International Journal of Science and Research (IJSR)
ISSN: 2319-7064
SJIF (2019): 7.583

Survey of Seamless Vertical Handoff Schemes for WiFi/WiMAX Heterogeneous Network

Ajmal Mohammed V M[1], Prapu Premanath[2], Lalji Cyriac[3]

[1]College of Engineering Vadakara, Kozhikode-673105, Kerala, India
ajmalvm[at]gmail.com

[2]College of Engineering Vadakara, Kozhikode-673105, Kerala, India
prapupnath[at]gmail.com

[3]College of Engineering Vadakara, Kozhikode-673105, Kerala, India
clalji[at]gmail.com

Abstract: ***The next generation Wireless network will consist of several overlapping technologies. One of the most important issue in wireless and mobile communication technologies is to provide uninterrupted services and minimum handoff time even though the mobile node (MN) moves across areas covered by different access technologies. It is also beneficial to use heterogeneous handoff to achieve cost effective spectrum utilization by optimally using different connectivity for suitable mobile trajectories and profiles. To achieve the above objective and increase the roaming distance we use vertical handoff mechanism between two heterogeneous networks. Here in this paper we have taken WiFi/WiMAX heterogeneous network into consideration and reviewed different handoff mechanisms used in different papers. In the papers surveyed herewith the mobile node (MN) supports both IEEE 802.11 and IEEE 802.16e interfaces. This paper reveals the pros and cons of each paper and help to adopt a better scheme for next generation wireless network.***

1. Introduction

With the development of wireless communication technology the next generation MN has to move around different access technology. Handoff is the mechanism that enables this feature. Handoff mechanism can be broadly classified into two

a) Horizontal handoff: It is the process of handoff that occurs during the movement of a mobile station among homogeneous base stations, i.e. BSs of same wireless standard. Based on the homogeneous network protocols, generally soft-hand-off process is followed, i.e. there is no disconnection during the process of handoff. This is shown in Fig.1 where horizontal handoff process occurs between BS_A and BS_B.
b) Vertical handoff: It is the process of handoff that occurs during the movement of a mobile station among the heterogeneous base stations, i.e. BSs of different wireless standards. Due to the packet formats of Layer2 and Layer3 and the differences between the communication protocols, there will generally be a disconnection during the process of handoff. This is shown in Fig. 1, where a vertical handoff occurs between BS_C and AP_D.

IEEE 802.16 WiMAX (Worldwide Interoperability of micro wave access) is a evolving wireless technology to provide coverage for metropolitan area with a radius of 25 kms. The limited coverage range of typically 500 metres for WiFi (Commonly known as WLAN) makes it difficult to provide "always on" connectivity services at any time, any where. It is economically infeasible to use a WiMAX base station for small cells or office. Hence we consider the heterogeneous combination of WiFi and WiMAX to provide both indoor /local and Medium distance/outdoor wireless connectivity.

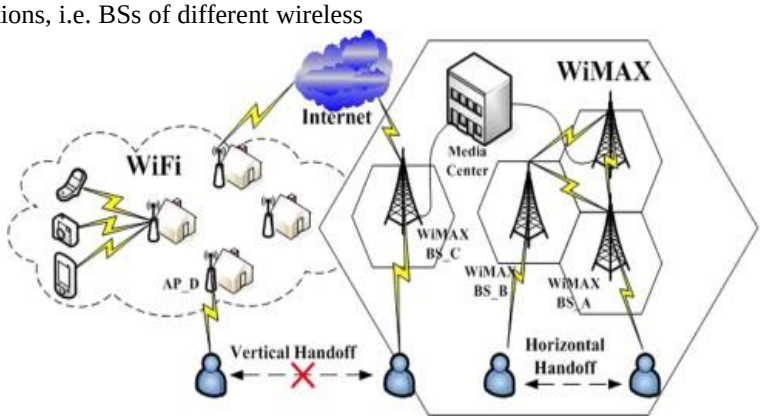

Figure 1: Vertical Handoff Horizontal Handoff illustration

2. Technology Overview

A. WiFi Overview

The IEEE 802.11 standard provides low cost and effective wireless LAN service. The deployment of high Speed network (11Mbps in 802.11b and 54Mbps in 802.11a/g) can be easily established by the free and unlicensed spectrum (2.4GHz in 802.11b/g and 5GHz in 802.11a). The IEEE

802.11b standard is one the most commonly used standards for the WLAN. There are 11 available channels in this standard and 3 of them are non overlapping channels. On the PHY layer, it employs the Direct Sequence Spread Spectrum (DHSS) technique with Complementary Code Keying (CCK) modulation scheme. This standard operates in two modes, namely Ad Hoc Mode and Infrastructure Mode. The Ad-hoc mode of operation allows the computing devices within range of each other to discover and communicate in peer-to-peer fashion without involving central access points. In an Infrastructure type of a WLAN, a structured approach is adopted with an Access Point to connect to all computing devices in it's coverage area.

B. WiMAX Overview

WiMAX is a new emerging Wireless technology based on the IEEE 802.16 standard. Its main objective is to provide broadband wireless access over long distances. WiMAX base stations can offer greater wireless coverage of about 5 miles, with LOS (line of Sight) transmission within bandwidth of up to 70mbps.The most popular WiMAX standards are IEEE 802.16d and IEEE 802.16e. The IEEE 802.16d proposed in 2004 by WiMAX Forum supports fixed PMP wireless connectivity and it does not support mobility. The IEEE 802.16e standard proposed in 2005 introduced to support low-speed mobility. WiMAX operates in three modes, Point to Point, Point-to-Multi Point (PMP) and Mesh mode. Wimax is rarely used for Point to Point links. In PMP mode every Mobile Station (MS) makes its own connection to the Base Station (BS), whereas in Mesh-mode every MS gets connected to BS through other MS. The Physical layer of WiMAX is based on the RF technology called OrthogonalFrequency Division Multiple Access (OFDMA). The inclusion of MIMO (Multiple Input Multiple Output) antenna techniques along with flexible sub-channelization Schemes enables the Mobile WiMAX technology to provide high data rates, larger coverage and better performance.

3. WiFi/WiMAX Handoff Scheme

3.1Advanced seamless vertical handoff architecture for WiMAX and WiFi heterogeneous networks with QoS guarantees, Yu-Chang Chen , Ja-Hsing Hsia, Yi-Ju Liao, Computer Communication February 2009

This paper proposes VHTC (Vertical Handoff Translation Centre) architecture using EBBM (Efficient Bandwidth Borrowing Module) in order to deal with packets translation processes and QoS Mapping. As to vertical handoff between heterogeneous wireless networks, a HPHWN (Handoff Procedure over Heterogeneous Wireless Networks with QoS Transparency Guarantees) is presented to achieve an advanced seamless heterogeneous network and reduced handoff delay. HPHWN is introduced for vertical handoff in heterogeneous wireless networks and admission control process. Continuously, PTM (Packet Translation Module) copes with packets format translation. After translating, the data connections will be classified by QoS Mapping module. Then, the bandwidth disposition will be controlled by EBBM based on the classes of priorities with a view to obtain the greatest bandwidth utilization.

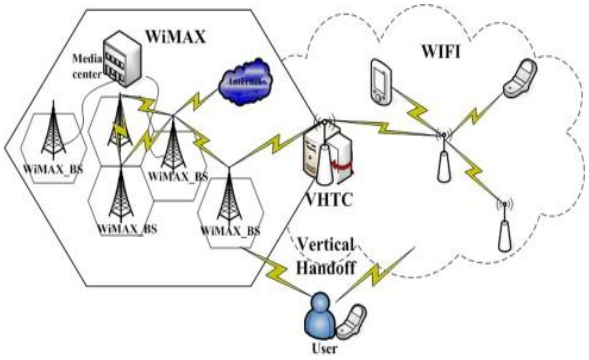

Figure 2: Advanced Seamless Heterogeneous Wireless Network Architecture

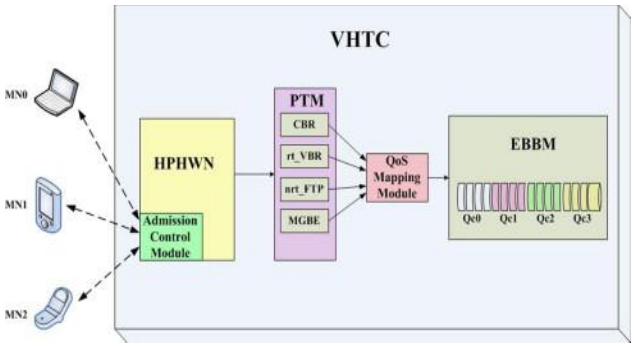

Figure 3: VHTC control flow

3.2 VHO strategy for QoS provisioning in the WiMAX/WLAN interworking system, M. Ismail, K. Jumari, Asian Journal of Applied Sciences October 2009

*T*he proposed algorithm for VHO as shown in Fig.4 aims to improve the performance and reduce the call blocking probability of mobile WiMAX network when they are no enough resources by utilizing the WLAN hot spots. This paper aims to improve the performance and reduce the call blocking probability of the mobile WiMAX by using two strategies.

1) Transfer the request from WiMAX user to WLAN if the user is within the WLAN coverage.

Figure 4: Proposed VHO

2) When the WiMAX user is outside the WLAN coverage we transfer the other WiMAX users who are inside the WLAN coverage to WLAN network and allocate the released resources in WiMAX network for the user under consideration.

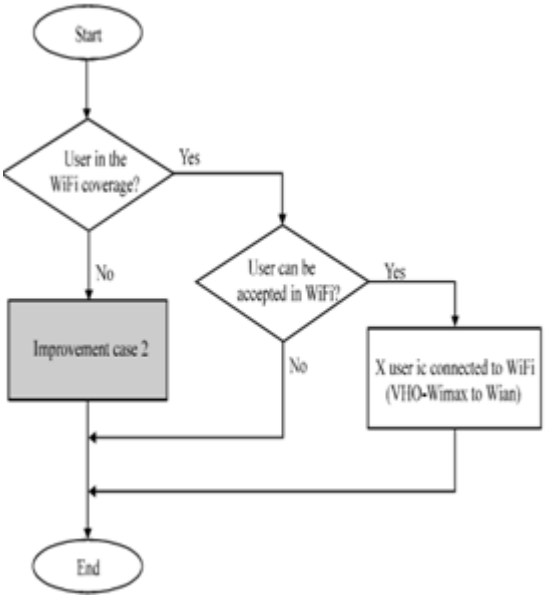

Figure 5: Stratergy 1

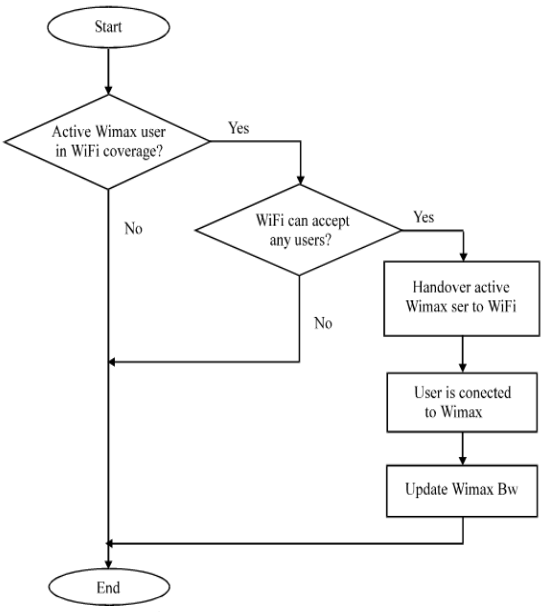

Figure 6: Strategy 2

3.3 End-to-End Mobility Solution for Vertical Handoff between Heterogeneous Wireles Networks,Iyad Alkhayat , Anup Kumar, Salim Hariri, Wireless Communications and Networking Conference (WCNC), IEEE October 2010

In this MN proactively monitors all the current and alternative link connections in order to choose highest quality link connection. The collected information will be

1) Interface MAC address
2) Delivery IP address
3) MN ID
4) Time stamp

Communication server maintains a tracking table for each MN which include

1) MN ID
2) MAC address of NICs
3) IP address of NIC
4) Master IP address

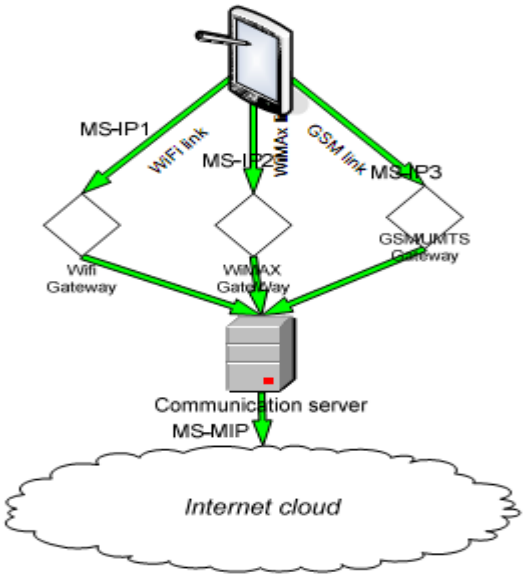

Figure 7: MN/Server architecture

3.4 Efficient Handover among WiMAX and WiFiHaidarali K. Ansari, Nilesh K. Modi, Manoj N. Modi, International Journal Of Computer Science and Application April 2011

The proposed scheme focuses on the handover between WiFi and WiMAX. Two RADIUSs servers, are used. One belongs to the WiFi network, named R11, and the other belongs to the WiMAX network, named R16. In addition, we assume that a MS has registered at one wireless environment, and is preparing to Handover to another wireless environment. The overall handover processes are classified into three phases and are described as follows.

1) First Phase
   At the beginning, a Mobile Station has registered and been authenticated with R11 by performing PACP. After executing the authentication process, R11 and the MS will share a master session key, MSK. R11 will relay the MSK to AP for further access between AP and the MS. Once the handover occurred, the preceding handover steps will be transferred first, such as measurement report, information query, link going down indication, scan for candidate network, resource availability check, target notification, resource reservation and establish new L2Connection. Due to the in sensitiveness of this information, they are not encrypted.
2) Second Phase
   WiFi and WiMAX have their own authentication and key exchange mechanisms. The IEEE 802.16 Standard adopts PKMv2 while IEEE 802.11 Standard adopts PACP. However, both of the PKMv2 and PACP execute EAP to generate a Master Session Key. In other words, MSK is the most important key used by PKMv2 and PACP. Nevertheless, generating MSK through EAP method consumes the most of time at authentication and key exchange phase. When a MS request for handover, the MSK used in the serving network will be transferred to the candidate network. By re-using the prior MSK, the EAP method can be omitted. After executing the preceding handover steps, AP and ASN gateway mutually establish an IPsec Tunnel. By using the IPsec Tunnel, AP and ASN gateway can securely communicate with each other. Then AP transfers the MSK used in WiFi network to the ASN gateway of WiMAX network via the IPSec Tunnel. After that, the sub-keys such as Pair wise Master Key (PMK) and Authentication Key (AK) can be generated by the MS and the ASN gateway as well as PKMv2 can be executed. Since WiMAX directly adopts the MSK used in WiFi, it need not execute the entire PKMv2, rather it just executes the rest steps that achieve the seamless character.
3) Third Phase
   Finally, “Establish new L2 connection” is finished, and the traffic flow is re-established. Now, the whole handover from WiFi to WiMAX is completed. The MS has successfully handover to the WiMAX network. The candidate PoS becomes new serving PoS.

4. Conclusion

4.1 Advanced seamless vertical handoff architecture for WiMAX and WiFi heterogeneous networks with QoS, Yu-Chang Chen, Ja-Hsing Hsia, Yi-Ju Liao, Computer Communication February 2009

Merit	Demerit
1.Connectivity between MN under Heterogenous nodes is possible.	1. It needs additional Hardware
2. It prevents starvation of low priority Q by reservation method.	2. If the source MN and destination MN are in different networks, then handoff time is high

4.2.VHO strategy for QoS provisioning in the WiMAX/WLAN interworking system, M. Ismail, K. Jumari, Asian Journal of Applied Sciences October 2009

MERIT	DEMERIT
1.Minimum Handoff Latency	1. Lack of central coordination introduces unnecessary wastage of bandwidth.
2.Minimum Packet loss	2 .Medium scalability 50 for WiMAX and 20 for WLAN..

4.3 End-to-End Mobility Solution for Vertical Handoff between Heterogeneous Wireless Networks, Iyad Alkhayat, Anup Kumar, Salim Hariri, Wireless Communications and Networking Conference (WCNC), IEEE October 2010

Merit	Demerit
1. It is a proactive approach.	1. Not Concerned with QoS of the system.
2. Minimum packet loss	2. Due to periodic broadcast about link quality consumes additional bandwidth.

4.4 Efficient Handover among WiMAX and WiFi, Haidarali K. Ansari, Nilesh K. Modi, Manoj N. Modi, International Journal Of Computer Science and Application April 2011

MERIT	DEMERIT
1. Highly secure.	1. Authentication delay is larger.
2. No need of additional hardware.	2. Starvation of low priority packet may occur.
	3.It uses FMIPv6 so scalability is medium and handoff latency is about 352ms

References

[1] Yu-Chang Chen, Ja-Hsing Hsia,Yi-Ju Liao, ” Advanced seamless vertical handoff architecture for WiMAX and WiFi heterogeneous networks with QoS” *Computer Communication*, February 2009
[2] M.Ismail, K.Jumari,”VHO strategy for QoS provisioning in the WiMAX/WLAN interworking system”, *Asian Journal of Applied Sciences*, October 2009
[3] Iyad Alkhayat , Anup Kumar, Salim Hariri,*”*End-to-End Mobility Solution for Vertical Handoff between Heterogeneous Wireless Networks*”,Wireless*

*Communications and Networking Conference (WCNC),*IEEE October 2010.
[4] Haidarali K. Ansari, Nilesh K. Modi, Manoj N. Modi, "Efficient Handover among WiMAX and WiFi", *International Journal Of Computer Science and Application,* April 2011
[5] Anshul Thakur, "vertical handoff algorithm for heterogeneous networks", *The International Journal of Computer and Telecommunications Networking*, April 2011
[6] Philip Branch, "Conservative Soft Handoff for Heterogeneous Wireless Networks", *Wireless Communications and Networking Conference (WCNC),* IEEE October 2010
[7] E.Prince Edward, Dr. V. Sumathi," "A Survey Of Seamless Vertical Handoff Schemes For Wi-Fi/WiMAX Heterogeneous Networks", *Signal Processing and Communications (SPCOM) International Conference*, November 2010
[8] Wi-FiIEEE802.11, http://en.wikipedia.org/wiki/802_11
[9] WiMAX Forum, http://www.WiMAXforum.org