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ALGORITHM FOR SEAMLESS HANDOVER BETWEEN WIMAX AND WLAN RADIO ACCESS TECHNOLOGY USING NS2

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Abstract- The convergence of mobile homogeneous networks to heterogeneous networks had put forth the challenge of seamless handovers between different radio access networks with maintained QoS. Efficient vertical handover decision strategy is vital for heterogeneous WiMax/WLAN networks that in return do combine advantages from both access technology in terms of data rates and coverage, offering high QoS to mobile users. As a compliment to WiMax; WLAN is used as it is designed for low range, high-medium data rate access and low mobility. An algorithm is proposed based on the speed of the mobile node, bandwidth and packet class priority for handover between WiMax and WiFi in this paper. The results showed that the channel utilization, handover latencies and average throughput has been improved with reduced packet loss.

Keywords - Heterogeneous networks, Radio Access Technology, Handover latencies, Throughput, Vertical handovers.

1. INTRODUCTION

The advances in the wireless technology and development of different radio access technologies has developed the need for having an integrated platform for mobile terminals equip with multiple interfaces to communicate and have seamless and continuous services. In these heterogeneous networks the main issue is mobility i.e. switching of mobile terminal from one network to another and handover is the integral component in mobility management i.e. when a mobile terminal moves away from one base transceiver station coverage area towards another base transceiver station coverage area a hand over is required. In heterogeneous networks when the handover is from one access technology to another access technology it is known as vertical handover. In our paper we have proposed an algorithm for vertical handover from WiMax to WLAN [1]. There are different parameters that can be considered while switching from one access technology to another that includes signal strength, bandwidth, cost etc. For real time multimedia packet sometimes bit is convenient to remain with the current access technology as the switching can result in disconnection or loss of packets; this is due the faster movement of the node. Number of vertical handover decision algorithms had been proposed considering different paratmeters for handover decision. An algorithm has been proposed for handover decision that makes the wireless access network to balance overall load between attachment points and increases the lifetime of battery of mobile nodes [2]. A user centric algorithm has been proposed for vertical handovers to maximize the through put of mobile node connected and for maintain the connection continuously. The decision criteria for a vertical handover from WiMax to Wlan are different to those when there is a vertical handover decision from WLAN to WiMax [3]. AS for the WLAN the coverage area is smaller to that of WiMax therefore the node may keep the connection with WiMax network while it moves into coverage area of WLAN. Whenever the mobile node moves from one network to another there are multiple types of data streams i.e. data, voice and video. Due to WLAN sensitivity to higher speeds in case the mobile node is moving at higher speed there is no need to do a handover as the mobile node with leave the WLAN coverage area and that may cause data loss or disconnection in communication. Speed is an important decision parameter to trigger a vertical handover from WiMax to WLAN network, therefore it is important to consider speed in decision parameters for handover [4]. The other integral parameter is the priority of the session whether it's a low priority or high priority. Often the priority is set low for data packets and high for voice/video packets. In our proposed algorithm we have taken priority and speed as parameter to design the vertical handover algorithm for WiMax to WLAN.

2. VERTICAL HANDOVER WIMAX TO WLAN PROCEDURE

In heterogeneous mobile networks, vertical handovers gives the capability of mobility i.e. uninterrupted service to mobile nodes while they move from one cell coverage area to another. The mobile mode switches between different radio access technologies i.e. from WiMax to WLAN, WiMAX to UMTS, WLAN to WiMax etc. When a mobile node switches between different radio access technologies the connection also switches between different base stations. Both the aforementioned networks support each other in terms of QoS support, installation cost, coverage area and data rates. The factors that involve in vertical handovers are availability, cost, speed and quality. The WLAN networks had minimal mobility support and coverage with low cost of installation whereas the WiMAX networks are offers wireless access for metropolitan area networks [5]. The mobility is supported by Mobile IP. The Mobile Internet protocol version 6 (IPv6) has

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three functional entities namely Mobile node (MN), Home Agent (HA) and Foreign Agent (FA). Upon movement of mobile node to a foreign network with different access technology the care-of-address (COA) is acquired to uniquely identify the mobile node in foreign network. HA register's the COA of the mobile node in the home network. The packet is than tunneled to COA of MN by HA.

The vertical HO procedure must be designed in a way that it is seamless to the mobile user. In today's networks the packet is multimedia packet i.e. composed of data, voice and video [6]. When its data packet the delay does not affect the quality of service till certain levels but the sensitivity increases with voice and video packets as a little higher delay will cost the quality of service. Therefore two factors are very important for vertical HO's i.e. handover latencies and packet loss. The minimum they are better is the QoS of the network and will be seamless.

When a MN moves from WiMAX coverage area and detects a WLAN network, the WLAN receives beacon frames from 802.11 and trigger event "Link Detected". Media Independent handover (MIH) agent that receives this event indicates WLAN interface of MN to connect to WLAN AP in case it is better interface than the former one. With "Association request" and "Response" events WLAN interface from MN and WLAN AP exchange frames. When the Association request is received the WLAN interface triggers "Link Up" event. The event is received from MIH agent in MN and MIPv6 in MN commands to request Neighbor Discovery (ND) agent to send Router Solicitation (RS) [7]. The AP from WLAN network receives RS, on detection that it is a new neighbor, it sends Router Advertisement (RA) which contains router advertisement interval, lifetime, network prefix and prefix valid lifetime. When WLAN interface of MN receives RA it reconfigures its address based on received prefix. MIH agent of MN is notified. MIPv6 issues command to WLAN interface to send "Redirect" message to CN in order to inform CN of new location of MN. MIPv6 of CN receives the "Redirect" and sends an Acknowledge (ACK) message to WLAN interface of MN. MIH agent of MN is than notified [2]. This is an indication that the MIH agent from the MN has confirmation that CN has new address of MN and diverts the packet from WiMax interface to WLAN interface. Now the packet uses Link between WLAN interface from MN and AP. MIH agent from MN gives command to WLAN interface to send MIH capability request to AP. The response is responded by AP that includes Media Independent Handover Function (MIHF) identification. As a result the MIH capability received from MIH Agent with new remote MIHF identification.

3. SIMULATION SCENARIO

For vertical handovers for MN moving from WiMax to WLAN network an algorithm is proposed in this paper based on the packet type and speed of the MN. The priority of the packet is set as data packets are at lowest priority than are voice packets and on the video packets are at highest priority. Based on these parameters the decision is made whether to trigger the handover or the MN should remain with the WiMax interface.

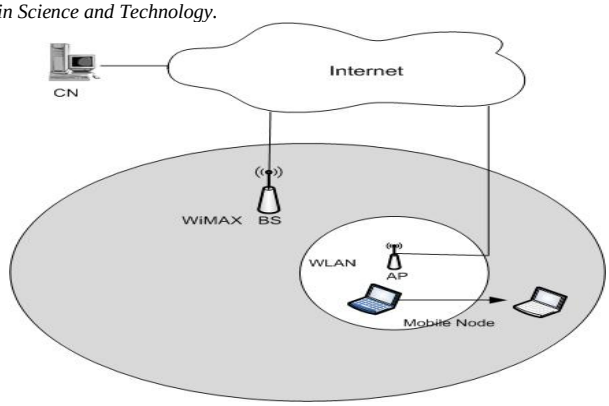

Fig1. Simulation Scenario

A threshold value for the incoming MN is set, in case the MN speed approaching the WLAN is higher the handover will be rejected, if it is less than the set threshold value then the session bandwidth will be checked, if it is lower and the session priority is lower than WLAN than the handover will be triggered in other case it will be rejected and the MN will remain in WiMax network. The flow chart is shown in Fig 2.

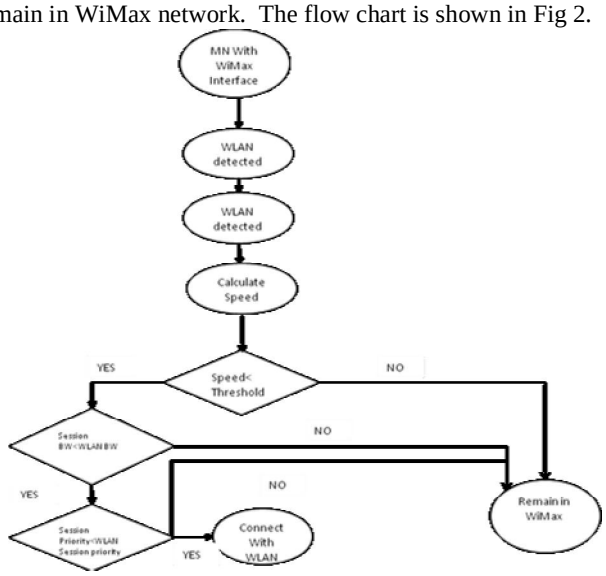

Fig2. Details of Simulation Scenario

The simulation is carried out for 30 MN with four different types of packets i.e MPEG-4, VoIP G.711, FTP and Telnet. The first two are high priority as these are for video and voice and the later two are low priority used for data. The packet size for VoIP G.711 is 160 bytes with an inter arrival time of 20ms. The propagation Model is Two Ray Ground; other details are given in Table I below:

4. SIMULATION RESULTS

The proposed algorithm achieved improved channel utilization when applied to aforementioned scenario as compared to the model without the algorithm. The WLAN networks has low coverage radius i.e. between 50-100 meters depending upon the type of 802.11 standards. In case the radius of the AP is lower and MN is moving at higher speed its recommended not to trigger the handover. The simulation was run first for the vertical handovers without proposed algorithm and then with proposed algorithm. The packet size

is 160 byes and the speed threshold is set to 10, 20, 40, 60, 80, 100 km/h. Following are the results in Table II.

Table I: Comparison parameters and values

Parameter	Value
Range	1500m*1500m
Simulation duration	400sec
Transmission Radius Wimax	500m
WiMax Transmission Power	0.025W
MAC scan Interval	45secs
MAC UCD & DCD Interval	5secs
WiMax RX Threshold	2.025e-12 W
WiMax CS Threshold	0.9*RX Threshold
WLAN Transmission Radius	50m
Frequency WLAN	2.412 Ghz
Bit Rate	11Mbps
TX Power	0.0134W
RX Threshold	5.25089e-10 W
CS Threshold	0.9 * RX threshold
Antenna Type	Omni
Propagation Model	Two Ray Ground

Table II. Vertical Handover Latency

α	Vertical Handover Latency [ms]				
	20kmh	40kmh	60kmh	80kmh	100kmh
1,01	65,642	64,366	64,366	67,071	66,773
1,02	66,342	64,23	64,366	67,071	66,735
1,03	66,342	65,707	64,366	67,071	66,101
1,04	66,785	66,773	67,493	67,071	66,933
1,05	66,125	66,773	64,152	67,071	67,071
1,06	**63,754**	66,773	64,152	67,071	67,071
1,07	66,101	66,773	64,152	67,071	67,071
1,08	66,735	66,347	67,095	67,071	67,071
1,09	66,42	64,366	64,366	67,071	66,933
1,1	66,42	**63,989**	64,366	67,071	66,933
1,2	66,435	66,347	**64,117**	67,129	66,933
1,3	66,435	64,417	64,509	**64,366**	66,933
1,4	66,435	67,107	67,459	67,071	**64,366**

Vertical handover latency results are significantly reduced between WLAN and WiMAX choosing the right combination for α and speed of the mobile node.

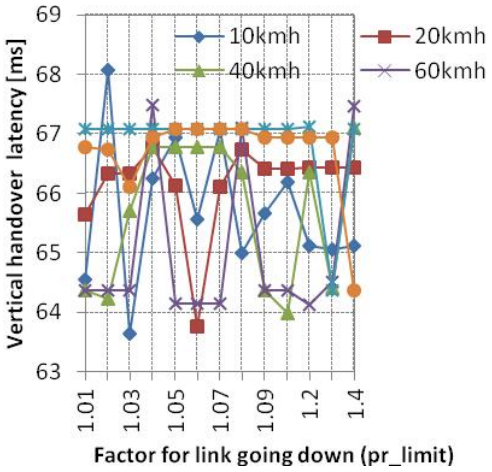

Fig3a. Handover Latency

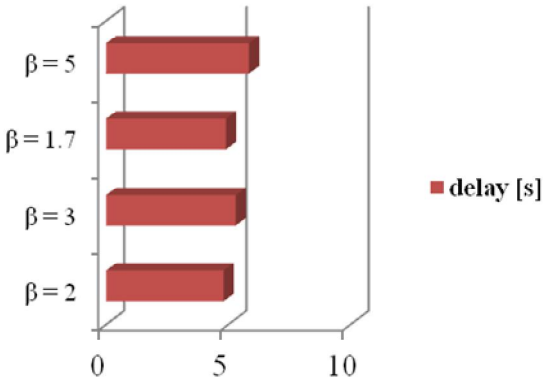

Fig3b. Delay

The handover latencies are shown in fig3a above and delay in fig 3b. The high the speed is more is the handover latency as shown in aforementioned figure. The delay comparison between WiMax and WLAN is shown in fig. 4 below, delay's are higher in WLAN as compared to the WiMax network due to low bandwidth and coverage area of WLAN.

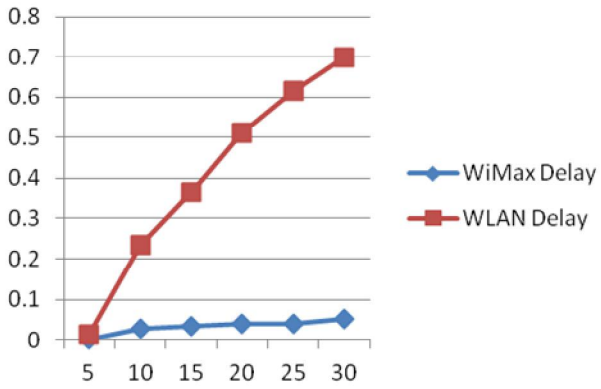

Fig 4. WiMax/WLAN Delay Comparison

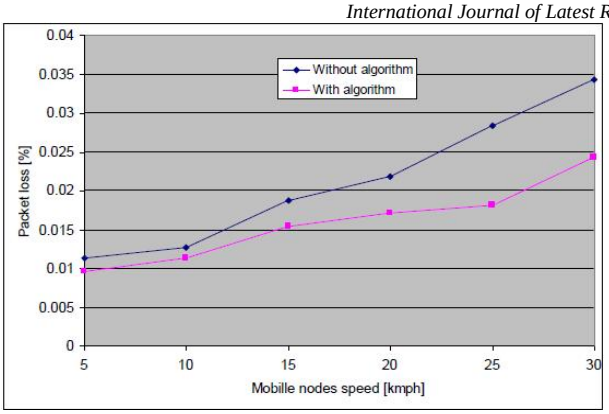

Fig 5. Packet Loss

The packet loss for vertical handovers with algorithm is lower as compared to without algorithm. As the mobile nodes moves at faster speeds and in case the handover is triggered it causes high data latencies and loss. In our algorithm we had set a threshold value that does not permit a handover in case the speed of mobile node is higher that eventually improves the QoS of the overall network by reducing delay and packet loss as obvious from the graph above.

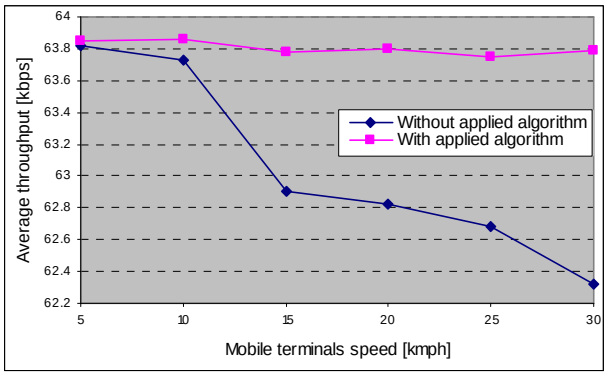

Fig 6. Mean Throughput for WLAN

Mean through put when MN's moves through WLAN area. As WLAN is sensitive to speed therefore for high speed moving MN's it's not permissible to do a handover therefore a handover should not be initiated and it should remain with the WiMax. When applied the algorithm we get better throughput results.

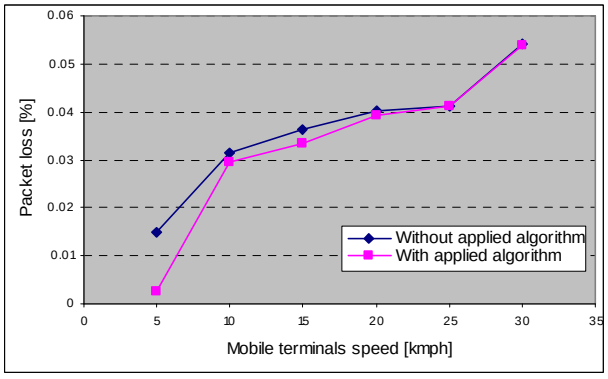

Fig 7. Mean Through put of WiMax

There are total of 24 MN's moving; when the algorithm was not applied all of them triggered handovers as a result there were heavy losses and handover latencies on the other hand when the algorithm was applied only 8 of them performed handover as they were moving at slower speed rest remained with the WiMax; hence improving performance by reducing packet loss, improve throughput and QoS.

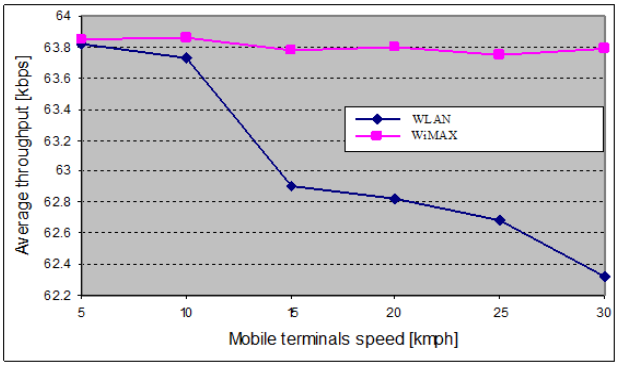

Fig 8 WiMax-WLAN Through put

The throughput for WiMax is higher than WLAN, as WLAN have low bandwith and the traffic intensity is lower than the WiMax.

5. CONCLUSION

The design of efficient handover decision strategies plays an import part to improve QoS that integrate advantages on coverage and improve data rates, offering quality services to mobile users. WLAN can be used as compliment to metropolitan networks like WiMax as they are designed for low range, low mobility and high-medium data rates. The proposed algorithm has improved the QoS in an environment where WLAN/WiMax terminals were performing handovers from WiMax to WLAN hotspots.

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