure3.3: Representing Monitoring Station, Base Station, Mobile Station

Figure shows the ranging between node 0 and node 1. The node 0 acts as serving base station for mobile station (node 1). The node 1 starts data communication with node 0. As the mobile station moves, its distance from serving base station increases and the mobile station looks for another base station for soft handover ie. Target Base Station. The below figure shows handover when the mobile station connects with target base station in between this to maintain the connectivity the monitoring station works. Node 2 is target base station.

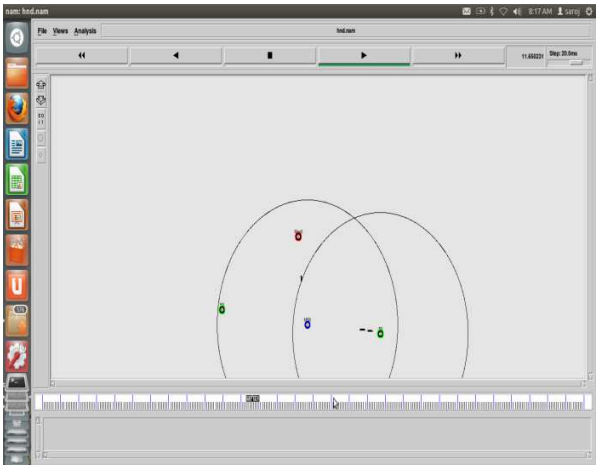

Figure3.4: Connectivity between various stations

Result is comparison between the existing handover and our proposed technique. It shows that using the proposed technique the performance of soft handover is improved.

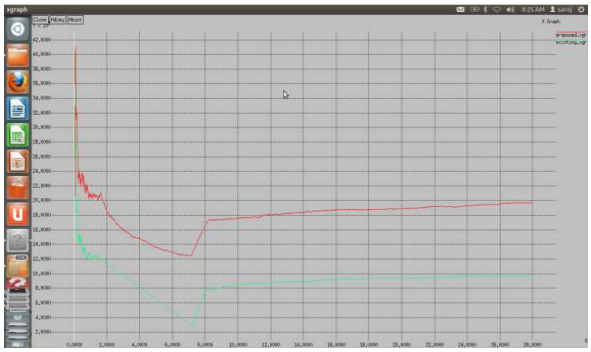

Figure3.5: Graph showing the comparison of proposed scheme and existing scheme.

4. Conclusion

WiMAX offers benefits for wire line operators who want to provide last mile access to residences and businesses, either to reduce costs in their own operating areas, or as a way to enter new markets. WiMAX's all-IP architecture lends itself well to high bandwidth multi-media applications, and with QoS will also support mobile voice and messaging services, re-using the mobile networks IP core systems.The main purpose of this research work is to study the basic concepts of mobile handover and the handover latency with the travelling speed of mobile station in mobile WIMAX networks.We have studied several scenarios and mechanisms of handover. Obviously, for every specific network environment specific handover mechanism is suitable and still this is the concern for researchers to give a stable and widely acceptable handover algorithm. Out of the presented technologies this can be concluded that rather hard handover is applicable for low speed mobile WiMAX networks but it is cheaper and simpler.We use the NS2 for simulation work with more realistic handovers in the mobile WIMAX. The main goal of this simulation is to maintain the connectivity in WiMAX. When we increase the monitoring station load then the connectivity will increase. Simulation results denotes that the throughput of proposed soft handover is increased and pdr has improved to 95% from 91.1% .In future this can implemented on real world applications.

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