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OPTIMIZATION OF HANDOFF DELAY IN GATEWAY RELOCATION IN WiMAX NETWORKS

C. Bhuvaneshwari[1] and N. Prabakaran[2]
[1]Department of Electronics and Tele-Communication Engineering, Sathyabama University, Chennai, India
[2]Faculty of Electrical & Electronics, Department of Electronics and Tele-Communication Engineering, Sathyabama University, Chennai, India
E-Mail: eshwari.bhuvana8@gmail.com

ABSTRACT

Broadband Wireless Access (BWA) has been serving great satisfaction of its users. The WiMAX technology is ideal for the challenges related with earlier versions of wired and wireless access networks. IEEE 802.16 working group standardizes PHY layer and MAC layer only. The most challenging tasks in WIMAX networks are Hidden delay such as Handoff delay and network selection delay, and also Packet loss, Signaling overhead and Average serving rate. The two-tiered mobility management defined in WiMAX can potentially minimize handoff delay and packet loss, but it leads to another problem such as Gateway relocation. In this paper, we propose Gateway Relocation Request Control (GRRC), which combines ASNGW relocation and RC algorithm to maximize system capacity. The proposed system can reduce the average signaling overhead and signal traffic and also increases the average serving rate by solving the ASN GW relocation problem which effectively minimizes the hidden delay. In existing techniques we can't predict the Main Station (MS) position instead it searches the Base Station(BS) which is nearer to the MS. In this paper we predict the MS position for the improvement of better hidden delay which includes Handoff Delay and Network Selection delay.

Keywords: WiMAX, main station (MS), base station (BS), handoff, call assigning controller (CAC), indispensible process first (IPF).

1. INTRODUCTION

THE IEEE 802.16-series standards [1], [2] are expected to provide broadband wireless access for a variety of multimedia services. Like other IEEE 802-series standards, IEEE 802.16 working group standardizes physical (PHY) layer and Medium Access Control (MAC) layer only. To build a complete system, higher layers are still necessary. One of the major objectives of WiMAX Forum [3], thus, is to develop and standardize the WiMAX Forum Network Architecture [4], [5], [6], [7] which is evolving into Internet Protocol (IP)-based wireless network. The Access Service Network (ASN) provides wireless radio access for WiMAX subscribers. It consists of one ASN Gateway (ASN GW) and many base stations (BSs). Each ASN is connected to Connectivity Service Network (CSN), which provides IP connectivity services. To support IP mobility, Mobile IP (MIP)1 is adopted. The Home Agent (HA) of a Mobile Station (MS) is located in the CSN of the MS's Home Network Service Provider (H-NSP). ASN GW supports the Foreign Agent (FA) functionality. The WiMAX Forum has defined a two-tiered mobility management: ASN Anchored Mobility and CSN Anchored Mobility.

Although the two-tiered mobility management defined in WiMAX potentially can minimize handoff delay and packet loss, it leads to another problem: When to perform ASN GW relocation? The WiMAX standards, however, only define the procedures for ASN Anchored Mobility and CSN Anchored Mobility. The standards do not address when the Anchored MSs should perform ASN GW relocation to relocate the traffic anchor point from the anchored ASN GW to the serving ASN GW. The problem is left for vendors and operators to develop their own proprietary solutions.

Besides, the problem is closely related to Admission Control (AC), which is widely used in wireless networks to ensure service quality and reduce network congestion by limiting the number of MSs served in the network

However, traditional AC algorithms cannot be used directly when the two-tiered mobility management is deployed in WiMAX. As aforementioned discussion, some MSs may be served by two ASN GWs. The resources are required in both ASN GWs. Therefore, those MSs will be counted twice in two ASN GWs by the AC algorithm. If there are many Anchored MSs, new incoming users will likely be rejected due to the lack of resources. If the ASN GW relocation can be performed before the system becomes overloaded, the system may be able to accommodate more MSs. Therefore, a well-designed RC algorithm should cooperate with the ASN GW relocation algorithm closely

In this paper, we propose Gateway Relocation Request Control (GRRC), which combines ASN GW relocation and RC algorithm to maximize system capacity. Here we assign a controller for each request. Here also MS will always be in roaming in prediction of nearest BS coverage area. The proposed system can reduce the average signaling overhead and signal traffic and also increases the average serving rate by solving the ASN GW relocation problem which effectively minimizes the handoff delay. Here we replace MSs instead of base stations and GWs can handover the data.

2. RELATED WORKS

Many issues in mobile WiMAX have been studied in [6], [7], [8], [9], [10]. In [8], the authors propose a fast intra-network and cross-layer handover protocol to support fast and efficient handover in WiMAX. In [9], a seamless IP mobility scheme is proposed and evaluated in the flat architecture of WiMAX networks. In [10], the authors propose an analytical model to study the cost of Anchor Paging Controller (APC) reassignment in ASN GW for location update. The APC relocation problem has a great impact on signaling overhead for location tracking significantly. In [11], they implemented the algorithms such as cut off priority and new call bounding and wiener process algorithms where these AC algorithms are much more complicated due to the movement of MSs. An MS served in current network may move to another network. The connection of the MS may be dropped if the required resources in the target network cannot be supported.

In the cutoff priority algorithm, a newly arrived MS will be blocked and a handover MS will be admitted. In the new call bounding algorithm, however, both a new MS and a handover MS will be admitted. There are still many other AC algorithms. The ideas are similar although they may have different names. Nevertheless, they cannot be applied to WiMAX networks directly. As aforementioned discussion, due to the specific mobility management techniques in WiMAX, an MS may be served by two ASN GWs simultaneously. Hence, the required resources of an Anchored MS are reserved in both ASN GWs. Besides, the Anchored MS will be counted twice in two ASN GWs in the AC algorithm. Thus, when many MSs are served by two ASN GWs in the system, a newly arrived MS or handover MS may be easily blocked or dropped by the AC algorithm. Without considering ASN GW relocation in the AC algorithm, the network performance will be degraded significantly.

3. HANDOFF IN WIMAX

Usually, continuous service is achieved by supporting handoff (or handover) from one cell to another. Handoff is the process of changing the channel (frequency, time slot, spreading code, or combination of them) associated with the current connection while a call is in progress. It is often initiated either by crossing a cell boundary or by deterioration in quality of the signal in the current channel. Handoff is divided into two broad categories hard and soft handoffs. They are also characterized by “break before make” and “make before break.” In hard handoffs, current resources are released before new resources are used; in soft handoffs, both existing and new resources are used during the handoff process. Figure.1. Illustrates the Handoff in WiMAX. Poorly designed handoff schemes tend to generate very heavy signaling traffic and, thereby, a dramatic decrease in quality of service (QoS).

A hard handoff occurs when the old connection is broken before a new connection is activated. The performance evaluation of a hard handoff is based on various initiation criteria. It is assumed that the signal is averaged over time, so that rapid fluctuations due to the multipath nature of the radio environment can be eliminated. Numerous studies have been done to determine the shape as well as the length of the averaging window and the older measurements may be unreliable. The above figure shows a MS moving from one BS (BS1) to another (BS2). The mean signal strength of BS1 decreases as the MS moves away from it.Similarly, the mean signal strength of BS2 increases as the MS approaches it

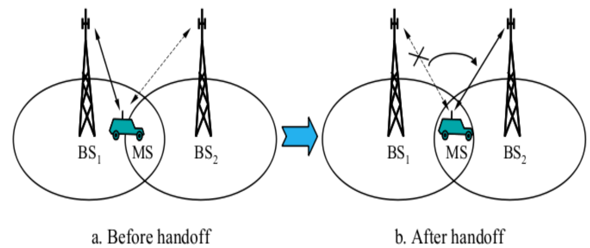

Figure-1. Handoff in WiMAX.

4. PROPOSED GATEWAY RELOCATION REQUEST CONTROL

In this paper we predict the MS position for the improvement of better hidden delay which includes Handoff Delay and Network Selection delay. Here we propose the algorithm which combines Gateway Relocation and Request Control. Here we assign a controller for each request. Here also MS will always be in roaming in prediction of nearest BS coverage area. The entire architecture of ASNGW in WiMAX is illustrated in figure.2. The proposed system can reduce the average signaling overhead and signal traffic and also increases the average serving rate by solving the ASN GW relocation problem which effectively minimizes the handoff delay. Here we replace MSs instead of base stations and GWs can handover the data. We further divide our work into small modules as follows,

A. Network design
B. Call connection
    1) Call Assigning Controller (CAC)
    2) Indispensable Process First (IPF)

a) Network design

This includes the architectural design of Access service network Gateway(ASNGW), Connectivity service network(CSN),Main Station(MS), Base Station(BS) in Wimax Networks which is illustrated in figure.2. The IEEE 802.16-series standards are expected to provide broadband wireless access for a variety of multimedia services. Like other IEEE 802-series standards, IEEE 802.16 working group standardizes physical layer and Medium Access Control (MAC) layer only. To build a complete system, higher layers are still necessary. One of the major objectives of WiMAX Forum, thus, is to develop and standardize the WiMAX Forum Network Architecture, which is evolving into Internet Protocol (IP)-based wireless network. The architecture is depicted; the Access Service Network provides wireless radio access for WiMAX subscribers. It consists of one ASN Gateway (ASN GW) and many base stations (BSs). Each ASN is connected to connectivity Service Network, which provides IP connectivity services.

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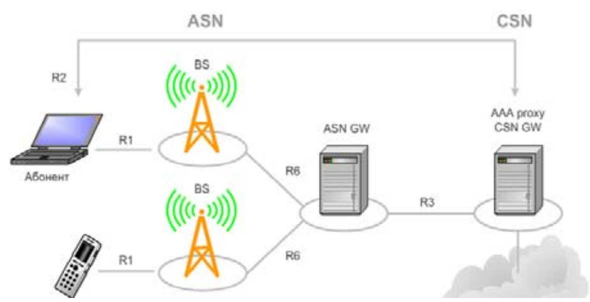

Figure-2. Network architecture.

b) Call connection

In order to provide QoS guaranteed services, the subscriber station (SS) is required to reserve the necessary bandwidth from the base station (BS) before any data transmissions. In order to serve variable bit rate (VBR) applications, which generate data in variant rates and cannot be modeled accurately, the SS tends to keep the reserved bandwidth to ensure that the QoS guaranteed services can be provided. If there are 3 or 4 base stations and there are nodes available in each base stations. Any node which is moving and come in intersection area of two base station and if it want to communicate with other base station, at the same time if that base station node want to communicate with his base station, the priority with be given to intersection node and the base station node is allow to wait in queue.

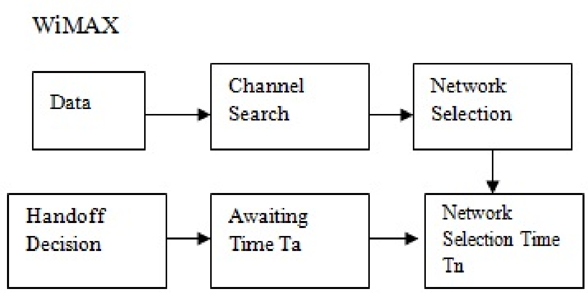

Figure-3. Call connection flow diagram.

In MIP, load balancing and load control mechanisms have been proposed.Figure.3 gives the idea that according to different criteria, MSs are equally served by HAs or Mobility Anchor Points (MAPs). However, if the approaches discussed in are used in WiMAX, the loads of the anchored and serving ASN GWs are all affected.
The MSs may also need to perform both ASN Anchored Mobility and CSN Anchored Mobility during an inter-ASN handover. The long handover latency and high packet loss will degrade the service quality. On the other hand, in WiMAX, when performing ASN GW relocation, the load of the anchored ASN GW is reduced but the load of the serving ASN GW is not affected. Although the aforementioned techniques can reduce the load of the old serving ASN GW, the load of the new serving ASN GW is increased. Therefore, only the Anchored MS needs to perform ASN GW relocation to reduce the load of the Anchored ASN GW. The load of the Serving ASN GW is irrelevant. Admission Control (AC) is one of the resource management techniques to limit maximum amount of traffic in the network to guarantee service quality for subscribers.

1) Call assigning controller

In wireless and mobile networks, the AC algorithms are much more complicated due to the movement of MSs. An MS served in current network may move to another network. The connection of the MS may be dropped if the required resources in the target network cannot be supported. It is generally agreed that keeping an ongoing connection un-broken is more important than admitting a new MS. Therefore, a handover MS is given higher priority to access the network resources.

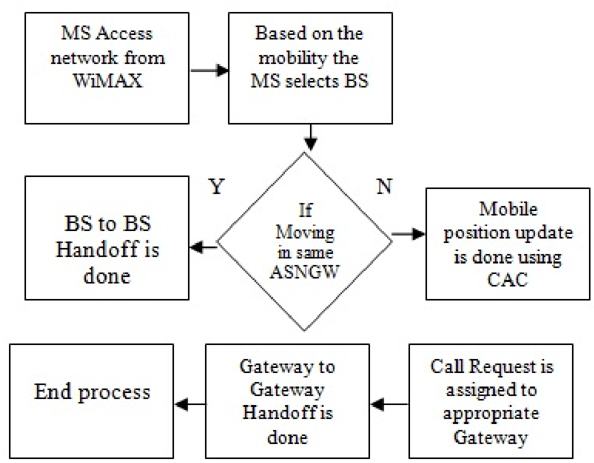

Figure-4. Block diagram of CAC.

Figure 4 illustrates the block diagram of CAC. Call Assigning Controller controls the complete network access. Single node transmission of data is done by CAC. It will allocate the Base Station for Main Station, when MS sends the request. Mobile position update and appropriate network selection is done using CAC. In CAC the priority with be given to existing call and the new call is bounded and allowed to wait in queue. Therefore better handoff scheme is maintained.

2) Indispensable process first (IPF)

Figure 5 illustrates the IPF block diagram. The most important component is the workload-aware channel assignment module, which interacts with workload distribution module and throughput computation module, and greedily assigns channels to the nodes. Noting that a node with higher workload is more likely to be a bottleneck, because the channel assignment depends on nodes' work- loads (generally nodes with higher workloads should be assigned with more channels), and nodes' workload depends on the channel assignment, there

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is a circular dependency between channel assignment and nodes' workloads. Figure.5 illustrates the IPF Architecture. To break this circularity, we start by assigning every node a default channel, and iteratively improve the throughput by greedily assigning channels based on nodes' per assigned channel workloads and then revoking under-utilized channels.

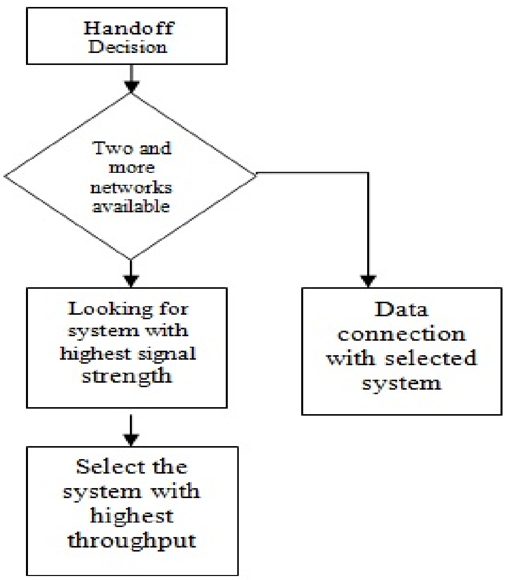


Figure-5. IPF block diagram.

For handover MSs, it is critical to perform ASN GW relocation at an appropriate time. Therefore, we propose a prediction algorithm based on Indispensable Process First (IPF) which provides a systematic way to determine when to request Anchored MSs to perform ASN GW relocation. If there are 3 or 4 base stations and each base stations are have 3 or 4 nodes. Hear, if any node while moving, come in intersection area or in other base stations area and if that node send hand shake signal to base station at the same time the base station node also send the same signal , the moving node will be give priority on the base node and the base node is allow to wait in queue ,the moving node which have connected to another base station , have to delete the link which is link to another base station.

5. SIMULATION RESULTS

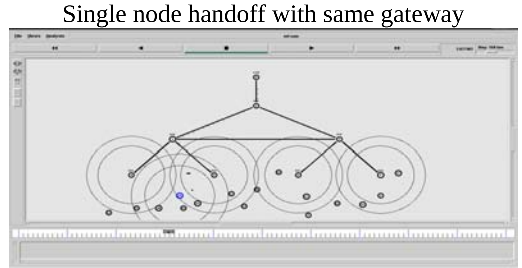
The module say network design is simply the designing of network in order to build the entire system using CSN, ASNGW, MS and BS. The following outputs illustrate the Handoff decision with single and multimodes.

The graphical output of packet delay for single and multimode is given respectively with the comparison of the existing tasks. The throughput comparison is also illustrated below. The delay reduces by 4.5ms when compared to existing work.

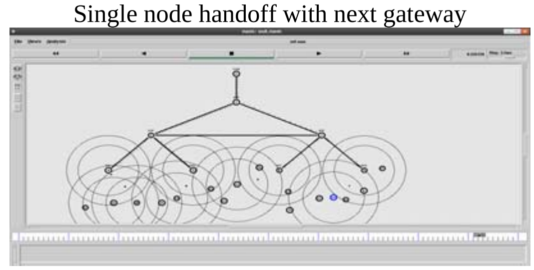
Table-1. Simulation parameter.

Adhoc Routing Protocol	AODC
Channel	Wireless channel
Link Layer type	LL
MAC Address	Mac 802_11
Interference Queue	Queue/Droptail
Interference Queue Length	50
Antenna Type	Omni Antenna
Propagation Type	Two Ray Ground
Physical Medium	Wireless Phy
Topography-X	X Dimension(2000)
Topography-Y	Y-Dimension(2000)
Number of Nodes	16

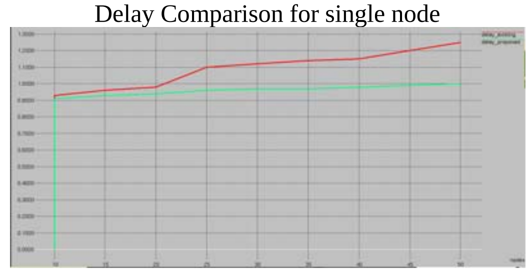
Single node handoff with same gateway



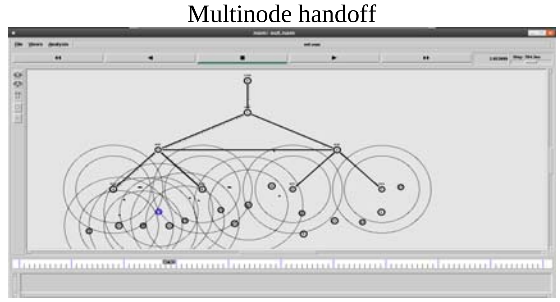
Single node handoff with next gateway



Delay Comparison for single node



Multinode handoff



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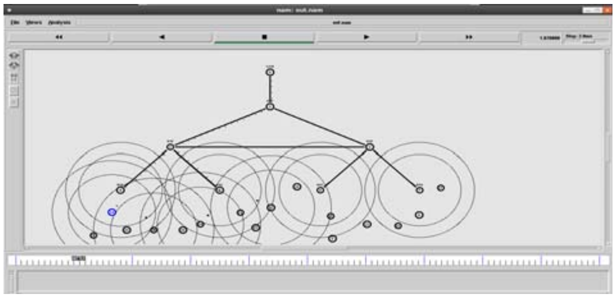
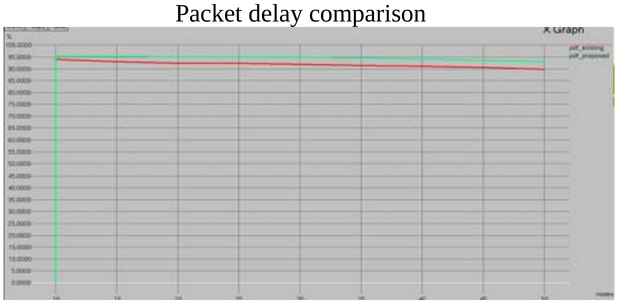
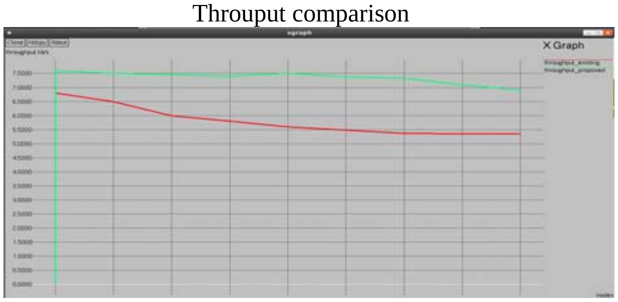
Multinode dataflow



Packet delay comparison



Throuput comparison



6. CONCLUSIONS

In WiMAX standards, an ASN GW can decide when to perform ASN GW relocation. In this paper, we consider that the system load is heavy, so Anchored MSs are forced to perform ASN GW relocation. We propose GRAC which considers admission control and ASN GW relocation jointly to improve the performance of WiMAX networks. The traditional AC algorithms cannot be used directly when the threshold cut off priority is chosen and hence through our predicted algorithms we can minimize the delay and optimal throughput is maintained as of in the existing techniques

Single node and multimode transmission is done successfully using Call Assigning Controller (CAC) and Indispensible Process First (IPF). Signal Traffic is controlled therefore better handoff is enhanced. Packet delay and throughput is being reduced and increased respectively as shown in graph. In existing packet delay is found to be 1.25 ms which is being reduced to 0.9ms for single mode. In multinode transmission of data the throughput is increased from 5.4ms to 7.5ms which helps to increase the stability and Quality of service.

REFERENCES

[1] IEEE 802.16-2004 Std., Air Interface for Fixed Broadband Wireless Access Systems, IEEE, October 2004.

[2] IEEE 802.16e-2005 Std., Part 16: Air Interface for Fixed and Mobile Broadband Wireless Access Systems- Licensed Bands, IEEE, February 2006.

[3] WiMAX Forum, http://www.wimaxforum.org, 2011.

[4] WiMAX Forum Std. 1.0, Rev. 4, WiMAX Forum Network Architecture (Stage 2: Architecture Tenets, Reference Model and Reference Points), WiMAX, February 2009.

[5] WiMAX forum Std. 1.0, Rev. 4, WiMAX Forum Network Architecture (Stage 3: Detailed Protocols and Procedures), WiMAX, February 2009.

[6] K. Etemad. 2008. "Overview of Mobile WiMAX Technology and Evolution," IEEE Comm. Mag., Vol. 46, No. 10, pp. 31-40, October.

[7] Z.-H. Liu, S.-Y. Pan and J.-C. Chen. 2008. "Access Service Network (ASN) Gateway Relocation Algorithms in WiMAX Networks," Proc. IEEE Int'l Conf. Comm. (ICC '08), pp. 2674-2679, May.

[8] J.-H. Yeh, J.-C. Chen and P. Agrawal. 2009. "Fast Intra-Network and Cross-Layer Handover (FINCH) for WiMAX and Mobile Internet,"IEEE Trans. Mobile Computing, Vol. 8, No. 4, pp. 558-574, April.

[9] S. Sim, S.-j. Han, J.-s. Park, and S.-c. Lee, "Seamless IP Mobility Support for Flat Architecture Mobile WiMAX Networks," IEEE Comm. Mag., Vol. 47, No. 6, pp. 142-148, June.

[10] Y.-B. Lin and Y.-C. Lin. 2010. "WiMAX Location Update for Vehicle Applications," Mobile Networks and Applications, Vol. 15, No. 1, pp. 148-159.

[11] Zong-Hua Liu and Jyh-Cheng Chen. 2012. "Design and analysis of gateway relocation and admission control algorithm in mobile WiMAX IEEE Transactions on Mobile computing, Vol. 11, No.1, January.