Advance Handoff Requirements Schemes in Wimax and LTE Networks in Wireless Sensor Network

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ABSTRACT
The emerging technology, which allows high speed broadband wireless access, is the WiMAX technology which is based on the IEEE 802.16 family of standards. Mobile WiMAX (Worldwide Interoperability Microwave Access) is a wireless system based on the IEEE 802.16e [1] standard. In this paper occurrence of the handover in Wimax & LTE systems is shown and what are the requirements that have to be considered during the handoff mechanism are discussed so that the efficiency & throughput of the network may be increased. Orthogonal Frequency Division Multiple Access (OFDMA) is selected here as it provides high spectral efficiency and robust performance in high mobility scenarios and fading environments. In order to ensure proper quality of service for real-time communication in a mobile wireless Internet environment it is essential to minimize the transient packet loss when the mobile is moving between different cells (subnets) within a domain.

Keywords
WiMAX, LTE, handoff, Wireless sensor network, OFDMA.

1. BACKGROUND
In telecommunications there may be different reasons why a handover might be conducted:

(i) When the phone is moving away from the area covered by one cell and entering the area covered by another cell the call is transferred to the second cell in order to avoid call termination when the phone gets outside the range of the first cell.

(ii) When the capacity for connecting new calls of a given cell is used up and an existing or new call from a phone, which is located in an area overlapped by another cell, is transferred to that cell in order to free-up some capacity in the first cell for other users, who can only be connected to that cell.

(iii) In non-CDMA [11] networks when the channel used by the phone becomes interfered by another phone using the same channel in a different cell, the call is transferred to a different channel in the same cell or to a different channel in another cell in order to avoid the interference.

(iv) In non-CDMA networks when the user behaviour changes, e.g. when a fast-travelling user, connected to a large, umbrella-type of cell, stops then the call may be transferred to a smaller macro cell or even to a micro cell in order to free capacity on the umbrella cell for other fast-travelling users and to reduce the potential interference to other cells or users (this works in reverse too, when a user is detected to be moving faster than a certain threshold, the call can be transferred to a larger umbrella-type of cell in order to minimize the frequency of the handovers due to this movement).

(v) In CDMA networks a handover may be induced in order to reduce the interference to a smaller neighbouring cell due to the "near-far" [21, 26] effect even when the phone still has an excellent connection to its current cell. Once the mobile moves to a new domain, most of the movement is limited to the subnets within the new domain until the mobile moves out again to another domain. Handover is one of the most important factors that may degrade the performance of transmission control protocol (TCP) connections [9] and real-time applications in wireless data networks. Handover can be divided into three stages; preparation (initiation), execution and completion. People send e-mails or browse the internet using high speed packet access (HSPA) [2] using HSPA modems instead of digital subscriber line (DSL) modems [17] .With LTE, the optimum usage of these techniques can be obtained. Some of the methods that can be applied to help take care of the transient data loss can be achieved by intercepting and forwarding the transient traffic or by multicasting.

2. INTRODUCTION
2.1 Types of Handoffs in WIMAX
In Wimax networks, the handoffs are classified into two main streams:-

Horizontal Handoff (HHO)

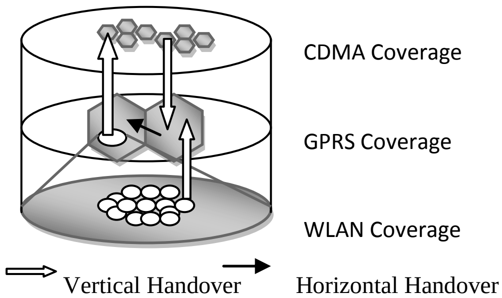

Fig 1: Horizontal Handoff of WLAN, GPRS and CDMA coverage

Handoff between two base stations (BSs) of the same system is called Horizontal handoff. Horizontal handoff involves a terminal device to change cells within the same type of network (e.g., within a CDMA network) to maintain service continuity [2]. It can be further classified into Link-layer handoff and Intra-system handoff. Horizontal handoff between two BS, under same foreign agent (FA) is known as Link-layer handoff [14]. In Intra-system handoff, the horizontal handoff occurs between two BSs that belong to two different FAs and both FAs belongs to the same system and hence to same gateway foreign agent (GFA).

Vertical Handoff (VHO)

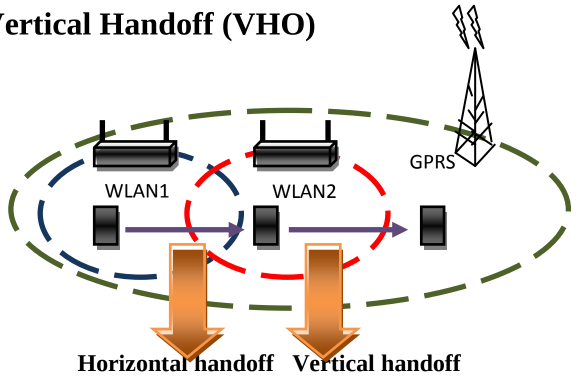

Fig 2: Vertical Handoff between WLAN Networks

Vertical handoff refers to a network node changing the type of connectivity it uses to access a supporting infrastructure, usually to support node mobility. For example, a suitably equipped laptop might be able to use both a high speed wireless LAN and a cellular technology for Internet access. Wireless LAN connections generally provide higher speeds, while cellular technologies generally provide more ubiquitous coverage. Thus the laptop user might want to use a wireless LAN connection whenever one is available, and to 'fall over' [16] to a cellular connection when the wireless LAN is unavailable. Vertical handovers refer to the automatic fallover from one technology to another in order to maintain communication [3].The vertical handoff mechanism allows a terminal device to change networks between different types of networks (e.g., between 3G and 4G networks) in a way that is completely transparent to end user applications[2]. The vertical handoff process involves three main phases [4], [5], namely system discovery, vertical handoff decision, and VHO execution. During the system discovery phase, the mobile terminal determines which networks can be used. These networks may also have the supported data rates and Quality of Service (QoS) parameters [1, 2] . In VHO decision phase, the mobile terminal determines whether the connections should continue using the current network or be switched to another network. The decision may depend on various parameters or metrics including the type of the application (e.g., conversational, streaming), minimum bandwidth and delay required by the application, access cost; transmit power, and the user's preferences.

Update of diversity set is depending on the threshold contained in Downlink Channel Descriptor (DCD) [1,7]. There are mainly two defined thresholds: H_Delete Threshold and H_Add Threshold [9]. There can come two situations. The first is dropping of the serving BS (the BS which provide services to MS) from diversity set. BS is dropped from diversity set if long term CINR [16] 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 than H_Add Threshold. The Updating of the diversity set is same as in the case of MDHO and FBSS.

3. PROPOSED WORK

Based on orthogonal frequency-division multiplexing (OFDM) technology [13, 23] the RAN includes a new radio link. RAN has an essentially different architecture, where the function of radio is deployed into the BS. LTE only supports hard HO and not soft HO, unlike WCDMA [11]. At each HO LTE needs to relocate the user context and control plane context from the serving eNB to target eNB. Since, it would be overly complex and not always feasible to transfer the whole protocol state, it is assumed in LTE that the RLC/MAC protocols [22, 9] are reset. The requirements of the next generation networks is targeted by the LTE within peak of more than 100 Mbps for downlink, 50 Mbps for uplink and less than 10 ms for radio access network (RAN) round-trip time (RTT) [13,17]. LTE supports flexible bandwidth from 1.4 up to 20 MHz for both frequency division duplex (FDD) and time division duplex (TDD) [7, 8].

Inter cell interference coordination (ICIC) handover mechanism OFDMA[13, 23] provides efficient spectral efficiency by reusing complete frequency band in all cells; however it projects high inter cell interference (ICI) especially at cell borders. One technique that has been proposed to overcome ICI problems is inter cell interference coordination (ICIC). This algorithm has shown that significant gain can be achieved by the use of ICIC while maintaining very low handover rates. OFDMA is selected because it provides high spectral efficiency and robust performance in high mobility scenarios and fading environments.

All HO mechanisms aim to reduce unnecessary HOs. The history based on handover prediction technique has revealed its weaknesses by judging its poor cost to its performance ratio. Almost all works on mobility prediction assume that there is only one path between any two points, ignoring the fact that user's movements are not completely random. But this technique has very good ping-pong handover [22] reduction rate. Intra-access HO technique introduces the importance of packet forwarding on the throughput performance of TCP at handovers.

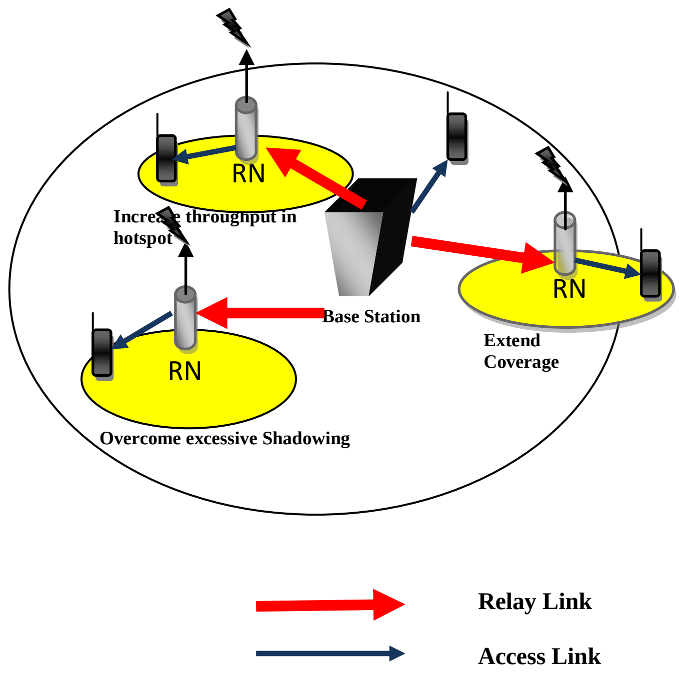

Fig 3: Example scenarios for the deployment of RNs in LTE network

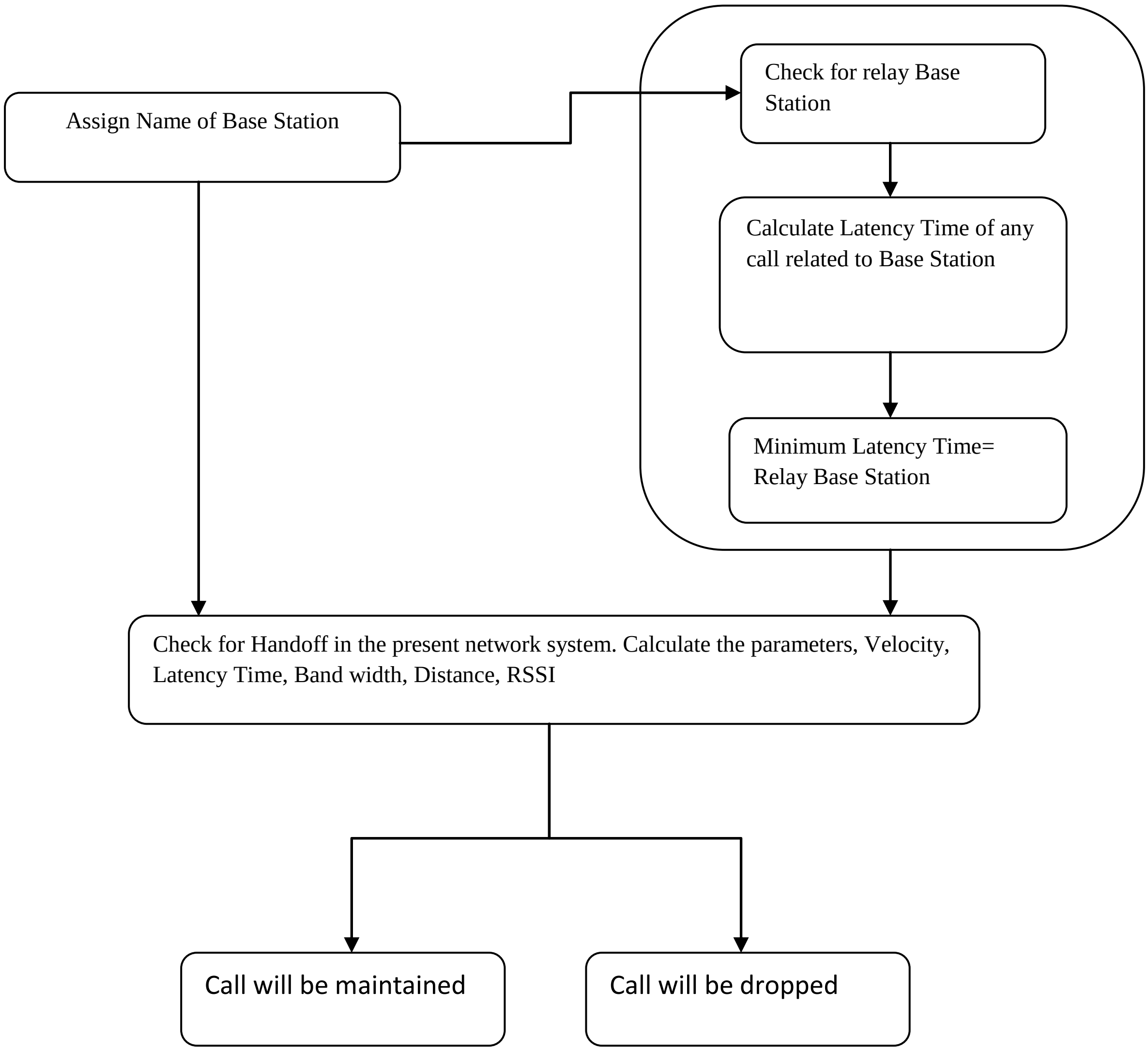

Fig 4: Architecture of Handoff Mechanism

3.1 MECHANISM

3.1.1Requirement for Handoff Mechanism

1. Bandwidth

Bandwidth is a measure of the width of the range of frequencies. It is the difference between the upper and lower frequencies in a contiguous set of frequencies. In order to provide seamless handoff for Quality of service (QoS) in wireless environment, there is need to manage bandwidth requirement of mobile node during movement. Bandwidth is generally known as the link capacity in a network. Higher offered bandwidth ensures lower call dropping and call blocking probabilities, hence higher throughput [9].Bandwidth handling should be an integral part of any of the handoff technique.

2. Power Consumption

In Wimax and LTE networks, there is need to find ways to improve energy efficiency. Power is not always consumed by user terminal but also attributed to base station equipments. Power is also consumed during mobile switching or handoffs. During handoff, frequent interface activation can cause considerable battery drainage. The issue of power saving also arises in network discovery because unnecessary interface activation can increase power consumption.

3. Network Throughput

Network throughput refers to the average data rate of successful data or message delivery over a specific communications link. Network throughput is measured in bits per second (bps). As network throughput is considered in dynamic metrics for making decision of VHO, it is one the important requirement to be considered for the VHO.

4. Handoff Latency

Handover of calls between two BS is encountered frequently and the delay can occur during the process of handoffs. This delay is known as handoff latency. A good handoff decision model should consider Handoff latency factor and the handoff latency should be minimized. Many proposed handoff decision models have tried to minimize the handoff latency by incorporating this factor in their handoff decision models. Handoff Latencies affect the service quality of many applications of mobile users. It is essential to consider handoff latency while designing any handoff technique. It is also important to incorporate power consumption factor during handoff decision.

5. Network Cost

A multi criteria algorithm for handoff should also consider the network cost factor. The cost is to be minimized during VHO in wireless networks. The new call arrival rates and handoff call arrival rates can be analyzed using cost function. Therefore, network selection cost is important in handoff decisions.

6. Received Signal strength (RSS)

The performance of a wireless network connection depends in part on signal strength. Between a mobile node (MN) and access point (AP), the wireless signal strength in each direction determines the total amount of network bandwidth available along with that connection. RSS [27] depicts the power present in a received signal. A signal must be strong enough between base station and mobile unit to maintain signal quality at receiver. The RSS should not be below a certain threshold in a network during handoff and VHO includes three sequential steps as discussed earlier in this paper, namely handoff initiation, handoff decision and handoff execution.

7. Velocity

Velocity of the host should also be considered during handoff decision. Because of the overlaid architecture of heterogeneous networks, handing off to an embedded network, having small cell area, when travelling at high speeds is discouraged since a handoff back to the original network would occur very shortly afterwards [9]. However, it was stated that the capability and bit error rate can also be considered during vertical handoff.

8. Network Security

With the increasing demand of wireless networks, seamless and secure handoff has become an important factor in wireless networks. The network security consists of the provisions and policies adopted by the network to prevent and monitor unauthorized access, misuse, modification, and network-accessible resources. In a wireless environment, data is broadcast through the air and people do not have physical controls over the boundaries of transmissions.

The security features provided in some wireless products may be weaker to attain the highest levels of integrity, authentication and confidentiality. Network security features should be embedded in the handoff policies.

PHASE1: CREATE RELAY BASE STATION IN WSN

STEP 1:Assigning BS_{NAME} for each base station.

Number of base station= BS_N //BS_N=Base Station Of the Network
for(i=0;i<=N;i++)
{
    BS_{NAME}[i]=Random Number Generator(); //BS_{NAME}=Name of the Base Station
}

STEP 2: Check for Relay Base Station

Relay Base Station()
{
    LT=LT[0]; // LT= Latency Time
    for($BS_{NAME}=0;BS_{NAME}<N;BS_{NAME}$++)
    {
        if($LT>BS_{NAME}$[i])
        {
            $LT_{STATIONi}=BS_{NAME}$[i];
    //$LT_{STATIONi}$= Latency Time of the Station
        }
    }
}

PHASE 2: CHECK FOR HANDOFF IN THE PRESENT NETWORK SYSTEM:

BaseStation()
{
    for($BS_{NAME}=0;BS_{NAME}<N;BS_{NAME}$++)
    {
        if($VELO_{RBS}<VELO_N$ && $LT_C>LT_{RBS}$)
    /*$VELO_{RBS}$= Velocity of the Relay Base Station
    $VELO_{MN}$= Velocity of Mobile Node
    LT_C= Latency Time of Call
    LT_{RBS}= Latency Time of Relay Base Station*/
        {
            Call will be dropped
        }
        elseif($DST_N>DST_{RBS}$&& $BAND_C>BAND_{RBS}$ && $RSSI_C<RSSI_{NET}$)
        /* DST_N= Distance of the Mobile Node
        DST_{RBS}= Distance of the Relay Base Station
        $BAND_C$= Bandwidth of Call
        $BAND_{RBS}$= Bandwidth of Relay Base Station
        $RSSI_C$= Received Signal Strength Information of Call
        $RSSI_{NET}$= Received Signal Strength Information of Network*/
        {
            Again call will be dropped
        }
        else if
        {
            Call will be maintained
        }
    }
}

4. FUTURE SCOPE

Future generation wireless networks should provide mobile users the best connectivity and services anywhere at anytime. The most challenging problem is the seamless intersystem/vertical mobility across heterogeneous wireless networks. In order to answer it, a vertical handover management system is needed. In this paper an intelligent solution answering user requirements and ensuring service continuity is proposed, focus is on a vertical handover decision strategy based on the context-awareness concept. The given strategy chooses the appropriate time and the most suitable access network among those available to perform a handover. It uses advanced decision algorithms (for more efficiency and intelligence) and it is governed by handover policies as decision rules (for more flexibility and optimization). To maintain seamless service continuity, handover execution is based on mobile IP functionalities. The decision system is based on a case of a 3G/UMTS-WLAN scenario and all the handover decision issues are discussed in the solution.

5. CONCLUSION

Mobility enhancement is an important aspect of the usefulness of LTE network. LTE should support various mobile speeds from low to a high vehicular speed. The higher speed will cause more frequent handover, therefore handover performance will be more critical at these speeds, and especially for real time services. This paper also analyzes the current handover situation in WiMAX networks. In the first version of WiMAX standards, the mobility was not supported at all and 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. The Wimax wireless system must have the capability to provide high data transfer rates, quality of services and seamless mobility. The users for variety of applications would like to utilize heterogeneous networks on the basis of their preferences such as real time, high availability and high bandwidth. When connections have to switch between heterogeneous networks for performance and high availability reasons, seamless vertical handoff is necessary. The vertical handoff will remain an essential component for Wimax wireless networks. In this paper, a few works in vertical handoff mechanisms are described. The Wimax wireless networks create new handoff challenges due to multiple requirements for vertical handoff. In this paper, the requirements of a vertical handoff for Wimax wireless network were proposed. The requirements include high bandwidth, low handoff latency, lower power consumption, minimum network cost, balanced network load, network security, user preferences, throughput and RSS of a switching network. Establishing the requirements of a vertical handoff mechanism for Wimax wireless networks is a critical milestone in the development of vertical handoff mechanism. The evaluations indicate the need to have a VHO mechanism for LTE AND Wimax wireless networks that has the ability to satisfy maximum number of requirements. However, it is difficult to consider all the parameters during designing the decision model for VHO but if we consider more parameters, the outcome of the decision mechanism would definitely improve.

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