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RESEARCH ARTICLE

Seamless Vertical Handoff between WLAN and WiMAX

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Abstract*— *The next generation of wireless communication systems is expected to include heterogeneous broadband wireless networks that will coexist and use a common IP core to offer a diverse range of high data rate multimedia services to end users with contemporary mobile devices that are equipped with multiple network interfaces. This requires the provision of seamless vertical handoff. So, in this research work we have considered heterogeneous network which consists of two sub networks (WLAN and WiMAX) to analyse vertical handoff and have discussed an approach to improve service quality in network. We have used ASN (Access Service Network) anchored mobility For performance evaluation VoIP application is chosen For improving QOS we have introduced QOS configuration Profile in the network whose different profiles such as RSVP, PQ, RED are set and have been added at the interface of ASN gateway which resulted in the improvement over the existing handoff techniques in terms of values we get for different performance parameters.

Keywords*— *Handoff, Mobility, RSVP, PQ, RED

I. INTRODUCTION

Wireless networking has become an essential part in the modern telecommunication system. The demand of high speed data transfer with quality has led to the evolution of technologies like WiMAX and WLAN and is still increasing. Hence, new ways to enhance quality and speed of connectivity are being searched for. With step towards the fourth generation communication networks, integrated networks are coming into operation.

WLANs are mostly designed for private wired LANs and have been enormously successful for data traffic but voice traffic differs fundamentally from data traffic in its sensitivity to delay and loss. Voice over WLAN is popular, but maintaining the speech quality is still one of many technical challenges of the VoIP system. VoIP is spreading rapidly and there is need to support multiple concurrent VoIP communications but WLAN support handful number of users. WiMAX (also known as IEEE 802.16) is a wireless digital communications system that is intended for wireless "metropolitan area networks" (WMAN). WiMAX uses microwave radio technology to connect computers (or mobile devices) to the internet instead of wired network connections (DSL, ADSL, Cable modem).It can provide broadband wireless access (BWA) up to 30 miles (50 km) for fixed stations, and 3 - 10 miles (5 - 15 km) for mobile stations. So, while wireless LAN supports transmission range of up to few hundred meters, WiMAX system ranges up to 30 miles. Unlike a typical IEEE 802.11 WLAN with 11Mbps bandwidth which supports very limited VoIP connections, an IEEE 802.16 WiMAX with 70Mbps bandwidth can support huge number of users. These motivations led to study of handovers in an integrated network of IEEE 802.11b WLAN and IEEE 802.16 WiMAX so that we can take advantages of both the networks.

II. INTEGRATION OF NETWORKS

Integration of networks means combining two or more different networks (e.g. WLAN and WiMAX) to form a heterogeneous network **.** The unique similarities between WLAN and WiMAX that make the integration promising and meaningful are that both the technologies are fully packet switched and use IP- based technologies to provide connection services to the internet. This standards and IP- based network approaches provide compelling benefits to the service providers to collaborate between these technologies. The inter-working capabilities between WLAN and WiMAX enable service providers to deliver consistent, transparent, and user-friendly broadband services to their subscribers. Achieving this transparency requires two key elements:

- Multi-mode subscriber devices that can communicate on both WLAN and WiMAX networks.
- The ability to provide service across WLAN and WiMAX networks when users move between them. This is generally implemented through a controlling Access Service Network Gateway (ASN GW) and common Authentication, Authorization, and Accounting (AAA) service functionality located in the service provider network.

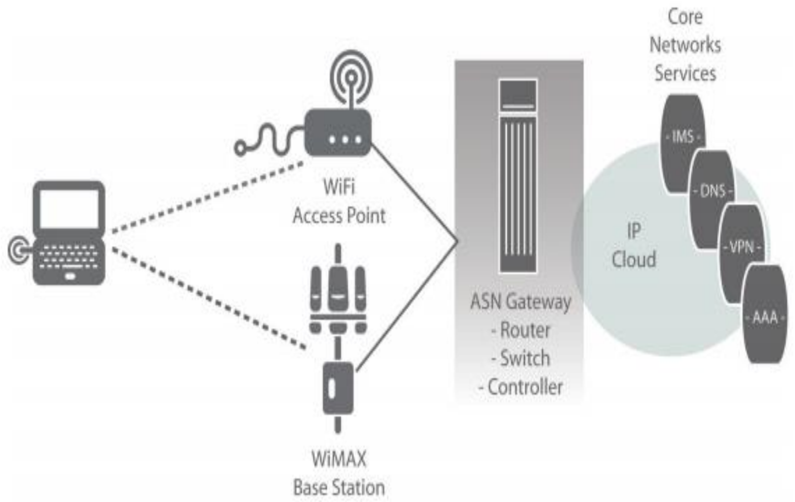

Fig. 1 WLAN/WiMAX Integration

Network integration is crucial for next generation wireless networks, where the diverse of the technologies available have been optimized for different usage models. WLAN and WiMAX are the most promising techniques for future wireless networks; interworking between these technologies is inevitable for better usability of networks infrastructure and support for seamless mobility and roaming. By combining WLAN and WiMAX access together, service providers can deliver high-speed Internet connectivity to the subscriber.

III**. TYPES OF INTEGRATION**

The two types of integration are described below-

A. Loose Coupling

The loose coupling technique depends on gateways to connect the integrated wireless via IP-based internet backbone. In this approach, there is no direct link between the different radio access networks. Additional equipment's, such as WLAN/ WiMAX gateways may be needed to support authentication, QOS mapping, billing and other services. Fig.2 illustrates a loose coupling integration between WLAN and WiMAX networks.

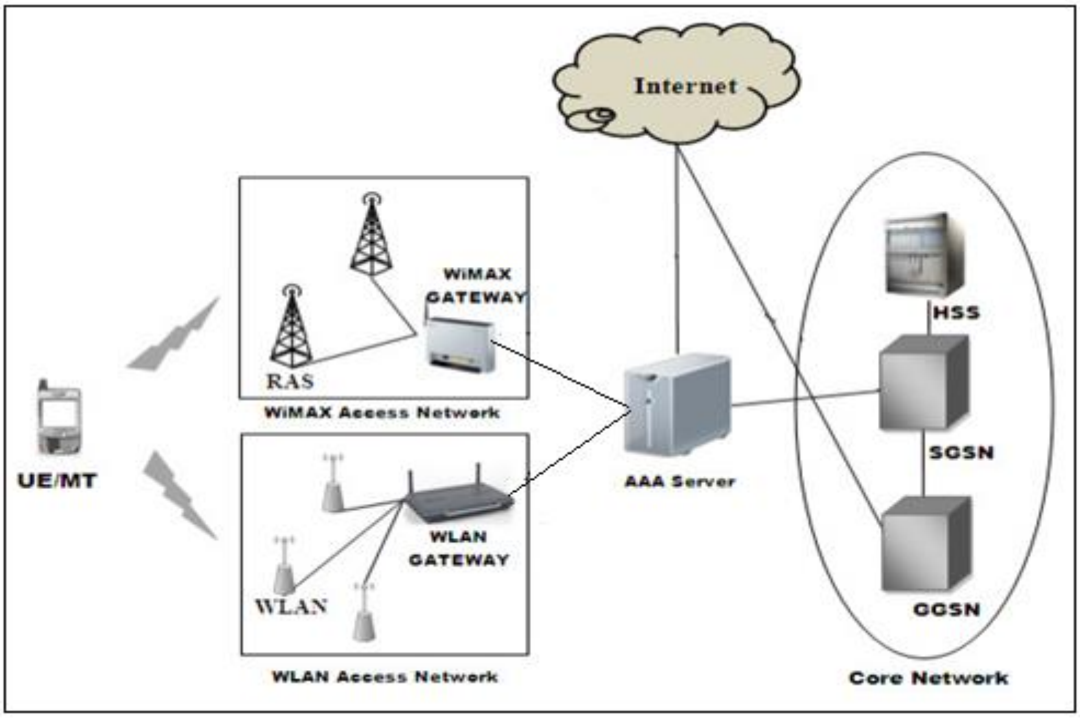

Fig.2 Loose coupling

B. Tight Coupling

In the tight coupling approach, on the other hand, the WLAN and WiMAX access networks are directly connected to the cellular core network, and appear as parts of the cellular radio network forming one single radio access network (RAN). Integration between the different wireless access networks is achieved by introducing WLAN and WiMAX gateways, where the WLAN, WiMAX data traffic goes through the cellular core network before reaching the external Packet Data Networks (PDNs).

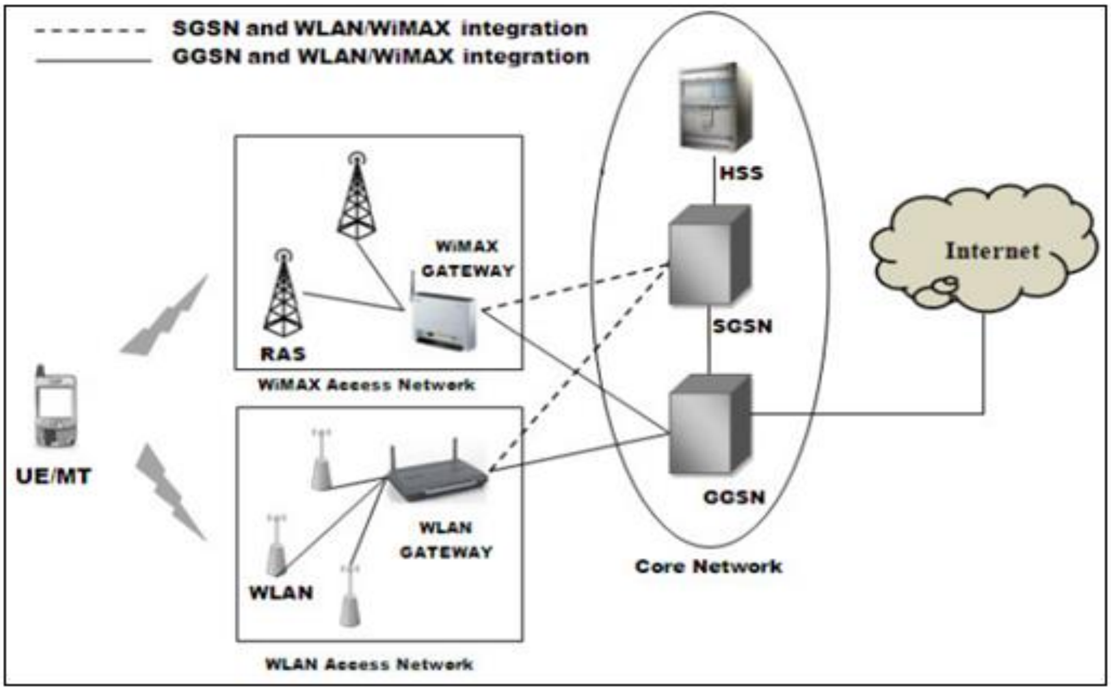

Fig. 3 Tight coupling

IV. HANDOFF

The handoff is a process during which a mobile station (MS) immigrates from air interfaces for its current base station (BS) to air-interfaces of adjacent BS. Handoff is an important process of mobility support in wireless network. Handoff is unavoidably incurred when a cell is overloaded or a MS moves out of a BS's signal coverage. There are two types of handoff-

A. Horizontal handoff

When the HO is within the same technology, for example, between WiMAX cells, it is called a horizontal HO or traditional handoff. In horizontal handoff process, the handoff of a mobile device takes place between base stations supporting the same network technology. Horizontal HOs are easy to implement because the operation is typically made under the same operation domain. Horizontal handoffs are homogeneous intra-network inter-cellular.

B .Vertical Handoff

If handoff is executed between different technologies, for example, WiMAX to WLAN, then it is called vertical HO. Vertical HOs, on the other hand, are typically executed between different operators and require a much more complex signalling. For the development of the 4G wireless networks the design of seamless and efficient Vertical handoffs is an essential and challenging issue.

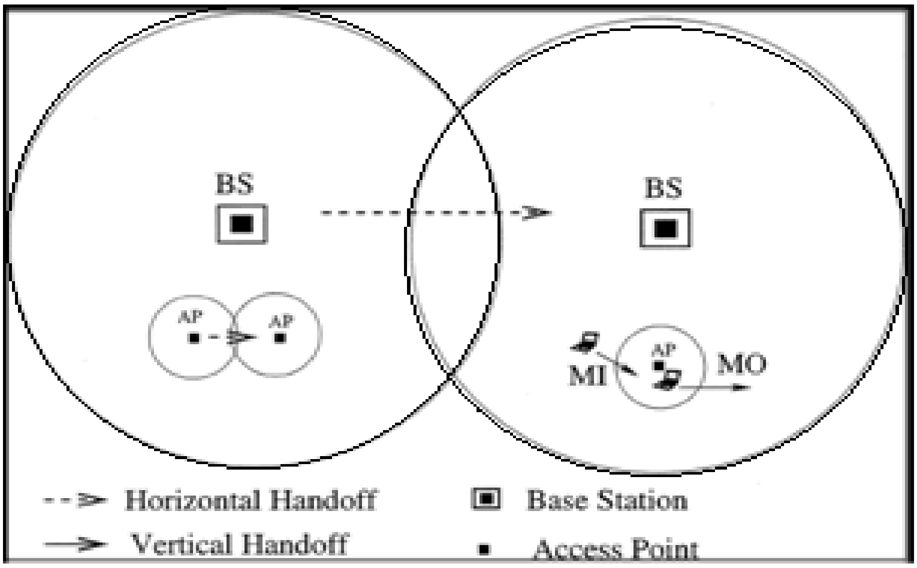

Fig.4 Vertical and horizontal handoff

V. HANDOFF METHODOLOGY

Mobile WiMAX has different types of handoff techniques: handoff based on Mobile IP, SIP (Session Initiation Protocol) based mobility, MIH (Media Independent Handoff) based mobility and ASN-based mobility. We will study the ASN Based Network Mobility. WiMAX with very high data rate and huge spectral radius along with OFDMA based IP technology is well equipped to overcome the high data rate demand. Efficient back-end support for different sizes of base stations and handling data hungry applications are possible because of all the IP technology used. The IEEE 802.16e-2005 standard specifies the PHY and MAC requirements and provisions for the mobile WiMAX. WiMAX network comprises of mobile station (MS), Access Service Network Gateway [that is, ASN comprises of base station (BS), Access Service Network Gateway (ASN-GW)] and Connectivity Service Network (CSN).

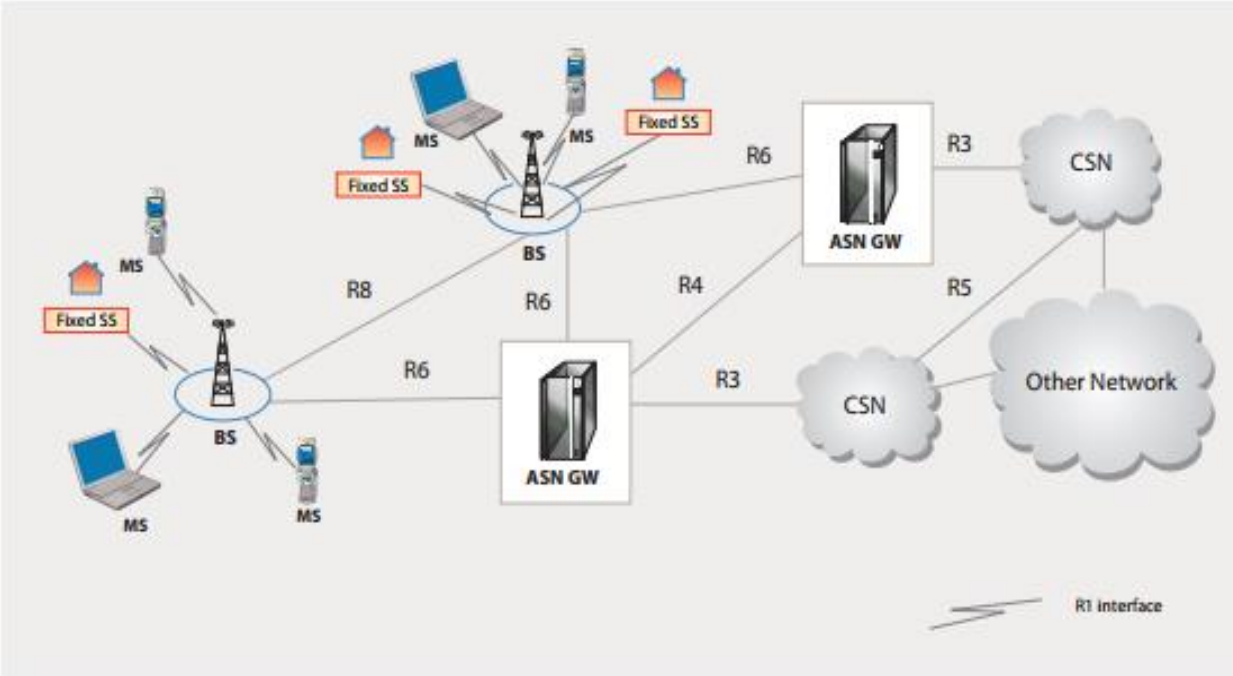

Fig.5 ASN-GW

The Mobile Station is the end-user equipment for forwarding and receiving network data according to the user's subscription. It connects with the Base Station over air and with ASN-GW or CSN using a logical interface. The Base Station is the next hop in the network, which mainly deals with the air interface between MS and itself for better service quality. It takes care of registration and connectivity of MS in the network. The ASN-GW can be seen as a network entity, in the WiMAX network, between Base Station (BS) and Connectivity Service Network (CSN), and broadly helps in service flow management, mobility, authentications, accounting. Its interfaces with BS, other ASN-GWs and CSN have been shown in the Fig.5 Interaction between ASN-GW and BS can be one to many or many to one. The ASN-GW is a combination of Control Plane and Bearer Plane routing or bridging functionality. The ASN-GW operational functionalities are present as corresponding functionalities in Base Station and the CSN. At any particular moment of time a subscriber in the network has to associate with exactly one default ASN-GW while several ASN-GWs along with the serving ASN-GW can collectively provide services.

VI. **PROPOSED APPROACH**

In heterogeneous systems, improving QOS is of paramount importance to assure seamless vertical handoff. We have used ASN (Access Service Network) anchored mobility for which GRE Tunnels are set up between the Base Stations and the ASN Gateway. This enables the Base Stations to send information about the mobile node to the ASN Gateway and the ASN Gateway thereby sends the traffic destined for the mobile node to be sent through the GRE Tunnels. For performance evaluation VoIP application is chosen For improving QOS we have introduced QOS configuration Profile in the network whose different profiles such as RSVP, PQ, RED are set and have been added at the interface of ASN gateway which resulted in the improvement over the existing handoff techniques. These profiles are discussed below:-

A. Resource Reservation Protocol (RSVP)

This protocol allows application to dynamically reserve network bandwidth. It uses mean data rate, the largest amount of data that the router will keep in queue and minimum QOS to determine bandwidth reservation.

B. Priority Queuing (PQ)

PQs sort packets in the buffer according a priority tag which reflects the importance and urgency required in the transmission of packets. Priority Queues are not made up of a single buffer. The arriving packets are tagged with a certain priority, thus allowing packets with higher priority to cut to the front of the line in the sorted packet buffer. Applications that require negligible delay times can use this queuing method to differentiate and prioritize their packets from other packets in order to manage the limited network resources.

C. Random Early Detection (RED)

RED is basically a queue management scheme. It drops the packets randomly before the router gets full. It is a congestion control mechanism that leads to increase in throughput and reduced delay.

After simulating the network for 1800 seconds we observed that application of RED resulted in low jitter, applications that require best quality of voice at the destination should use PQ as it gives consistent improved voice quality. RED is also the optimum choice for those real time applications that are delay sensitive. If the application is required to have high throughput then RSVP is the best choice as it reserves resources well in advance. So, after having such observations we can say that the proposed approach is an improvement over the existing techniques in terms of values we get for different network performance parameters (jitter, delay, MOS, throughput).

VII. SIMULATION MODEL AND ANALYSIS

A. Simulation Scenario

An integrated scenario comprising of WLAN and WiMAX hot spots is developed. A special type of node called SS_WiMAX_WLAN_AP having dual stack and behaving both as WLAN AP and WiMAX subscriber station is used as an interface for integration. This node at the same time behaves both as the Subscriber Station of the WiMAX network and Access Point of the WLAN hot spot and acts like a bridge. ASN anchored mobility is used for handoff, for which GRE Tunnels are set up between the Base Stations and the ASN Gateway.

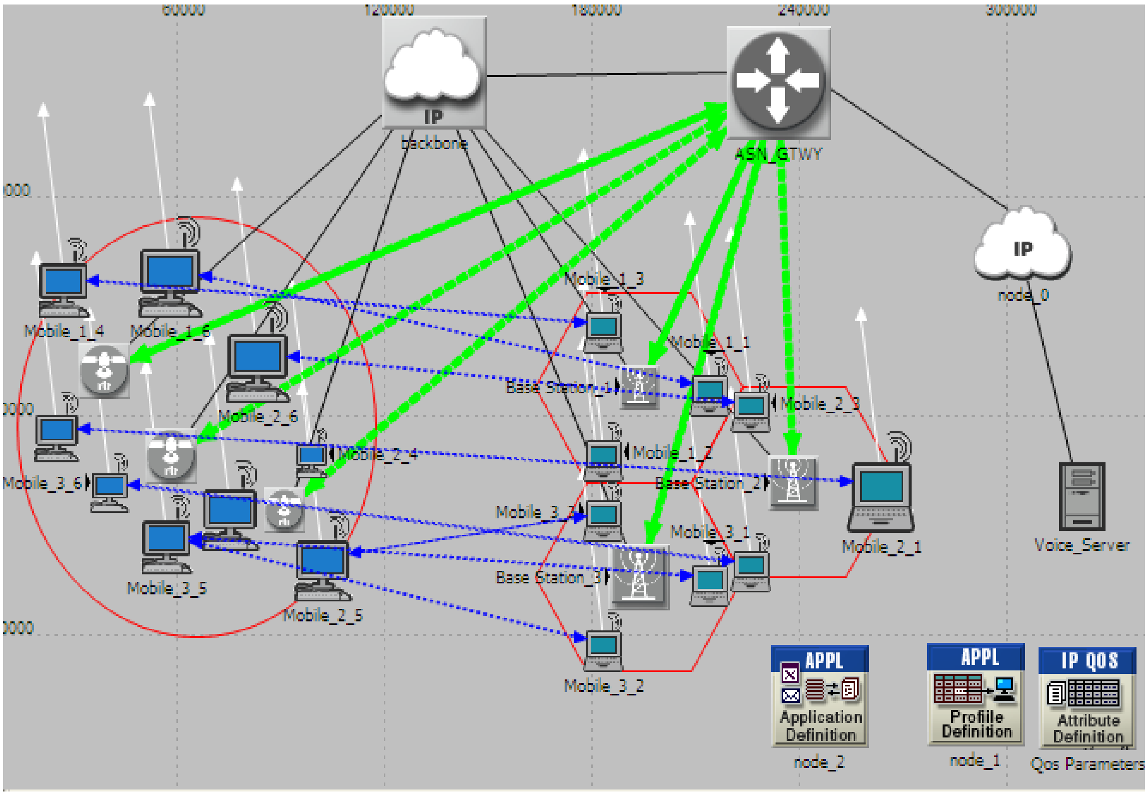

Fig. 6 A Heterogeneous Network

B. Simulation Parameters

The principal objective of this simulation is to analyse the performance of the network under different QOS Profiles. Accordingly, it is important to select appropriate simulation parameters and the network configuration. All the parameters used for performing experiments are presented in tabular form in Table I.

TABLE I

SIMULATION PARAMETERS

Parameters	**Value**
OFDM PHY Profiles(default)	Wireless OFDMA 20 MHz
Transmission Power(Watts)	0.5
Modulation and Coding	QPSK ½
Traffic Type	VoIP
Service Class	Gold
Scheduling Type	UGS
Pathloss Parameter	Vehicular
Network Size(No. of Nodes)	18 (3 nodes/cell)
Mobility Speed (Km/h)	10,40,70
Mobility Pattern (Trajectory)	Random Waypoint Mobility Modelling
Simulation Time	30 Minutes (1800 Seconds)
Handoff	Enabled

C. Results

The following graphs were obtained after running the above described simulation scenario.

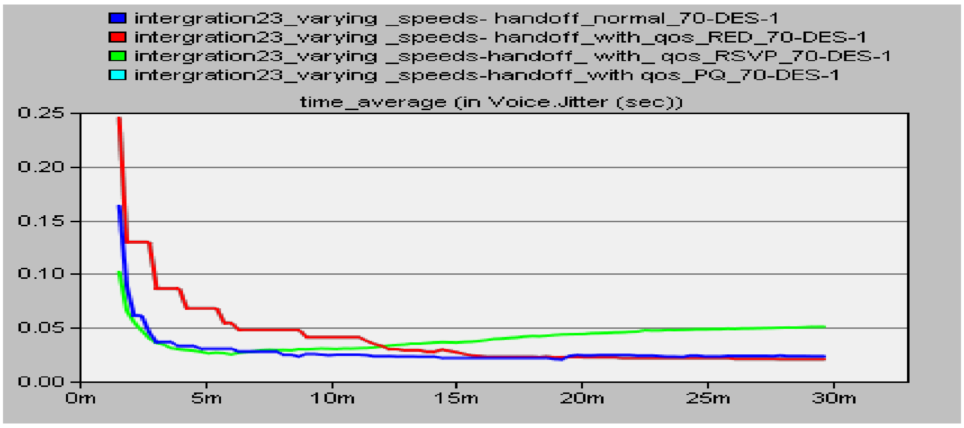

Fig. 7 Jitter at 70 km/h

Jitter is the variation of delay of each packet .It is measured by the variance of time latency in a network. Fig.7 shows that that when mobile nodes move at a speed of 70 km/h in a heterogeneous network, the value of jitter is minimum in case of RED which is required for good voice quality. So for application services which require low jitter RED is the optimum choice.

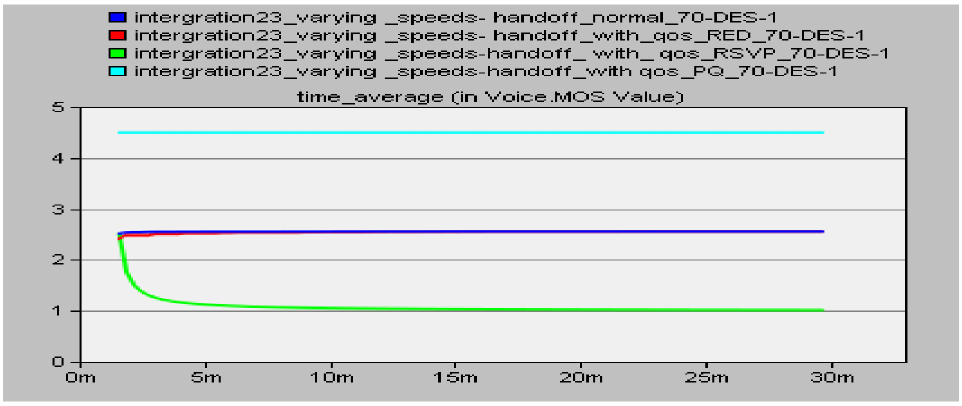

Fig. 8 MOS at 70 km/h

MOS (Mean Opinion Square) specifies the quality of voice as received at the destination, MOS is expressed in one number, from 1 to 5, 1 being the worst and 5 the best. As seen in the Fig. 8 application of PQ gives us the best value of MOS when compared to other profiles.

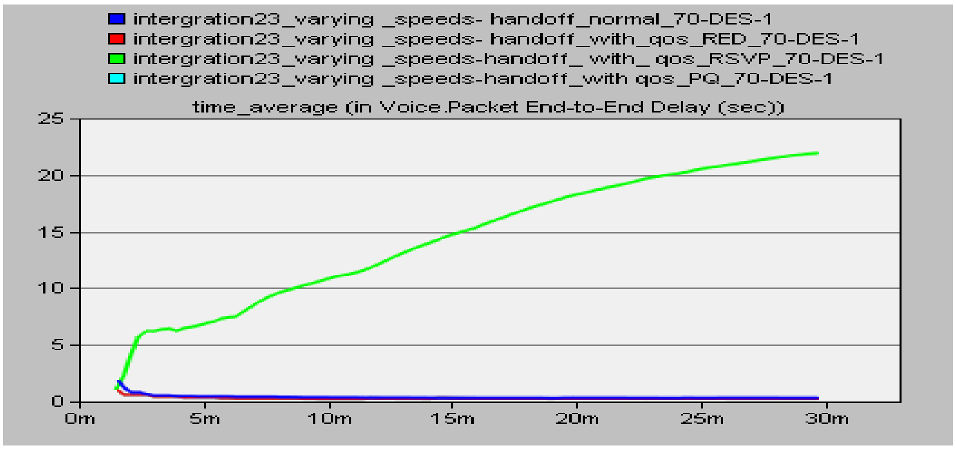

Fig. 9 End to end delay at 70 km/h

End-To-End Delay refers to the time taken for a packet to be transmitted across a network from source to destination. As seen in Fig. 9 delay is minimum in case of RED thus providing us good QOS.

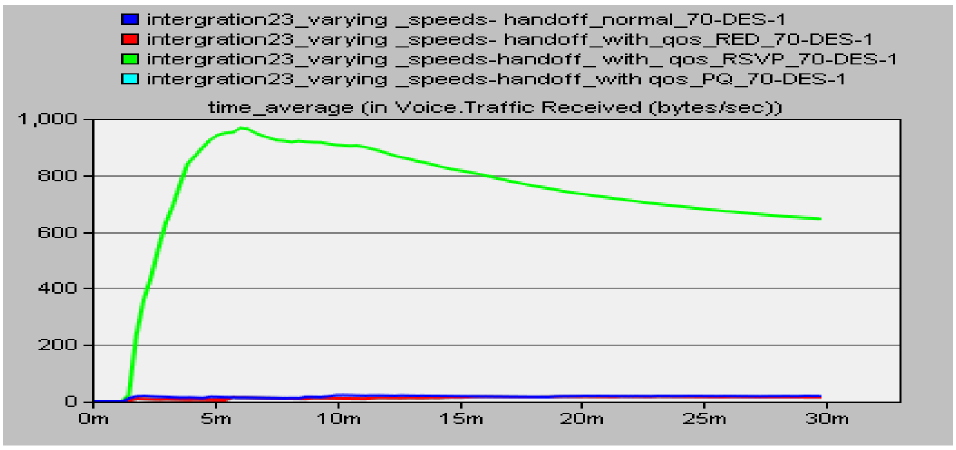

Fig.10 Throughput at 70 km/h

Throughput is measure of number of bytes successfully delivered in a network. As seen in Fig. 10 the throughput in case of RSVP is maximum in comparison to other profiles.

VIII. CONCLUSION

In this research work we have formed a heterogeneous network by integrating two different networks (WLAN and WiMAX) and presented a vertical handoff scheme using ASN –GW. For performance evaluation VoIP application is chosen and we have also taken node mobility into account. An attempt was made to provide seamless handoff in the network. We have done addition of the QOS Profiles (RSVP, PQ, RED, CQ) at the interface of ASN gateway which resulted in the improvement over the existing handoff techniques .Close observation reveal that application of RED resulted in low jitter, applications that require best quality of voice at the destination should use PQ as it gives consistent improved voice quality. RED is also the optimum choice for those real time applications that are delay sensitive. No matter speed of mobile nodes increase RED will provide the minimum end to end delay. If the application is required to have high throughput then RSVP is the best choice as it reserves resources such as bandwidth etc in advance, thus gives us good performance in terms of throughput.

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REFERENCES

1) Bathich, A.A.; Baba, M.D.; Ibrahim, M.; “IEEE 802.21 Based Vertical Handover in WiFi and WiMAX Networks”, *IEEE Symposium on Computers & Informatics*, pp. 140-144, 2012.
2) Bhosale, S.K.; Daruwala, R.D.; “Simulation of Vertical Handover between WiFi and WiMax and its Performance Analysis-An Installation Perspective”, *Annual IEEE India Conference*,Vol. 2:3, pp. 1-4, 2011.
3) E.Gustafsson, and A. Jonsson, “Always Best Connected”, *IEEE Wireless Communications*, Vol.5 Issue 6 pp. 49-55, February 2010.
4) E.P. Edward and Dr. V.Sumathy, “A Novel Scheme to Support WiMax/WiFi Vertical Handoff using SIP”, *Global Journal of Computer Science and Technology*, Vol. 10 Issue 6 Ver. 1.0 ,pp. 8. July 2010.
5) E.Stevens-Navarro and V.W.S. Wong, “Comparison between Vertical Handoff Decision Algorithms for Heterogeneous Wireless Networks”, *Proceedings of IEEE Vehicular Technology Conference* (VCT-06), Melbourne, Australia, pp. 947-951, 2009.
6) F.Siddiqui and S.Zeadally, “Mobility Management across Hybrid Wireless Networks:Trends and Challenges”, *Computer Communications*,Vol.4 Issue 7,pp. 1363-1385, May 2013.
7) G.Fodor, A. Eriksson, and A. Tuoriniemi, “Providing Quality of Service in Always Best Connected Networks”, *IEEE Communications Magazine*, Vol. 41,No. 7,pp. 154-163,July 2012.
8) Jaeho Jo and Jinsung Cho; “A Cross-layer Vertical Handover between Mobile WiMAX and 3G Networks”, *International Wireless Communications and Mobile Computing Conference* , Vol. 12:3, pp. 644-649, 2010.
9) Kangwook, B.J.; “A Study of the Impact of Traffic Type and Node Mobility on the Performance of an IEEE 802.16 WiMAX” *In Proc. Winter Simulation Conference*,, pp.1141, 2011.
10) Khan, M.M.A.; Ismail, M.F.; Dimyati, K.;“Seamless Handover between WiMAX and UMTS”,*IEEE 9th Malaysia International Conference on Communications*, Vol.11:1,pp. 826-830, 2009.
11) Latif, M.A. and Khan, A.A.; “Quality of Service during Vertical Handover In 3g/4g Wireless Networks”, *IEEE Communication Magazine* pp. 1-68, Feb 2011.
12) M. Stemm, and R. Katz, “Vertical Handoffs in Wireless Overlay Networks”, *ACM Mobile Networking, Special Issue on MobileNetworking in the Internet*, Vol. 3,Issue 4, pp. 335-350, 2013.
13) Mohamed Lahby, Leghris Cherkaoui, Abdellah Adib,” New Optimized Network Selection Decision In Heterogeneous Wireless Networks”, *International Journal of Computer Applications* Volume 54 , No. 16, pp.975 – 8887, September 2012.
14) M. Ylianttila et al., “Optimization scheme for Mobile Users Performing Vertical Handoffs between IEEE 802.11 and GPRS/EDGE Networks”, *Proc. of IEEE GLOBECOM’01*,San Antonio,Texas,USA,Vol 4,Issue 9,pp. 3439-3443, Nov 2012.

