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ENHANCEMENT OF QOS IN MOBILE MULTIMEDIA APPLICATIONS DURING VERTICAL HANDOFF IN HETEROGENEOUS NETWORK

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ABSTRACT

Multimedia applications in wireless communication have been increased in recent years. A variety of wireless access technologies are introduced for various needs. The abundant increase in mobile computing devices and different networking systems leads to the support of user's mobility in Heterogeneous Wireless Networks (HWN).This paper addresses a Scheduling Based Vertical Handover Management Scheme (SBVHM) when a user migrate between WLAN and WiMAX for seamless and ubiquitous access. Various wireless technologies such as wireless LAN, WiMAX and 3GPP are interlaced to support many wireless services in global environment. In addition QoS has become more significant in many applications where wireless network resources are utilized. The proposed scheduling based vertical Handover management scheme analyses the QoS enhancement of the mobile user in a Heterogeneous network. Our simulation results show that by introducing proper scheduling, the QoS parameters such as Reauthentication delay and Signalling Cost are reduced significantly. The algorithms Genetic Queuing, Proportionally Fair Queuing and WiMAX QoS Aware Load Balancing are proposed in the scheduling process during handover. The simulation is implemented using NS-2 and the experimental results are obtained for the proposed algorithms and compared with the standard scheme.

Keywords: *Heterogeneous Network, Quality of Service, Reauthentication Delay, 3GPP, Signalling Cost.*

1. INTRODUCTION

Multimedia applications in wireless communication have been increased in recent years. The abundant increase in mobile computing devices and different networking systems leads to ubiquitous environments.To support the ubiquitous environments a rapid Handover scheme must be enhanced between Heterogeneous wireless networks, which is one of the complicated techniques[1]. Since the roaming users expect a rapid Handover experience while switching from one wireless network to another the Handover operation must be invoked by the networks[2]. Various wireless technologies such as wireless LAN, WiMAX and the 3G Partnership Project (3GPP) are interlaced to support many wireless services in global scenarios [3]. Among several wireless technologies for broadband networks, IEEE 802.16 operated WiMAX shows guaranteed services.The WiMAX Forum first developed IEEE 802.16 Fixed WiMAX standard [4]. But in later years since the users were expecting for mobility services IEEE 802.16 Fixed WiMAX could not support such wireless system[4][5].Eventhough various scheduling schemes are considered in [6] the required QoS parameters delay and cost were not analysed.In order to support mobility on terminal stations IEEE 802.16e Mobile WiMAX standard is proposed by WiMAX Forum, with data rates urto 100 Mbps. Due to this mobility support provided by the WiMAX standard to the target customers in mobile users, several interconnection scenarios are developed in the multimedia services [7]. In general when a user is moving away from the current serving cell and trying to associate to the target cell, the outgoing call must be directed to the target cell in order to prevent call termination [8], which is known as Handover. If the Handover occur between base stations supporting the same network technology, it is said to be Horizontal Handoff, otherwise if it occurs between base stations that supports different wireless technologies then Vertical Handoff is supported [9]. Nowadays Broadband Wireless Access (BWA) technology has acknowledged a fast growth in new services based

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on multimedia applications for Next Generation systems.As technology increases, the number of users also increased. Since many users are sharing the available network system and they all are expecting a faultless Handover during Vertical Handoff in a Heterogeneous network system [10]. In this interworking architecture of WLAN, 3GPP and WiMAX during Handover every user must get mutually Authenticated from the 3G Home Network (3GHN) [11]. If the user visits the target network from the serving network for first time the authentication is executed. Once the user is authenticated in the new domain, then for the second time if the user is visiting the same domain, then Reauthentication is executed. Because of this authentication and reauthentication process a delay is occurred in the scheduling process which may cause QoS violation. In order to satisfy the QoS demands modern communication networks are required [12] to support the QoS guarantee. By introducing proper scheduling mechanism this QoS violation can be prevented. The scheduling algorithms proposed in this paper are Genetic Queuing(GQ), Proportionally Fair Queuing(PFQ) and WiMAX QoS Aware Load Balancing(WQLB). Thus the QoS parameters Reauthentication Delay and Signalling Cost are reduced by doing proper scheduling in the Heterogeneous network. These proposed algorithms are executed during Handover by the Advanced INEA protocol and proper scheduling is completed which in turn enhance the QoS satisfaction.

1.1 Quality of Service

QoS is also known as resource reservation control mechanism.QoS is significant in wireless heterogeneous network during vertical HO. It is defined as the overall performance of the network and particularly the performance seen by the users of the network system. Many applications are supported with different stricter service demands under QoS requirements. The main QoS parameters like throughput, bandwidth availability, signaling cost and delay are being measured in several scenarios. Among these parameters Reauthentication delay is the main issue. The time difference between the mobile user gives request for Reauthentication and the user gets response is known as Reauthentication delay. Similarly the signaling cost records the accumulative signaling traffic exchanged in the network due to an HO Reauthentication.

2. RELATED WORK

In Heterogeneous network a fast HO protocol is introduced for the roaming users. For priority queuing of HO calls in wireless networks an analytical framework is introduced [13] based on the roaming time in overlap region between two domains.The algorithm considered in this work is FIFO queuing and QoS enhancement is not achieved. The QoS parameters packet loss, power consumption and throughput are analysed using channel quality and service quality in [14], which deals with WiMAX only but not on a heterogeneous network. Eventhough the above mentioned parameters have been analysed, during vertical HO a fast and secure HO mechanism is expected by the user for QoS satisfaction.So a HO decision scheme is analysed with respect to throughput gain [15].Another HO decision mechanism is proposed based on fuzzy inference system which makes the decision with respect to user performances, but the Reauthentication delay and signaling cost are not considered in this work [16]. Consecutively the limitations and challenges in mobile video chat according to processing powers, network conditions and battery levels have been discussed [17]. During Handover the user's service granting status is updated by the network operators. It is often essential to verify the user's access rights before granting service. This is actually verified by the network operator. So, there is a trade-off between the network access control and to the QoS expected by the user.

3. SCHEDULING BASED VERTICAL HANDOVER MANAGEMENT SCHEME

In mobile networks since each network operator is allocated with limited spectrum they have to design the cell size as reduced as possible.Due to the increase in the number of users in recent years many users are crossing the cell boundaries in Heterogeneous network such as WLAN – WiMAX. According to the 3GPP and WiMAX Forum the 3GPP users moving in the WLAN-3GPP-WiMAX interworking environment, must get authenticated by the authentication servers. In 3GHN the Home Authentication , Athorization and Accounting server (HAAA) are interlaced. Now the HO calls must be handled with high QoS demand which is observed by the user. The handling mechanism of HO calls has a direct impact on QoS satisfaction expected by the user. The interworking principle of WLAN-3GPP-WiMAX is implemented with high quality service coverage, a lesser amount of cost and consolidated

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billing. It also introduces many service challenges such as provision of efficient Reauthentication mechanism during an HO.In such a Heterogeneous network while a user migrate from WLAN-WiMAX the outgoing call should be directed to the target WiMAX domain.Fig.1 shows the interworking architecture of this scenario.

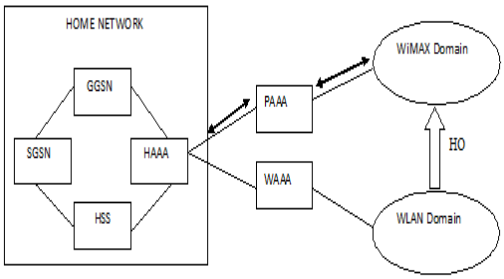

Figure. 1 Interworking Of WLAN, 3GHN And Wimax

If the mobile station visits the WiMAX first time then the user gets authenticated by 3GHN. Once the user is authenticated, then for second time, if the same user comes to the same domain which is already visited by the mobile station , it gets Reauthentication from the Proxy server called PAAA. In other words it is stated that in Heterogeneous network the authentication is done by the intermediate Proxy AAA server. Thus the distance is reduced during Reauthentication, which eventually decreases the Reauthentication delay and thereby the QoS enhancement is achieved.

3.1 Algorithm Description

A Handover is the process during which a user's outgoing call is transferred from its current cell to another target cell. In this work a heterogeneous network WiMAX – WLAN domain is considered. During vertical HO the Advanced EAP–AKA protocol is executed, to authenticate the user within the new domain. This will enable the user to communicate inside the domain as determined. For the duration of authentication process the required informations of the user's are being stored in the Home Network and due to this a delay is caused in the process which will affect the required QoS satisfaction of the user, correspondingly the delay is extended during Reauthentication process. In order to reduce this Reauthentication delay a proper scheduling mechanism is needed. The traditional methods employed the algorithms FCFS, WFQ and RED. In FCFS the data packets which arrive first will be served first, the remaining packets are stored in the queue depending on the time of arrival. The drawback of this algorithm is its static nature of queue length, that is the length of the queue is unaltered. The another aspect is the data packets that arrive when the queue is already full, gets dropped. Hence there happen a critical situation for the sender, where to retransmit the data packets and this will augment the delay in the network. The same conditions hold for signalling cost also. For the Weighted Fair Queuing (WFQ) each data flow has its own FIFO queue. The drawback of this algorithm is, it is difficult to configure. Since an average data rate is assigned for all data flows, the data flows having higher data rates than that of the average data rate, will suffer from the holdup. This introduces a delay in the network. In Random early Detection (RED) early drop is an queuing discipline for a network scheduler, which is applicable for congestion network. If a network is carrying so much of data then its QoS deteriorates. Then the delay, packet loss or blocking of new connections may occur unusually. As a consequence of these the actual throughput is reduced in the network. Due to these reasons RED is not considered for this HO situation. Fig.2 shows the flow control of the proposed mechanism.

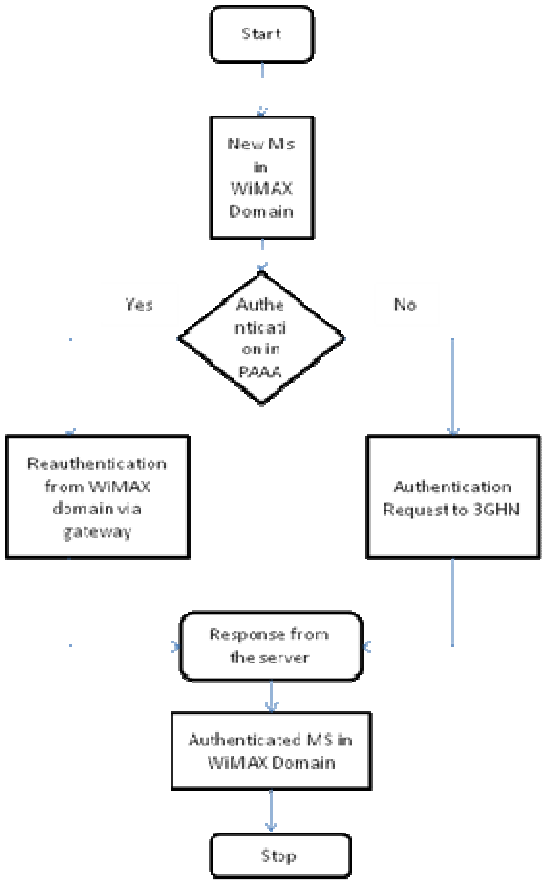

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Figure. 2 Control Flow Of A User In New Domain

3.2 Reauthentication Delay

Minimizing handover reauthentication delay considerably reduces total handover delay. The reauthentication delay caused by an HO in a WLAN – WiMAX domain is given by

$$W_{SD} = \sum_{i=0}^{n} K_m \qquad (1)$$

Where 'Km' is the keying message sending the request message and ending by reception of reply message.

3.3 Signalling Cost

Handover reauthentication signalling cost records the accumulative signalling traffic exchanged in the network due to an HO reauthentication operation. Reducing reauthentication signalling cost leads to a reduction in HO signalling traffic to and from the 3GHN. The average reauthentication signalling cost is given by

$$T_c = N * \sum_{i=0}^{n} R \qquad (2)$$

Where 'R' is the request frames or message,'n' is the number of nodes,'N' is the total domains considered including WLAN and WiMAX and 'T_c' is the average cost.

4. SIMULATION SCENARIO

The experimental results are obtained and comparisons of standard and proposed algorithms are performed using Network Simulator [18] NS-2.32 with Linux-cent OS. As roaming users are entering into a WiMAX domain the HO takes place and the corresponding QoS requirements are analysed in this setup.

Fig.3 shows the nodes are transmitting while they move towards WiMAX. Once the node entered into the WiMAX domain, the Request and Response, sent and received are happened.

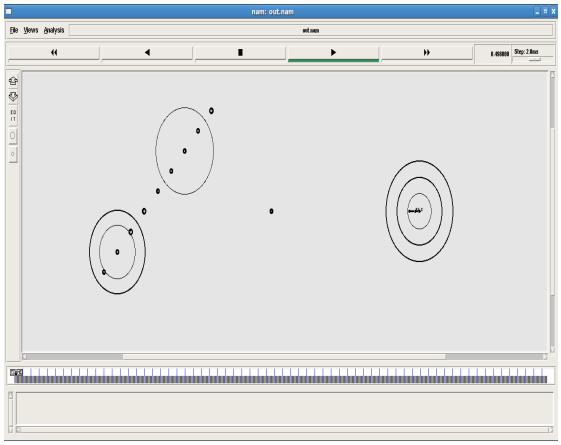

Figure. 3 Transmission Of Node

The simulation parameters for the scenario using which the experimental setup is developed for the heterogeneous network system is shown in Table.I.

TABLE. I Simulation Parameters

Parameters	Value/Description
IEEE Configuration	802.16
Movement of MS	Uniform
Packet interval	0.05 ms
Total Simulation time	200 s
Time out	0.02 s
Types of traffic	Voice and Video
IP address class	MIPv6
Coverage area (Radius)	1000m
Antenna	Omni direct
Propagation/type	Two way / singlehop
Simulation area	4000 X 2000 Pixels

4.1 Experimental Results

The performance analysis of WLAN-WiMAX handover is obtained in terms of both reauthentication delay and signalling cost. Fig. 4 shows the comparison of proposed algorithm with the standard algorithm for reauthentication delay. Initially the delay is reduced in PFQ till the number of HO reaches 8 and beyond that WQLB performs in a better manner. Thus in the graph it is observed that the gap between PFQ and WQLB widens for

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larger values of nHO.Where nHO is the number of handovers.

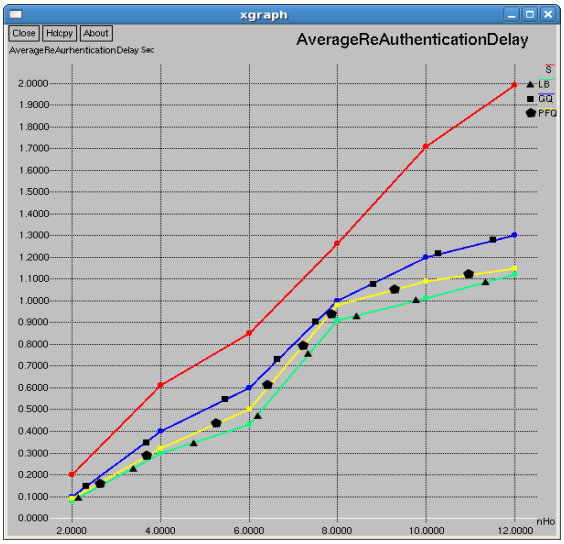

Figure. 4 Re-Authentication Delay

Table. Ii Re-Authentication Delay (Sec)

No.of HO's	Standard	WQLB	GQ	PFQ
2	0.2	0.08	0.1	0.09
4	0.7	0.3	0.4	0.32
6	0.9	0.43	0.6	0.50
8	1.2	0.91	1.0	0.98
10	1.5	1.01	1.2	1.09
12	1.7	1.12	1.3	1.15

Table.II shows the comparison of the reauthentication delay determined by all the algorithms proposed in this scheme and to the standard algorithm.

In the same way the comparison of signalling cost is shown in Fig.5. From this graph it is observed that, as number of HOs increases the cost is significantly controlled in PFQ algorithm than the other two algorithms GQ and WQLB. But in overall performance the proposed algorithms performs well than the standard scheme

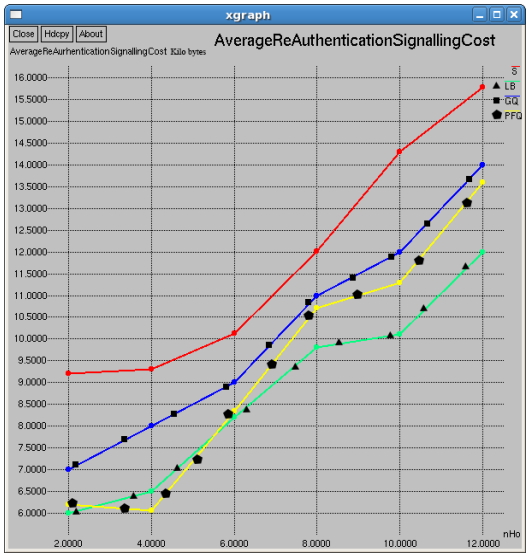

Figure. 5 Signalling Cost (Kbytes)

Table. Iii Signalling Cost (Kbytes)

No.of HO's(nHO)	Standard	WQLB	GQ	PFQ
2	9	6	7	6.2
4	10	6.5	8	6.06
6	11	8.2	9	8.34
8	13	9.8	11	10.7
10	15	10.1	12	11.3
12	17	12	14	13.6

Table.III shows the comparison in term of signalling cost. In Fig.6 the bargraph of Reauthentication Delay is shown. It compares the standard algorithm with the proposed algorithms, where initially the proposed PFQ gives better performance than WQLB. As the number of handovers increases the WQLB performs in a better manner than PFQ.

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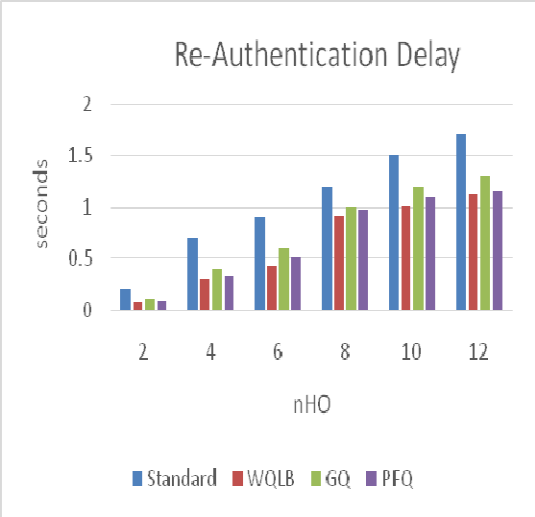

Figure. 6 Re-Authentication Delay

In Fig.7 the bargraph of Signalling Cost is shown. It compares the standard algorithm with the proposed algorithms, in which the proposed PFQ gives better performance than the other algorithms.

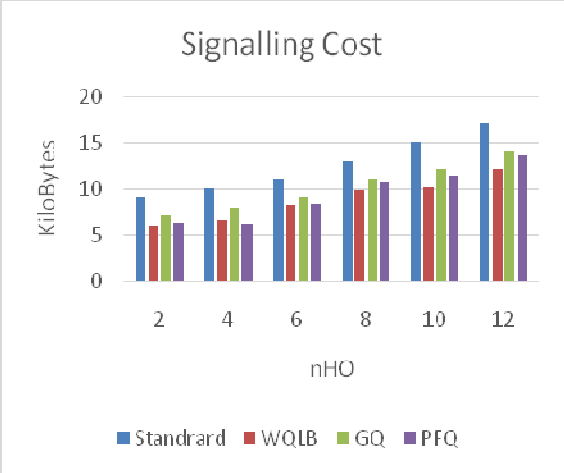

Figure .7 Signalling Cost (Kbytes)

5. CONCLUSION

Advances in wireless access technologies, bridges the gap between static and dynamic characteristics of the user. In an aim to reduce the trade-off between the security offered by the network and the quality of service observed by the user, enhancement of the re-authentication protocol is performed in this paper. On analysing the results of various algorithms which are executed during handover (HO) in the heterogeneous network, the better results are obtained for the proposed schemes than the standard algorithm. In this paper, the re-authentication delay and the signalling cost significantly reduced during handover between the WLAN-WiMAX HO. The reauthentication delay is reduced to a value of 25.81%, 33.38% and 37.77% in case of GQ, PFQ and WQLB respectively, and the signalling cost is reduced to 18.67%, 25.07% and 30.16% in case of GQ, PFQ and WQLB respectively. Thus the reauthentication delay and the signalling cost are reduced. Since the proxy server is used in between the mobile station and the main server, the traffic due to signalling is reduced.

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