A REVIEW OF GATEWAY RELOCATION MECHANISM IN WIMAX NETWORKS

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Abstract : Wimax was aimed to provide high bit rate, high rapidity, large coverage area, quality of service (QOS), multimedia services and to assist all sort of real time applications. In order to maintain the good quality of service and good network performance the load on Access Service Network Gateway (ASN GW) has to be reduced. In order to reduce load on ASN gateway the relocation has to be accomplished. ASN Gateway relocation is the procedure in which the connection point of one mobile station is changed from one gateway to another gateway. Wimax Forum has introduced two mobility management schemes for this relocation purpose. These mobility management schemes reduce the packet loss and handover delay to minimum. But the mobility management techniques do not answer when to relocate the Access Service Network Gateway. Two gateway relocation algorithms were introduced to upgrade the overall working in terms of dropping probability, blocking probability, average signalling overhead; it also reduces the load of ASN gateways. In this paper we will review the gateway relocation mechanism for WiMax Network.

Keywords: ASN connected mobility, CSN connected mobility, Handover, Relocation algorithm, WiMax

I. INTRODUCTION

There was a demand for high speed internet access, multimedia services, high data rate and last mile access. So Wimax i.e. Worldwide Interoperability for Microwave Access was introduced. Wimax provides last mile access with high speed, high bit rate and good quality of service for all sort of real time applications. Wimax has large coverage area as compared to Wifi [1][2]. Wimax is installed on wireless Metropolitan Area Network communications technology. It's such an easy term that people replace it for 802.16 standards. It supports voice and data services. Wimax provides wireless broadband services to buildings located in any type of area whether rural or urban, densely populated or thinly populated. It may also bridge WLAN hotspots to internet. It also assigns services to mobile devices. For exorbitant multimedia service, exorbitant bandwidth is needed, Wimax aids this also, maintaining costs low. One major aim of Wimax Forum [3] is to enhance conformance and compatibility of IEEE 802.16 standards.

II. LITERATURE SURVEY

A. Wimax Architecture

The two layers are explicated in Wimax/802.16 are Physical layer [PHY] and Media access control layer [MAC]. Physical layer develops the manual link through wires across two communication entities.MAC layer does the upkeep of the connections made [4].The protocol layers are shown in figure 1. The basic aim of MAC layer is to impart an interface linking lower layer and higher layers. MAC layer is again spilted into three sub-layers i.e. Security Sub Layer, Convergence Sub Layer and Common Part Sub Layer. Security Sub Layer is across physical layer (PHY) and Common Part Sub Layer. Sub layer performs the encryption and decryption of data that is to and fro from the Physical Layer to Common Part Sub Layer. It performs secure exchange of data between the two adjacent layers.[5][6]. The Convergence Sub Layer interface with high layer protocols for example Ethernet, ATM, IPv4, Ipv6 etc.

Common Part Sub Layer defines the bandwidth allocation, system access, connection control, uplink scheduling, automatic repeat request (ARQ). [5][6]

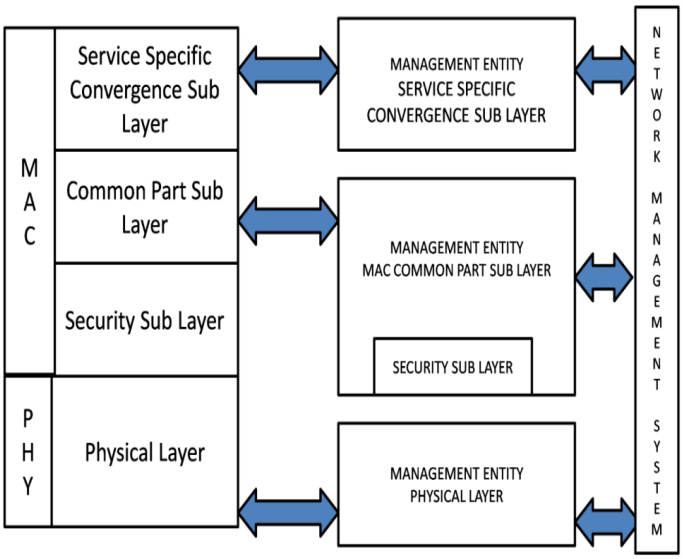

Figure 1. Protocol layers

There are two topologies described in IEEE 802.16 standard –Point to Multipoint topology and Mesh Topology. In point to multipoint topology there is a one to many connections that provides various paths from a common end point to various other end points [7]. In mesh topology all the communicating entities are interconnected with one another allowing for data to be distributed among all end points. Following different services are defined in IEEE 802.16 e standards -1) Voluntary Grant Service 2) Optimum effort 3) Real time polling service [6].

B. Handover

It's the process in which mobile connection to one access point is changed to another access point. Home agent cache the data of mobile station which has Home address (HA) in home network.
The data of mobile access points visiting the network is stored in Foreign Agent (FA).

Why handover was required?
1) To maintain absolute connection whenever the power of signal goes below threshold.
2) Whenever there is a heavy load on Base Station and its capacity is full, thus to offload the Base Station.
3) To allocate a better quality of service.
4) If reasonable network is available.
5) If rapid network is available.
6) Whenever Mobile Station is in motion.
7) Retaining co-channel interference from adjoining cells.

First of all handover making decision has to be taken, decision making involves deciding the terminating point of coupling to accomplish a handover and duration of the link. Secondly, links to be established with new base station and allocation of the resources to the channel.

C. End to End Architecture of WiMax

Wimax end to end architecture proposed by Wimax Forum [8] [9] consists of CSN i.e. connectivity service network, ASN i.e. Access Service Network, Base Station (BS), mobile station (MS), ASN GW i.e. Access service network gateway. It is shown in figure 2. Wireless radio access is assigned by access service network to Wimax benefactors. Internet Protocol (IP) connectivity series is alloted by CSN (Connectivity Service Network). ASN comprises of ASN GWs and BSs, MSs. ASNs are bridged to CSN [8][9]. To retrieve the network, Mobile Station is used by the end user. The Access Service Network may have either one Base Station or more than One Base Station. Also ASN may have either one Gateway or more than one Gateway. Base Station allocate air interface to Mobile Station. Other functions of Base Station are handoff triggering, channel establishment, quality of service enforcement, session management, key management. Access Service Network Gateway forms the common communicating point of various Base Stations together. Other functions of ASN gateway are intra ASN gateway management, admission control, management of mobility channel with Base Station. It does the validation of the users, devices and specific services. It also provides management of quality of service to every user. It does support for roaming between various Network Service Providers, mobility and roaming between Access Service Networks, IP address management, location management between Access Service Networks [6].

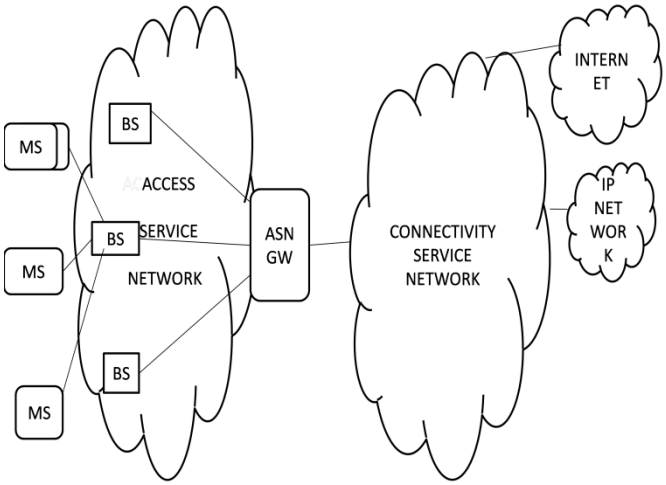

Figure 2. End to End Architecture of WiMax

D. Inter ASN and Intra ASN Handover

Also there are two types of handover. First intra ASN handover in this mobile station moves from one BS to another BS within the same ASN gateway, the handover performed is called intra ASN gateway handover. Secondly there is inter ASN gateway handover in which MS moves from one ASN gateway to another ASN gateway, the BS are changed as well as ASN gateways are also changed. The handover performed is called inter ASN gateway handover as shown in Figure 3.

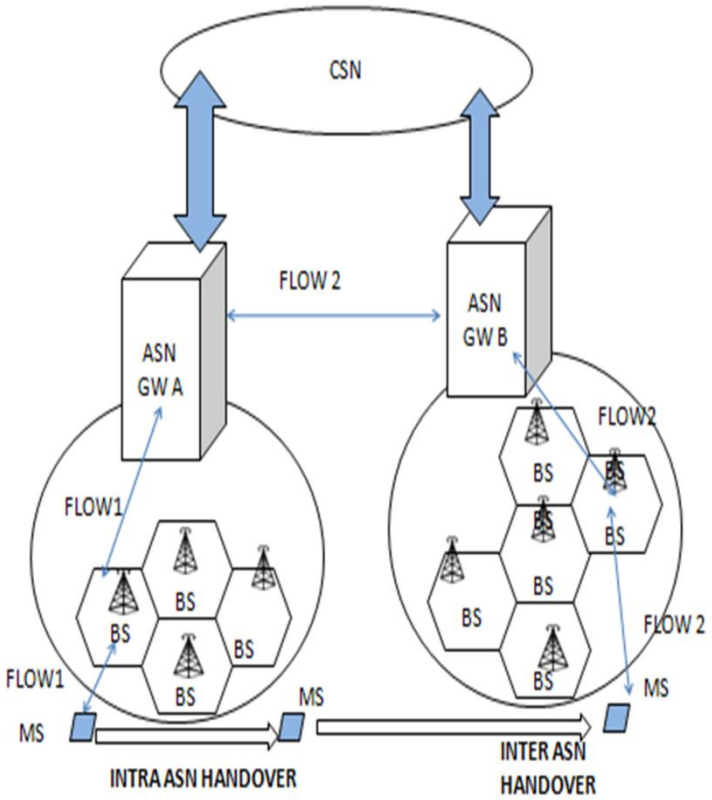

Figure 3 Types of handover

III. MOBILITY SCHEME

There are two types of mobility schemes used CSN connected (anchored) mobility and ASN connected (anchored) mobility [10][11][12][13]. In ASN anchored mobility mobile stations are associated to the same ASN GW before and after handover. For

example there is an ASN GW A comprising of different Base Stations and Mobile Station. One mobile station starts moving and it goes to another ASN GW B. The traffic tunnel is formed such that MS is connected first traffic tunnel which goes to ASN GW B then traffic tunnel goes to ASNGW A then it finally connects to CSN. Here ASN GW A is termed as connected ASN gateway and ASN GW B is termed as serving ASN gateway [11][12]. In figure 4 Flow 2 depicts the ASN connected (anchored) mobility scheme.

In CSN connected mobility GW relocation is executed when a mobile station goes from ASN gateway A to ASN gateway B and it stays there, new mobile station adds up in ASN GW B. Thus load gets heavier on ASNGW A and thus to maintain and provide connections to all new Mobile stations it leaves the connection of anchored mobile station and the MS form new traffic tunnel to ASN GWB to CSN network. Flow 3 shows the CSN anchored mobility in figure 3.Thus new tunnel is formed and old tunnel disappeared. Thus ASN GW relocation takes place. This relocation reduce end to end latency and does resource optimization [11][12].

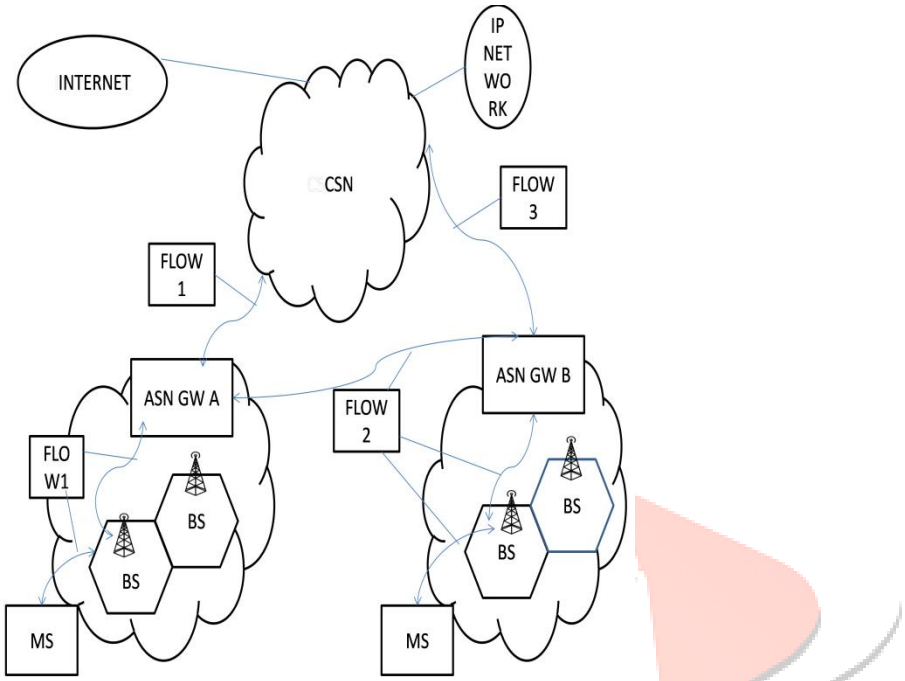

Figure 4: CSN connected mobility and ASN connected mobility.

The mobility management procedure definitely reduces packet loss but it does not answer when to execute ASN gateway relocation that is when to relocate traffic anchor point. Operators were left to design their own provision. The problem is similar to Admission Control (AC). AC shields service quality and minimize network traffic. In AC algorithm some Mobile Stations will be served by two ASN gateways and thus counted twice in two ASN gateways. It will create lack of resources. And thus system becomes overloaded, a well-planned AC algorithm should follow ASN gateway relocation algorithm. Thus GRAC GATEWAY RESOURCE ADMISSION CONTROL algorithm was introduced.

IV. GATEWAY RELOCATION ALGORITHM

A. Non Predictive ASN Gateway Relocation Algorithm

In non predictive algorithm for a definite period of time load condition is calculated and when calculated load is greater than pre defined threshold ASN gateway relocation is accomplished.[16]

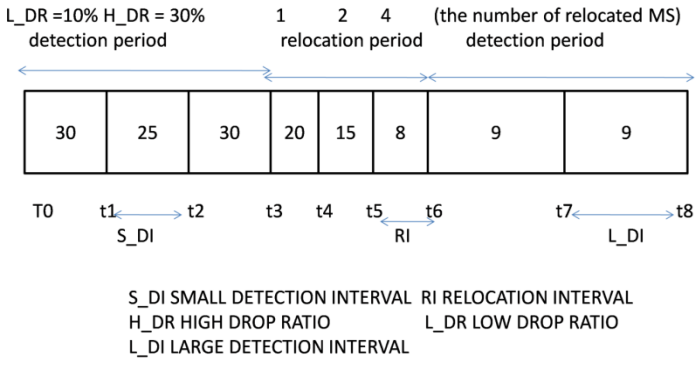

Figure5: Non Predictive relocation algorithm [18]

In this algorithm there are two periods: detection period and relocation period.
In detection period, following terms have been evaluated that is 'Dynamic Detection Interval (DDI),Detection Interval '(DI),large Detection Interval (L_DI),and small Detection Interval(S_DI),low Drop Ratio(threshold),Weighted Moving Average(WMA),Weight (W), Maximum Drop Ratio(M_DR), and Minimum Drop Ratio (Min_DR),High Drop Ratio (H_DR),Low Drop Ratio(L_DR).[16]
If following condition is statisfied i.e. n>=Min_DR & n<=Max_DR; WMA is evaluated.
When WMA is greater than H_DR ; ASN Gateway starts its Relocation Period.
In relocation period, first anchored Mobile Station is requested to perform Gateway Relocation. RI (Relocation interval) is detected from t3 to t4.The DR AND L_DR are compared. IF DR>L_DR, relocation is performed. This algorithm is explained in figure 6.

PHASE 1 : WMA examination
1. Input DR, DDI, n ;
2. /* STEP 1 : Generate the latest WMA */
3. WMA = $\frac{\sum_{i=x-n}^{x}(DDI_i \cdot W_i \cdot DR_i)}{\sum_{x-n}^{x}(DDI_i \cdot W_i)}$; i=1,2,... n;
4. if DR < L_DR && WMA < L_DR then
5. DDI_{x+1}= L_DI ;
6. else
7. DDI_{x+1}= S_DI;
8. end if
9. n= n+1 ;
10. if n < MIN_DRs then
11. retum DDI_{x+1}
12. end if
13. if WMA > H_DR then
MS relocation mechanism;
PHASE 2 : MS relocation mechanism
1. Input RI , DR;
2. /* STEP 1 : Relocate the anchored MSs */
3. Action : request the anchored MSs to carry out ASN GW Relocation procedures;
4. /* STEP 2 : Check DR for next RI or go back to PHASE 1 */
5. $MS_{relocation} = MS_{relocation} * 2$;
6. if DR > L_DR then
7. Action : MS relocation mechanism;
'8. Else
9. DDI= L_DI;
10. n= 0;
11. Action : WMA examination:
12. end if

Figure 6. Non predictive ASN gateway relocation algorithm [18]

B. Gateway Relocation Admisssion Control Algorithm

Mobile station can execute ASN connected mobility rather than CSN connected mobility to decrease the time taken for handover. In case when Mobile Station is moving rapidly among various ASN then ASN anchored mobility is preferred. When Mobile Station moves from one ASN to other ASN, it perform ASN connected mobility, if the load of the ASN keep increasing that is new Mobile Station are getting added continuously, then to support all Mobile Station ASN gateway relocation need emerges. Relocation help anchored Mobile Station to go to new ASN and thus keeps load low so that new mobile station are connected. Otherwise if load kept high, new users may be restricted and handover users may be collapsed and thus network performance degrades. So to keep performance of ASN network optimized ASN gateway relocation is the basic need. This proposed GRAC answers the two questions that are when to conduct relocation and how many anchored Mobile Station are to be relocated. To maintain network service quality there should be a limit on maximum number of Mobile Station's in ASN gateway. The proposed algorithm neither exchange information between neighboring ASN Gateways nor requires centralized coordination. It does not need any help from extra servers. It conducts ASN gateway relocation by including AC algorithm. [17]

New call bounding Admission Control with Access Service Network gateway relocation

In the algorithm all resources are divided and some resources are reserved for handover among Mobile Station. Here the author's focus is on transforming the AC algorithm for two tier mobility management. In this algorithm the author has limited the number of serving Mobile Station and anchored Mobile Station in a ASN gateway. Max_MS denotes maximum number of mobile station. Limit of number of new mobile station is denoted by N_MS. T(t) denotes gross number of Mobile Station in Access Service Network gateway at time t.[17]

T(t) comprises of S_MS,A_MS, H_MS that are number of serving Mobile Station, anchored Mobile Station and handover Mobile Station respectively at time t.

New MS added to ASN gateway is serving MS. After MS executes inter ASN handover, MS becomes anchored MS. Thus

A_MS increased by 1

S_MS decreased by 1

The algorithm has following condition

If S_MS +A_MS < min((N_MS,Max_MS –H_MS(t))) a new MS arrives, it is accepted.

And

if S_MS(t) +A_MS(t)=min (N_MS,Max_MS-H_MS) and A_MS > 0 one anchored Mobile station is requested to execute gateway relocation.[17]

Algorithm : New call bounding AC with ASN GW relocation.
Required: A new or handover MS is requesting to connect with the ASN GW at time t.
1. If a new MS arrives then
2. If S_MS(t) +A_MS(t) < min (N_MS,Max_MS –H_MS(t)) then
3. S_MS(t) ← S_MS(t)+1 /*the new MS is accepted*/
4. Else if S_MS(t) +A_MS(t)=min (N_MS,Max_MS-H_MS) then
5. If A_MS > 0 then
6. A_MS ← A_MS-1 /* requesting one of the Anchored MSs to perform ASN GW relocation*/
7. S_MS(t) ← S_MS(t)+1 /*the new MS is accepted*/
8. Else
9. The new MS is blocked
10. End if
11. End if
12. Else if a handover MS arrives then
13. If T(t) < Max_MS then
14. H_MS ← H_MS +1 /*the handover is accepted*/
15. Else
16. The handover MS is dropped
17. End if
18. End if

Figure7: New call bounding AC with gateway relocation [17]

V. CONCLUSION

We studied the Wimax handover, end to end architecture and two types of mobilities i.e. ASN anchored mobility and CSN anchored mobility. There was a need of gateway relocation but query arises was when to perform gateway relocation .The new call bounding algorithm and non predictive algorithm has tried to solve this query. The given algorithms are wholly compatible with existing system and have increased throughput and intercept the overloading of ASN gateway. The new call bounding algorithm reduces the dropping probability, blocking probability and it grows the mean serving rate.

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