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Gateway relocation by Bandwidth based Admission Control Scheme in WiMax

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Abstract: To support multimedia services with different Quality of Services (QoS) and bandwidth requirements is current aim in the wireless networks. To enhance network performance is important in effective management of limited resources. Access Service Network Gateway (ASN GW) relocation is the process of changing the traffic's Anchor Point (AP) from one GW to another which is independent of Mobile Station's (MS's) Link Layer (LL) handover. The existing standardsdo not specify when the ASN GW relocation has to be performed, buthave details about the ASN relocation procedures. The proposed system combines gateway relocation and Admission Control to determine when to perform ASN GW relocation, as relocation is closely related to Admission Control. This novel Bandwidth based Admission Control (BAC) Scheme considers the size of requests from each MS rather than taking the number of MSs as a whole. Hence the mobility management, which refers the IEEE 802.16e, scheme minimizes the packet loss, new call blocking probability, maximizes the throughput, handover delay and handover probability.

Index Terms: Gateway Relocation, Handover, Admission Control, Blocking Probability, Dropping Probability.

I. INTRODUCTION

IEEE new standard based on Broadband Wireless Access (BWA) systems, Worldwide Interoperability for Microwave Access (WiMAX) is an air Interface for Fixed BWA Systems validated by IEEE as a Wireless Metropolitan Area Network (WMAN) Technology. It aims at providing broadband wireless- last mile access in a MAN with high rapidity, easy exploitation, large spanning area, Quality of Service (QoS) and high data rate. Digital Subscriber Line (DSL) can provide coverage of 3 miles whereas Wi-Fi can only cover 30 meters.Demands for high-speed internet access and multimedia service for residential and business customers have increased greatly, as we seen in the past recently. QoS can provide different priority to different users and data flows or guarantee a certain level of performance to data flows in accordance with requests from the application programs or the internet service provider policy.The OSI model separates the functions of different protocols into a series of layers. In that each layer uses only the functions of the layer below and exports data to the layer above. The lower layers areimplemented in hardware while the higher layers are implemented in software. The physical layer and the Data link layer are the two lower most layers.

IEEE 802 splits the OSI Data Link Layer into twosub-layers namely Logical Link Control (LLC) and Media Access Control (MAC). The physical layer creates the physical connection between the two communicating entities, while the MAC layer is responsible for the establishment and maintenance of the connection.IEEE 802.16 standard defines two possible network topologies - PMP (Point-to-Multipoint) topology and Mesh topology or Mesh mode [3].The five service types defined in IEEE 802.16e-2005 standard are

- UGS (Unsolicited Grant Service)
- ertPS (Extended Real-time Polling Service)
- rtPS (Real-time Polling Service)
- nrtPS (Non Real-time Polling Service)
- BE (Best Effort)

II. HANDOVER MECHANISMS

One of the main features for enabling mobility is handover.Mobile WiMAX promises ubiquitous broadband wireless access by enabling real-time and multimedia applications.Handover is the process of changing the physical layer connectivity of mobile node from one Access Point (AP) to anotherAccess Point (AP).Home Agent (HA) stores information about mobile nodes whose permanent Home Address (HA) is in the HA's network.Foreign Agent (FA) stores information about all the mobile nodes visiting its network.If there is no FA in the host network, the mobile device has to take the responsibility of getting an address and advertising it.

NEED FOR HANDOVER

The main reasons of the handover are:

a. If the signal strength goes below the threshold for maintaining proper connection at the edge of the cell
b. BS capacity is full and more traffic is pending or to offload the capacity
c. Disturbing co-channel interference from neighboring cell or when Radio Conditions change

d. When a BS with better QoS is available or to increase the Quality of Service (QoS)
e. Faster and cheaper network is available
f. Mobile Station Movement

HANDOVER STAGES

The handover process is distributed over in to the 3 stages:

- *Handover Decision*
  Handover decision involves making adecision to choose the point of attachment to execute a handover and the time/ duration of connection.
- *Radio link transfer*
  Radio link transfer is the task of establishing links with the new BS.
- *Channel assignment*
  Channel assignment deals with allocation of resources.

As shown in the fig.1 the hybrid mobility management scheme comprising of two layers in Mobile WiMAX networks.ASN Anchored mobility or Link layer mobility, it performs FA, handover is the first layer and the mobile APs before and after handover are attached to ASN itself and are not relocated as a part of handover.

The second mobility management in WiMAX is the Connectivity Service Network (CSN) located at the IP layer.

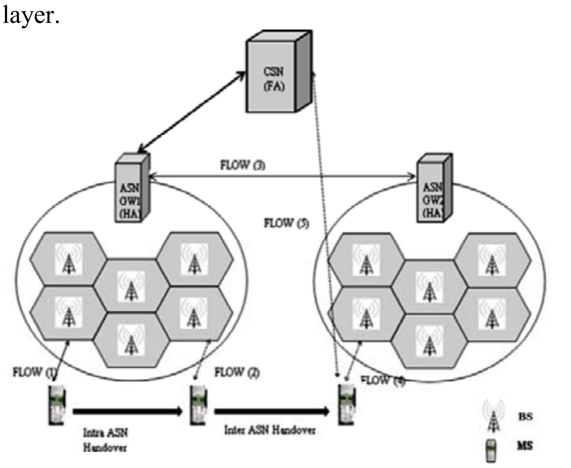

Fig.1. ASN and CSN Anchored mobility

HA is located in the CSA, while AP remains unchangedwhereas ASN AP in NAP is relocated to different ASN-GW.CSN acts as the HA and ASN acts as the FA as shown in the fig.1. A GW is an internetworking medium that is capable of connecting two different Networking protocols, while each ASN or ASN-GW is connected to CSN.Intra ASN handover takes placebetween BSs of the same ASN GW in the flow 1. In Flow 3 the traffic will be forwarded from the same GW. It overloads the GW and the GW cannot accommodate any new MSs.In flow 1, 2 and 3, only the ASN-Anchored mobility takes place, whereas in case of flow 4 the traffic will be tunneled to ASN GW-2 as the MS is currently in the second GW.

III. Admission Control

Admission Control (AC) is a resource management technique that guarantees QoS and reduces network congestion by limiting the maximum amount of traffic in the network.if the MS connects to the BS which is under another ASN then the MS performs ASN Anchored Mobility. If both ASN Anchored mobility and CSN Anchored mobility are performed simultaneously, the handover delay will be high.In wireless and mobile networks the AC algorithms are much more complicated due to the movement of MSs.The connection of the MS might be dropped if the required resources in the target network are not available. A handover MS is given higher priority to access the network resources. The overall resources are partitioned and some resources are preserved for the handover MSs only.

IV. Related Work

The two-tiered mobility management defined in WiMAX is similar to that of Hierarchical MIP (HMIP) [2]. The multiple levels of FA hierarchy reduce the handover latency and localize the MIP signaling traffic.Each MS dynamically determines the hierarchy of FAs according to the call-to-mobility ratio [4].The two commonly used priority-based AC algorithms are Cut-off Priority algorithm [5, 6 and 7] and New Call Bounding algorithm.In [8] a dynamic bandwidth allocation algorithm for WiMAX called Efficient Bandwidth Management (EBM) is proposed. The bandwidth will be increased in the upcoming frames when the allocated bandwidth is not sufficient to transfer the data.

An efficient bandwidth management scheme named WiMAX Dynamic Channel Allocation Scheme (WDCAS) is proposed to uses a cognitive radio for dynamic channel allocation to improve bandwidth utilization while satisfying the QoS requirements.Maximum entropy principle for performance analysis is introduced and closed-form expressions for state and blocking probabilities are obtained. The network administrator can prevent a small number of applications or users from consuming all the available bandwidth by controlling the amount of bandwidth allocated to an application or user.

Partition-based link bandwidth architecture was targeted at improving the capacity utilization and the flow acceptance or the total traffic accepted. To establish a connection with QoS requirement, the Resource Reservation Protocol (RSVP) can be adopted to reserve the desired bandwidth in the WLAN through the assistance of AP. In wireless networksone major concern about QoS is call dropping. Previous research on this issue suggested reserving a certain amount of bandwidth for handoff calls.A new approach that combines dynamic channel allocation and Call Admission Control for bandwidth management is proposed [9].

A layer-2 handover scheme based on mobile WiMAX causes many handover failures in mobile WiMAX based wireless mesh networks because it does not consider the characteristics of wireless mesh networks. A new methodology using data latency for characterizing handover performance that enables the detection of issues during handover by projecting data latency pattern. A simulation campaign was undertaken to identify the sets of configuration parameters having a major impact on the handover process for the IEEE 802.16e MS. A Serving BS (SBS)-controlled fast Target BS (TBS) selection scheme for Mobile WiMAX networks is given. Orientation Matching (OM) between the geographical position of each NBS and the MS' direction of motion both with respect to the SBS and the Signal Strengths of the different neighboring Base Stations (NBS) as received by the MS.

The handover target cell selection algorithm for WiMAX network based on the effective capacity estimation and neighbor advertisement, which effectively avoids the Ping-Pong effect and handover synchronization effect [10]. The standards only define the ASN GW relocation procedures without specifying when the ASN GW relocation should be performed. That incorporates traditional Admission Control (AC) and Wiener Process (WP)-based prediction algorithms to determine when to carry out ASN GW relocation.

Location-aware scanning includes scanning and network re-entry, where it reduces interruption of data transmission during handover by decreasing both the scanning delay and the number of the neighbor BSs to be scanned. The MS finds its position using GPS and selects the target BS based on the distance. A Pre-Coordination Mechanism (PCM) for supporting fast handover in WiMAX networks is designed [11]. The distance between the BS and the MSS is measured and the time of handover occurrence is predicted. A Mobile Station (MS) - controlled fast MAC-layer handover (HO) scheme based on the Received Signal Strength (RSS) from any Base Station (BS) to reduce the HO latency in Mobile WiMAX is proposed

V. ASN GW RELOCATION BY NEW CALL BOUNDING ALGORITHM (NCB)

Considering that, the system load is heavy then the Anchored MSs are forced to perform ASN GW relocation to accommodate new MSs. Anchored MS is requested to perform ASN GW relocation only when no more resources are available for new coming users. The algorithm involves the following steps:

- A New or Handover MS requests to connect with the ASN GW at time 't'.
- If New MS arrives then ASN GW compares the number of current Serving and Anchored MS with the threshold value. The New MSs are served. If both are equal, if it is less than that of threshold value, then it checks for any Anchored MS.
- If any Anchored MS is found in the system then the ASN relocation is performed and the MS is removed from current ASN and the new call is accepted. Otherwise, the call is blocked.
- The number of MSs in the current ASN GW is calculated for Handover MS, and if it is less than the maximum number of MS in one ASN GW then the Handover MS is accepted. Otherwise, it is dropped.

Fig.2: Steps in the New Call Bounding Algorithm

When a new MS arrives and if there is no resource for newly arrived MS if the Anchored MSs are available in the system. Then it will request an Anchored MS to perform ASN GW relocation. The resources will be counted twice as it is required by two ASN GWs. Thus, there is a larger probability of call dropping. Accepting/ rejecting based on the number of users do not hold good. Each user has different requirements, considering the number of users as the threshold leads to misconceptions in the system performance.

VI. BANDWIDTH BASED ADMISSION CONTROL (BAC) SCHEME

The New Call Bounding Algorithm, which was discussed earlier, includes threshold values for the number of MSs entering the network. The proposed method considers the available bandwidth to permit any MS into the network.

B_{TOTAL} - Total Bandwidth in a GW

N_A (t) - Number of Anchored MSs in one ASN GW at time t

N_S (t) - Number of serving MSs in one ASN GW at time t

N_H (t) - Number of Handover MSs in one ASN GW at time t

B_{REQ_S} / B_{REQ_A} - Bandwidth requested by Serviced and Anchored MS respectively

B_t - Total Bandwidth used at time't'

B_{THRESH} - Threshold Bandwidth

Considering the number of users alone is not adequate, and then the requests may demand different amounts of bandwidth. A Threshold Bandwidth (B_{THRESH}) is set for each GW in Bandwidth based Admission Control (BAC) Scheme. If the Requested Bandwidth (B_{REQ}) of the new call or handover calls is less than the Threshold Bandwidth (B_{THRESH}) in one particular Gateway. B_{REM} is the difference between the Total Bandwidth (B_{TOTAL}) of a GW and sum of bandwidths allocated to MSs currently serviced by that GW. As shown in the fig.2 the involves in the following steps:

```
Bt = 0
if a new or handover MS arrives then
        if (BREM ≥ BTHRESH & BREQ_S < BTHRESH ) then
        Ns(t)= Ns(t)+1
        Bt + = BREQ_S
                BREM - = BREQ_S
        else if (BREQ_S = BTHRESH) then
                if (NA(t) > 0) then
                  NA(t) = NA(t) - 1
                  Ns(t)= Ns(t)+1
                  Bt = Bt - BREQ_A +
                       BREQ_S
                  BREM = BREM + BREQ_A
                            - BREQ_S
        else
                BW=∑_{i=1}^{n} B FREE
          If (BW ≥ BTHRESH)) then
                Ns(t)= Ns(t)+1
                Bt + = BREQ_S
                BREM - = BREQ_S
          else
                The MS is blocked or dropped.
          end if
        end if
   end if
```

Fig.3. Bandwidth based Admission Control Scheme

VII. PERFORMANCE ANALYSIS

To yield better results the proposed Bandwidth based Admission Control Scheme (BAC) comparing to the existing New Call Bounding Algorithm. Table 1 shows the some of the list of simulation parameters.

Parameters	Value
MAC protocol	802.16
Bandwidth	2 Mbps
Threshold Bandwidth (BAC)	0.5 Mbps
Packet size	1024 bits
Data Rate	512 kbps
Routing protocol	NOAH
Transmission Range	250 - 400 m
Queue Length	50
Queue Type	Queue/Droptail/PriQueue
Simulation time	80.0
Capacity (NCB)	100

Table.1. Simulation Parameter

PLR is less for BAC when compared to NCB algorithm. As bandwidth at time 't' is taken into consideration, packet loss is reduced to a greater extent as shown in the fig.4. X-axis represents the speed and the Y-axis represents the PLR.

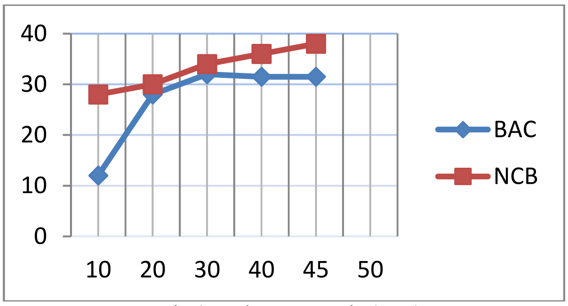

Fig.4. Packet Loss Ratio (PLR).

Throughput of the proposed system is high the movement of MSs are reduced. Fig.5 shows the throughput of the both the algorithms. In the evaluated graph X- axis represents the speed and the Y-axis represents the throughput.

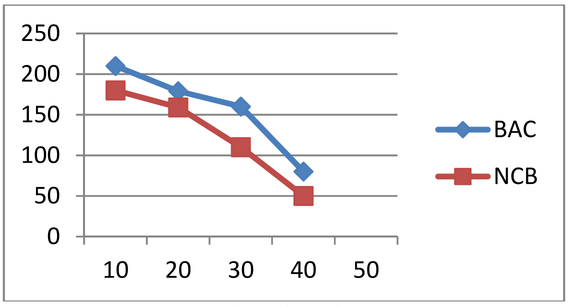

Fig.5. Throughput

The proposed system yields better results. New calls are accepted immediately if the requested bandwidth is less than the remaining bandwidth. Handover calls are accepted only if the total bandwidth at time't' is less than the threshold.

CONCLUSION

The proposed Bandwidth based Admission Control (BAC) performs better Scheme as the bandwidth requirements of the MSs are considered rather than the number of MSs. The Handover MSs and Anchored MSs are handled efficiently. Hence, handover is minimized. The blocking probability of new MSs and the dropping probability of Handover MSs are also reduced, thus improving the average serving rate.

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