Enhanced QOS Factors for Load Balanced Handoff WiMAX Net

P.Kavitha
Mca, Mphil, B.Ed.
Hod,Department Of Computer Scince,
Bharathiyar Arts And Science College
For Women Deviyakurichi, Attur, Salem

M.Santhalakshmi
M.Sc.,Mca.,Mphil.,
Hod,Department Of Computer Applications,
Bharathiyar Arts And Science College For Women,
Deviyakurichi,Attur,
Salem

ABSTRACT

WIMAX is a wireless high speed internet communication technology in geographical areas which is having higher data transfer rate. This is a emerging data transfer mechanism for its superior quality over their former communication technology like cable-modem and DSL connections. Mobile devices scans more channels in order to search neighboring base stations which selects the optimal target. The IEEE 802.16e produces temporarily breaking communications among the base stations and mobile stations to search channels. Handoff detection includes network discovery and handoff decision. Which kind of handoff metrics should be used and how to apply them to make the handoff decision are the main problems in handoff detection. In handoff process we propose our future WiMAX to support multimedia applications like VOIP, etc., Our WiMAX based multimedia networks enhance the quality for the medium duration calls.

Keywords

WiMAX, IEEE 802.16, Handoff, VOIP, Multimedia Applications.

1. INTRODUCTION

WIMAX technology is a wireless networking standard that addresses interoperability across IEEE 802.16 standard-based products. So far, two standards have been already approved, the IEEE 802.16-2004 [1] intended for fixed scenarios and the IEEE 802.16e [2] implementing mobility features such as handover (HO) and power management modes to the former standard.

The Hand Over process is of several phases [1]: Circular of Network Topology, Mobile Station Searching, Cell Reselection, Hand Over decision and Network Re-entry. This paper mainly emphasizes on the cell reselection and HO decision and initialization phases. In conventional IEEE 802.16e which uses only downlink channel parameters to make a decision.

The HO mechanism implemented in WiMAX allows a motion of a Mobile Station from the air interface of a single Base Station to the air surface provided by another BS. The IEEE802.16e standard defines HO only among BSs, but it does not consider booster station. The Booster Stations are generally simplified BSs and may be used either to extend a coverage of a BS or to increase of a capacity in the specific area [3]. The RSs are connected to the network via radio interface, so there is no wired connection to the backbone network. The implementation of RSs into WiMAX networks is the target of currently specified standard IEEE 802.16j [4]. In the scope of paper, the relay stations designed for purpose of throughput enhancement are assumed.

Two types of handover decision and initiation criteria are assumed by the IEEE 802.16 direction contents. Those mechanisms are summarized in [5]. First, channel quality indicators, such as Carrier to Interference and Noise Ratio or the signal strength, can be exchanged. Second, QoS is characterized by the service level prediction. The service level prediction indicates the level of service expected by MS from target BS. Depending on their availability, other criteria such as the bit error rate (BER), packet delay / jitter, service pricing [6], the MS velocity [7], and the MS location [8] can be used. If RSs are introduced into WiMAX system, new challenges for handover decision and initialization arise. General principle of handover in networks with RSs is introduced in [9].

Mobile WiMAX was the initial moving broadband wireless-access solution based on the IEEE 802.16e-2005 basic that allowed overlap the mobile and fixed broadband networks through an ordinary wide-area radio access technology and elastic network architecture. The mobile WiMAX air interface uses the orthogonal frequency division multiple access. There are typical features and advantages such as adaptability and the protractible of its physical and medium access layer protocols that make mobile WiMAX and its evolution more enchanting and more acceptable for the recognition of omnipresent mobile Internet access.

Mobility also introduces another important aspect of system wide QoS. Generally dropping an existing connection or lowering its QoS is considered being worse than blocking a new one. Thus when providing QoS system wide, the system has to often prioritize ongoing connections over new ones and set aside sufficient radio resources so that ongoing sessions are not dropped when the session is migrating (handed over) to another Base Station. If a Base Station is heavily loaded, if the number of MSSs in the overlapping areas is small or if the MSSs are very mobile, load balancing might not release sufficient amount of free resources for this. Therefore another goal of this thesis is to examine how we could complement the load balancing scheme by rendering such a guard band and what kind of a relationship they have. We will also study the possibility of setting different defend stripes for connections using different scheduling services. Prioritizing traffic by providing different level of service is one of the fundamental features of fixed WiMAX and using such multiple thresholds could extend this concept to mobility. Such handover and traffic prioritization will also have an impact on how and when load balancing is triggered which makes their examination even more interesting.

The arriving generation of mobile WiMAX will repose the success of the former WiMAX technology and its reward over other mobile broadband wireless access technologies. All OFDM-based mobile broadband technologies have been formulated recently to enhance and elaborate fundamental concepts that were originally used in mobile WiMAX.

Channel scanning in IEEE 802.16 are comparatively time intense and causes quality of service to demean, it is preferable for the mobile station to perform this scanning and obtain a list of adjacent Base Stations before it is ready to perform a deliver. In fact the IEEE 802.16 extension standard bears transient freezing the communication between the Base Station and Mobile Station in order to perform channel reading.

In Mobile WiMAX load balancing can be carried on by pushing handovers from highly loaded Base Stations to lightly loaded ones. When a Base Station is overloaded by traffic the QoS of many users will reduce and hence load balancing can be used to equip better QoS system wide. The Mobile WiMAX system profile only determines a framework for processes and observations, but leave the actual detailed implementation and algorithms to be chosen by the vendor.

2. RELATED WORKS

The work presented in this chapter on the bounds of variable-range transmissions in wireless ad hoc networks uses traditional graph theory [8]. In particular, we used the theory explaining the behavior of minimum spanning trees (MST) to compute the weight of a minimum spanning tree [10]. As a reference, the two main algorithms to construct MSTs are the Prim [8] and Kruskal [9] algorithms. A similar problem to computing the weight of a minimum spanning tree is the traveling-salesman problem, or the problem of finding the shortest path through many points [12]. In the work described in [7], the authors discuss the impact on TCP throughput on the number forwarding nodes in static wireless ad hoc networks for unreliable links. Results from [7] show that there is an optimum transmission range that maximizes TCP throughput.

Power control can also impact the connectivity and performance of the network layer. Choosing a higher transmission power increases the connectivity of the net-work. Routing protocols can take advantage of highly connected networks to provide multiple routes for a given source-destination pair in cases where some nodes or links fail. Systems based on common-range transmission control like MANET protocols [12] usually assume homogeneously distributed nodes. As discussed earlier, such a regime raises a number of concerns and is an impractical assumption in real net- works. The authors in [13] discuss this problem and propose a method to control the transmission power levels in order to control the network topology. The work in [13] is concerned with controlling the connectivity of non-homogeneous networks, but it does not provide a mathematical description of the problem space, and ignores the power savings and traffic-carrying capacity aspects of the problem.

2.1 Interworking

Different radio access technologies present distinct characteristics in terms of mobility management, security support, and QoS provisioning. To achieve seamless mobility and end-to-end QoS guarantee for the users, these issues should be care-fully addressed while developing interworking schemes. The interworking between different wireless access networks has been a hot research topic in recent years. Most of the researchers mainly focus on interworking between WLAN and 3G cellular networks such as UMTS and CDMA2000, which are the two major standards for 3G mobile/cellular networks specified by the 3rd generation partnership projects, i.e., 3GPP and 3GPP2. There are two main ways of integrating the WLAN and 3G cellular networks [2], defined as tightly-coupled interworking and loosely-coupled interworking.

2.2 Mobility Management

Mobility scenarios can be classified into macro-mobility and micro-mobility. Macro- mobility is referred to as inter-domain mobility where an MN moves between different administrative domains. Micro-mobility is referred to as intra-domain mobility where an MN moves within one administrative domain.

Mobility management contains two components: location management and handoff management [5]. Location management enables the network to track the current attachment point of a mobile user. The first step is location registration (or location update). In this step, the mobile terminal periodically informs the net- work of its up-to-date location information, allowing the network to authenticate the user and update the user's location profile. The second step is call delivery. The network determines the current location in which a mobile terminal is located so the incoming communication for the mobile terminal can be routed to the corresponding location. There are some challenges for the design of location management especially for inter-domain roaming in terms of the signaling overhead, call delivery latency, and QoS guarantees in different systems. Handoff management enables the network to maintain the on-going connection when a mobile terminal switches its access point. There are three stage processes for handoff. First the initiation for handoff is triggered by the user, a network agent, or changing network conditions. The second stage is new connection generation, where the network must find new resources for the handoff connection and perform any additional routing operations. Finally data flow control needs to maintain the delivery of the data from the old connection path to the new connection path according to agreed-upon service guarantees.

2.3 Handoff

Handoff process can be seen as having two stages: (1) Handoff detection, and (2) Handoff execution. Handoff detection includes network discovery and handoff decision. Which kind of handoff metrics should be used and how to apply them to make the handoff decision are the main problems in handoff detection. In handoff execution, the mobility management plays an important role. The signaling over- head and handoff latency are different in different mobility protocols. To achieve seamless and fast handoff, these two stages should be paid attention to. The time when the handoff decision is made can affect the overall performance of the handoff process such as packet loss. A heavy signaling overhead in handoff management leads to large handoff latency.

3. LOAD BALANCED HANDOFF

In recent years the mobile internet and wireless multimedia applications grows as an abundant demands which leads to the development of broadband wireless access systems. Based on the bandwidth availability and multi-antenna mode the mobile WiMAX can transfer the data more than present transmission speed of 2 Gb/s. They support high caliber and high power IP-based service and applications in maintaining the backward compatibility with the traditional WiMAX system.

Load balancing schemes that try to solve the hotspot problem can roughly be divided to resource allocation schemes and load distribution schemes. Resource allocation schemes the idea behind balancing the system load with resource allocation is to bring the resources (unoccupied frequencies) to where most of the users are located. In resource allocation schemes, a centralized element allocates additional resources to hotspot cells. One example of this is channel borrowing where a congested Base Station can borrow the channel of lightly loaded Base Stations

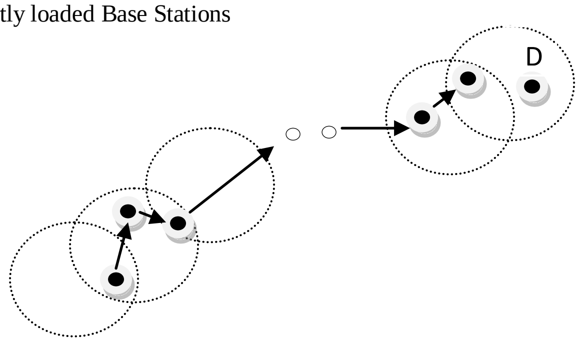


Figure 1 Route Maintenance

There will be none, one, or several intermediate forwarding nodes between source-destination pairs. Figure 1 illustrates an example of a route from a source node S to a destination node D involving several forwarding nodes. Each circle in Figure 1 represents the transmission range of each forwarding node in this route.

Channel borrowing requires that the system supports Dynamic Channel Allocation (DCA), which is an enhancement to the traditional Fixed Channel Allocation. DCA is able to adjust to changing traffic whereas FCA will keep the same frequency assignments irrelevant of the traffic load. Although Mobile WiMAX provides a flexible way to allocate frequency resources making DCA between BSs possible, DCA won't be used at least in the early stages of deployment. FCA will be applied for the frequency sets resulting from PUSC aspects.

In resource allocation based load balancing the aim is to bring the resources to where most of the traffic is, with load distribution the goal is to direct the traffic to where the resources are. The way to do this is to use handovers. Load distribution with handovers can be conducted many ways. One commonly used simple approach is cell breathing. There load balancing is done by adjusting the transmission levels of the SBSs pilot signal (shrinking the cell) according to the traffic level, resulting in a situation where MSs at the edge of the cell are forced to conduct rescue handovers. In systems based on CDMA cell shrinking happens automatically as the number of MSs Increases.

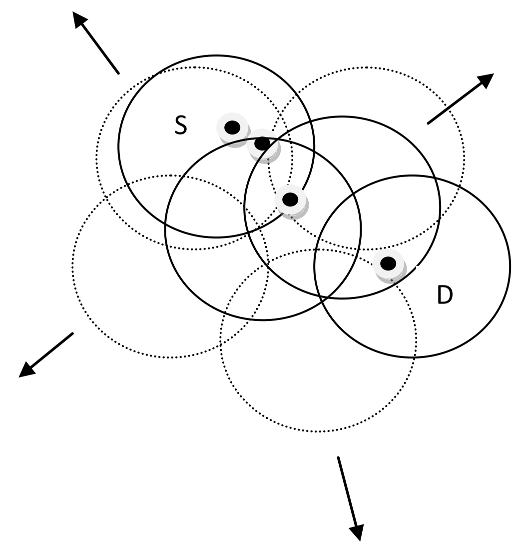


Figure 2 Route Discovery

Figure 2 illustrates a route-discovery process where node S searches for a route toward node D. The solid circles in Figure 2 illustrate the transmission range of the nodes associated with the final route, whereas the dotted circles illustrate the transmission range of nodes in all other directions that did not become part of the final route. Route-discovery can become very demanding in terms of both the number of signaling packets generated as well as the delay involved in finding the intended receiver. This is especially true in medium and large size networks3. An important part of the complexity found in most routing protocols for on-demand ad hoc networks is how to reduce this overhead. Some of the preferred choices to achieve this goal include limiting the geographic scope of the flooding as well as taking advantage of route-caching at intermediate nodes. In this analysis, however, we will consider that the process of route-discovery consist of flooding the entire network with a route-discovery request.

The rate of signaling packets generated by the routing protocol has an impact on the capacity available to nodes for data transmission. We showed an expression for λ'(R), the average traffic carrying capacity per node that can be supported by the network. Now let C be the number of bits exchanged by the routing protocol triggered by a route-repair event. The value of C depends on the number of signaling messages exchanged during a route-repair operation and the average size of each signaling message. Then the total capacity available to nodes using a transmission range R removing the portion of the capacity used by the routing protocol is

$$\lambda^{'}(R,t) = \lambda(R,t) - CJ(R,t) \quad \textbf{(1)}$$

Channel borrowing requires that the system supports Dynamic Channel Allocation (DCA), which is an enhancement to the traditional Fixed Channel Allocation. DCA is able to adjust to changing traffic whereas FCA will keep the same frequency assignments irrelevant of the traffic load [Ira00]. Although Mobile WiMAX provides a flexible way to allocate frequency resources making DCA between BSs possible, DCA won't be used at least in the early stages of deployment. FCA will be applied for the frequency sets resulting from PUSC aspects. We define a new minimum transmission range, $\overline{D}^{new}_{i,j}$ as:

$$\overline{D}^{new}_{i,j} = \overline{D}^{old}_{i,j} + \Delta \qquad (2)$$

Where Δ represents how much time the transmitting node over estimates the transmission range of the next node en route. The value of Δ depends on the average speed of nodes and the time interval between the last time the next redirector en route was overheard and the current time; we refer to this interval as the silence-interval. The longer the silence-interval the greater the uncertainty about the current range of the next node, and therefore, the larger the value of Δ. Load balancing schemes that try to solve the hotspot problem can roughly be divided to resource allocation schemes and load distribution schemes.

4. QOS BASED HANDOVER

QoS-based handover decision algorithm between WLAN and wide-area access network have been proposed by taking account of the network transport capability and user service requirements. In [15], the author uses a decision function which enables devices to assign weights to different network factors to make a handoff decision. It requires much empirical work. In [16], an adaptive multi-criteria handoff decision algorithm is designed by using fuzzy logic concept. In [17], a vertical handoff scheme between IEEE 802.16a networks and IEEE 802.11n networks is proposed. The available bandwidth in WLAN and the RSS are the metrics used for handoff decisions. It is assumed that the MN will stay in the IEEE 802.11n networks as long as possible. So only the RSS is used for handoff from the IEEE 802.11n network to the IEEE 802.16a network.

After a handoff decision, the handoff management procedure is performed to change the network interface and maintain the on-going connection. The mobility management protocol is to implement this function. Some extensions or combinations of existing mobility protocols are proposed to implement vertical handoff in heterogeneous networks. In [18], an interworking architecture between WLAN and GPRS links is presented by introducing a simple extension to the existing Mobile IP implementation. A virtual network interface is used to tunnel packets to the foreign agent over a TCP connection because GPRS interface on an MN cannot be accessed directly by Mobile IP. The vertical handoff can take place by triggering a horizontal handoff between the WLAN interface and the virtual interface for GPRS. A SIP-based vertical handoff between WWAN and WLAN is performed with numerical analysis for handoff delay in [12]. In [17], vertical handoff is implemented by using the transport layer protocol SCTP (Stream Control Transmission Protocol) and the application layer protocol SIP.

5. EXPERIMENTAL RESULT

According to Handover algorithm it dynamically adopts the Mobile Terminal (MT) velocity. Also the value of MIT is taken as less than the value of MOT to decrease the unnecessary number of handovers and ping pong effect. Here according to handover the probability of handover increase with the increase in distance along x-axis. It also shows that the number of unnecessary handovers using handover algorithm is less than that of traditional hysteresis handover.

5.1 Transverse Distance vs. Received Signal

This graph is shown overall transverse distance vs. received signal the red line shows the traversed distance for all considered scenarios.

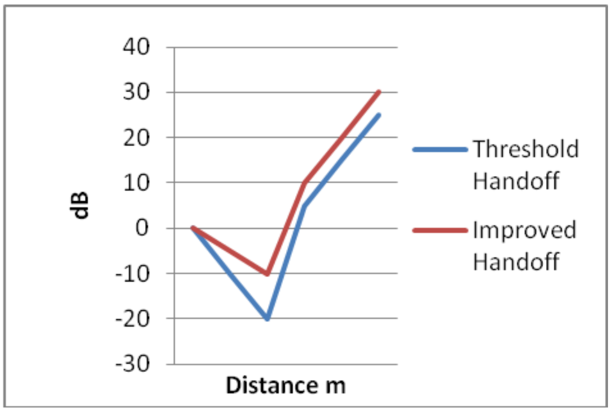
The first case represents scenario when the HO is always initiated with a respect to CINR in DL with a disregard to UL direction. Thus HO triggering mechanism corresponds to IEEE 802.16m conventional HO. The second case reflects the fact when decision algorithm takes into accounts RSs and RRC metric is considered. It is apparent that overall system has been slightly increased approximately by 1.6 Mb/s. However, in UL direction is more convenient to initialize HO according conventional DL CINR metric.

5.2 Transverse Distance vs. No. of BS handling the call

The graph is shown between overall transverse distances vs. no of bs handling

Load balancing with handovers will be the way system wide load balancing will be conducted in Mobile WiMAX. In this section we will first classify the different ways load balancing can be conducted in telecommunications systems, see what kind of a relationship Mobile WiMAX has with them and finally dig into the theory behind load balancing from the point of view of Mobile WiMAX.

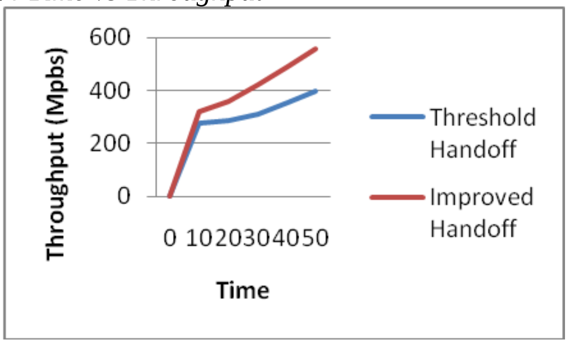
5.3 Distance vs DB



The graph is shown between Distance m and db

Resource allocation schemes the idea behind balancing the system load with resource allocation is to bring the resources (unoccupied frequencies) to where most of the users are located. In resource allocation schemes, a centralized element allocates additional resources to hotspot cells. One example of this is channel borrowing where a congested Base Station can borrow the channel of lightly loaded Base Stations.

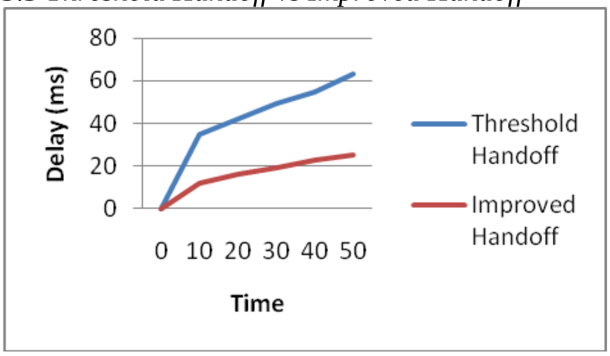
5.4 Time vs Throughput



The graph is shown between the Time and Throughput

The throughput allocation among all three traffic flow categories shows throughout the lifetime of the simulation. We can see that initially the greedy sources utilize as much capacity as the channel can offer to support their traffic flow.

5.5 Threshold Handoff vs Improved Handoff



The graph is shown between the Threshold Handoff vs Improved Handoff

According to Handover algorithm it dynamically adopts the Mobile Terminal (MT) velocity. Also the value of MIT is taken as less than the value of MOT to decrease the unnecessary number of handovers and ping pong effect. Here according to handover the probability of handover increase with the increase in distance along x-axis. It also shows that the number of unnecessary handovers using handover algorithm is less than that of traditional hysteresis handover

6. CONCLUSION AND FUTURE WORK

Wireless relay has been proposed as a solution to extend the coverage of a single base station. This paper has analyzed the reduction of user access capacity due to multi-hop relay when it is used for coverage extension in a WiMAX system. It has been shown that with the increase of hop number, the achievable user access capacity decreases dramatically. Also, using higher-level modulation scheme or higher turbo-coding rate can significantly enhance the achievable access capacity. As a result, for the feasible application of a multi-hop WiMAX relay system, it is recommended that: (i) radio processing of relay station should be enhanced to support 64QAM-3/4 in the radio relay link; (ii) hop number should not be larger than 3 in order that there's enough capacity left for local user access. In future we improve our WiMAX to extend to the multimedia application like VOIP and video streaming applications. The WiMAX-based network solidly supports VoIP, providing adequate quality for short to medium duration calls. The voice quality degradation compared to high-speed Ethernet is moderate, despite higher packet loss and network delays. The effects of the uplink and the downlink on call quality are comparable, despite their different characteristics.

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