International Journal of Electronics Communication and Computer Engineering
Volume 4, Issue 1, ISSN (Online): 2249–071X, ISSN (Print): 2278–4209

Survey on Seamless Vertical Handover between Wi-Fi and WiMAX Networks Using RSS and Motion Detection

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Abstract **- In today's world network has become as important as basic needs for human being. People may need internet connectivity to do their work even when they are on the go. For such people connectivity to network is very important and they expect uninterrupted services even when they move from one network to another or one place to another. Different wireless internet services are used by different users to connect to internet while they are on the go. In this information crazy world, everyone wants an uninterrupted, and quality of service for him. Different kinds of networks are used for getting connected to internet like Wi-Fi, WiMAX, GSM, etc. User may also wish to use different types of networks simultaneously. So, the process of switching from one network to another networks become important and critical for seamless internet connectivity.**

In this paper we are discussing implementation strategy for vertical handover between Wi-Fi and WiMAX networks. Wi-Fi provides Local Area Network for users and WiMAX provides broader network to users (MANs), but user expects his network access to be uninterrupted and he even want his session to be continued between this network switches.In this paper we also have considered a RSS and motion detection to decide the appropriate network for better seamless services.

Keywords **– Wi-Fi, WiMAX, RSS, Handover, WiMAX Overlay Networks.**

I. INTRODUCTION

Now days, users are expecting network connectivity wherever they go. This is not possible by using only single type of network or setting up only one Access point. Here comes concept of multiple types of networks in picture. Today, there are multiple networks exists all over the world like Wi-Fi, WiMAX, UMTS, GSM, etc simultaneously. For user to be able to access network services wherever he goes, he has to use multimode device. These devices are nothing but the device capable of accessing various kinds of networks. For this, we have to handover a device from one network to another network and this should be done without knowledge of the user. Hence the term "Seamless Handover" is used for above process. The process of connecting a mobile user to a new network access node and disconnecting from the node to which it is currently connected is called handover (or handoff) [1]. The process is called horizontal handover if the access nodes are from the same network; otherwise it is called vertical handover. Ideally, handover should occur seamlessly, without the user being aware that he/she has crossed a network boundary.

The vertical handover process is a three-stage process and takes a finite amount of time to complete [1]. The first stage is the network discovery stage where the user's mobile device identifies all the possible underlying networks it can use to access the Internet. This is followed by the handover decision stage, where the mobile device selects the network to switch to and the time to do so. The last stage is the handover execution stage when the mobile device switches over from its current network to the other network. For handover to be seamless, all these stages have to be completed prior to the mobile terminal leaving the coverage area of the access point to which it is currently connected to, otherwise the connection is dropped[1].

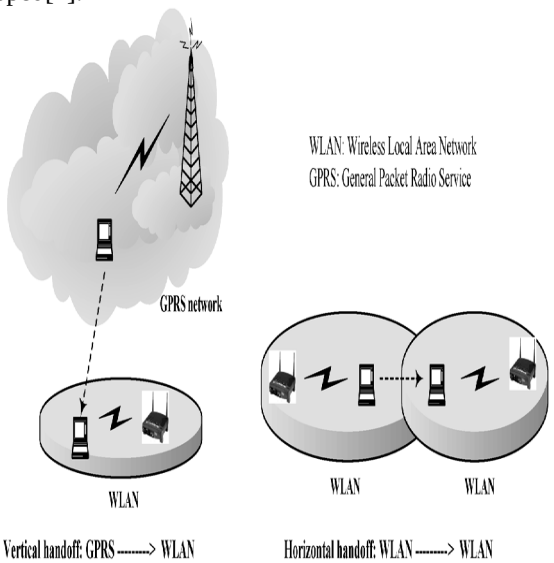

Fig.1. Handover Techniques

We divide vertical handoffs into two categories: an *upward vertical handoff* is a handoff to a wireless overlay with a larger cell size (and lower bandwidth per unit area), and a *downward vertical handoff* is a handoff to a wireless overlay with a smaller cell size (and higher bandwidth per unit area). A vertical handoff may be to an immediately higher or lower overlay, or the mobile host may "skip" an overlay. For example, a mobile may hand off from an in-room network directly to a wide-area network, or vice versa [2].

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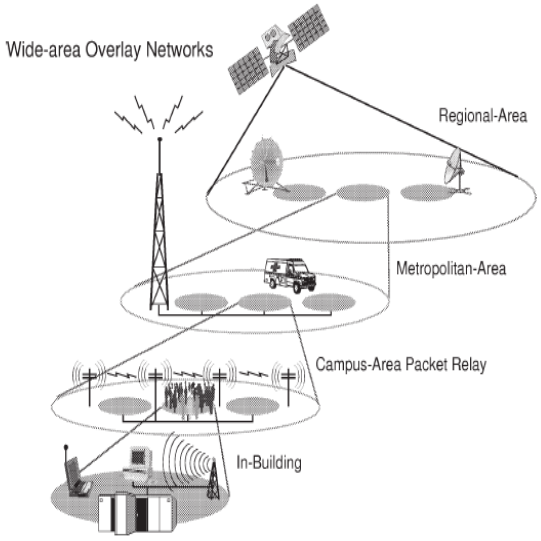

Fig.2. Wireless Overlay network

Figure 1 shows an example of a wireless overlay network. Lower levels are comprised of high bandwidth wireless cells that cover a relatively small area. Higher levels in the hierarchy provide a lower bandwidth per unit area connection over a larger geographic area. In our system, we have three overlay levels. The lowest level comprises a collection of disjoint room-size high bandwidth networks, which provide the highest bandwidth per-unit area: 1 Mbit/s or more per room. The second level consists of building-size high bandwidth networks that provide approximately the same bandwidth as the room-size networks, but cover a larger area (for example, a single floor of a building). The final level is a wide-area data network, which provides a much lower bandwidth connection (tens of kilobits) over a much wider geographic area [2].The integration of wireless-fidelity (Wi-Fi) and wireless metropolitan area networks (WiMAX) networks can combine their best features to provide ubiquitous access, while mediating the weakness of both networks[6].

II. Related Work

The importance of wireless communication is increasing day by day throughout the world due to cellular and broadband technologies. Everyone around the world would like to be connected seamlessly anytime anywhere through the best network. The wireless system must have the capability to provide high data transfer rates, quality of services and seamless mobility. When connections have to switch between heterogeneous networks for performance and high availability reasons, seamless vertical handoff is necessary.

Wi-Fi and WiMAX:

Wi-Fi stands for *Wireless Fidelity* is the name given by the Wi-Fi Alliance to the IEEE 802.11 suite of standards. We are assuming devices will use 802.11g standard for Wi-Fi connectivity [3]. Wi-Fi networks have limited range. WiMAX stands for Worldwide Interoperability for Microwave Access (WiMAX) is currently one of the hottest technologies in wireless. WiMAX operates on the same general principles as Wi-Fi. It sends data from one computer to another via radio signals. A computer (either a desktop or a laptop) equipped with WiMAX would receive data from the WiMAX transmitting station, probably using encrypted data keys to prevent unauthorized users from stealing access. The fastest Wi-Fi connection can transmit up to 54 megabits per second under optimal conditions. WiMAX should be able to handle up to 70 megabits per second. The biggest difference isn't speed; it's distance. The range of Wi-Fi is about 100 feet (30m) while range of WiMAX is 30 miles (50 km) with wireless access. WiMAX is not designed to clash with Wi-Fi, but to coexist with it [3]. When user terminal have to switch between the networks, there must be some mechanism provided for interfacing these two different kinds of the networks. This is shown in following figure.

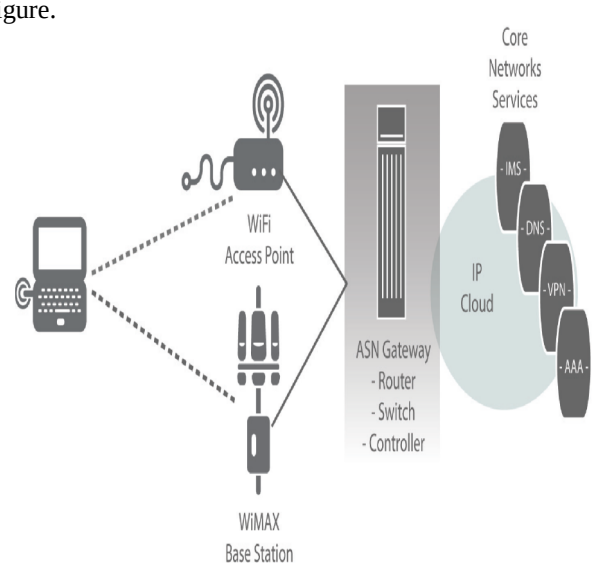

Fig.3. Wi-Fi and WiMAX interfacing

Either Wi-Fi or WiMAX terminal is connected to ASN gateway which in turn uses the different network services using different network agents like IMS, DNS, VPN, and AAA. IMS is an internet multimedia subsystem.DNS is called as Domain Name Server, VPN Virtual Private network and AAA is used for Authentication purpose also called as Authentication authorization and accounting agent [5]. After interfacing between two heterogeneous kinds of networks, handover process can be done.

The details of handoff operation following this approach are illustrated in Figure 4. Every time when a mobile station accesses either a WiMAX network or a Wi-Fi network, a Mobile IP tunnel is created between HA and FA, with the HA residing in the core network and the FA being located in a WiMAX Gateway or a Wi-Fi Gateway. All user data will go through the Mobile IP tunnel. In our solution, we developed a make-before-break handoff scheme, in which another Mobile IP tunnel will be established before the current tunnel in use is terminated.
In the network during a handoff operation, the user data would be switched live from the first Mobile IP tunnel to the other one, thus maintaining the connectivity from one wireless network to another. All of these operations are

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transparent to the mobile station and the end user as a result of using Mobile IP in such a make-before-break scheme [4].

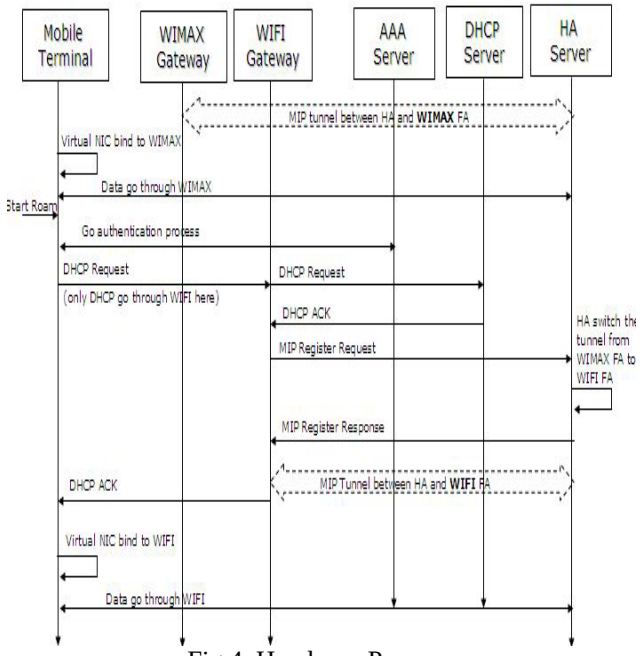

Fig.4. Handover Process

The decision about whether and when to do handover is based on different criteria's such as bandwidth, latency, battery power, BER (Bit Error Rate), user profile, etc [9]. The vertical handoff system gives mobile device the ability to roam freely in wireless overlay network with seamless transitions between networks with negligible interruption to application [2]. ALIVE-HO algorithm dynamically adapts to the mobile terminals velocity to decrease the un-necessary number of handoffs and "ping pong" effects. But by doing so, probability of handoff increases with the distance from AP (access point) [8] from studying this system, we conclude that we need to increase the transmitter power.

III. DESIGN

In this system the decision about initiating the handoff process is done based on two network parameters i.e. RSS (Received Signal Strength) and Motion Detection. Following Fig.5 shows the Flowchart of and algorithm proposed by Bushra Naeem and Able Nyamapfene in [1].

Most of strategies consider only RSS as an input for their algorithm but in this approach RSS along with motion detection is also considered.RSS is important parameter while making the handover but it is not sufficient on its own. The direction of the mobile user along with its speed also needs to be taken into account. MRSS (Moving RSS) is calculated by using this RSS and motion of the user terminal. This RSS along with direction are used to make the decision of handover initiation, decision and execution process so as to minimize the latency in handover process.

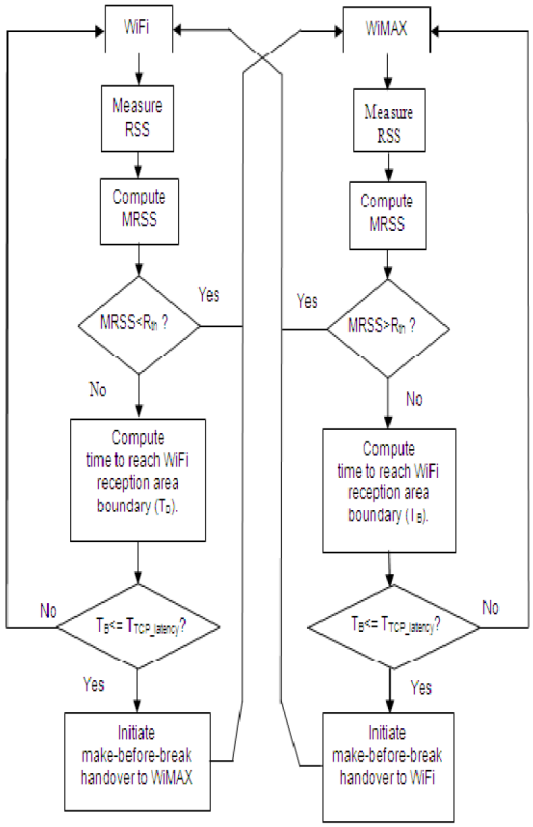

Fig.5. Flowchart of a Vertical handover between Wi-Fi and WiMAX

IV. PATH LOSS MODEL

The distance from the Wi-Fi reception limit at which the handoff process commenced is recorded for handoff latencies ranging from 100ms to 1100ms.This distance are the minimum possible distance, as determined by algorithm referred as a base for our project, for handoff to take place seamlessly [1]. The maximum reception distance from the Wi-Fi access point is obtained using the path loss equation:

$$PlossdB = 20\log10\ (4\pi/\lambda) + 10\rho\ \log10d \qquad \textbf{(1)}$$

Where *PlossdB* is the signal loss in dB between the transmitter and receiver; λ is the wavelength of the Wi-Fi signal; ρ is the path loss constant, and d is the distance between the between the transmitter and receiver.

The maximum reception distance for Wi-Fi reception occurs when the path loss, as computed by Equation 1 above equals the difference between the transmit power and the receiver sensitivity. Following [7], the uses of a Wi-Fi transmit power of +17dBm, an outdoor path loss factor of 2 and a receiver sensitivity of -76dBm is done for the experimental purpose. Substituting these values into Equation 1 gives a maximum reception distance of 994 meters. Our aim is to implement above system using NS2 (Network simulator tool).After analyzing the results of the system implemented proposed in base paper, optimize the algorithm give above.

V. FUTURE SCOPE

The Wi-Fi and WiMAX technologies are future of networking technologies that will be used by internet users to get connected to internet and access different services. Every user wants to use the internet connectivity in ABC (Always Best Connected) manner. Meaning of ABC is – a legitimate user should be able to access the internet services depending upon his need with minimum cost, minimum interruption and with high and reliable Quality of Services. To do so, the process of handover must be standardized and made efficient to increase throughput of data transfer. All the quality attributes can be taken into account depending upon the availability and need of services to the users with respect to cost. We can minimize the power requirement of the Wi-Fi and WiMAX sensors by switching of the other sensor of a user machine when node is not moving. This will result in reduction in bandwidth consumption by beacon messages which are used to check whether the Transmitting tower of Wi-Fi hotspot or WIMAX service terminal is available or not [2].

VI. CONCLUSION

WiMAX is said to be the future of networking. Hence the research on this topic is necessary and is of paramount important for the future technological development in the area of mobile computing and telecommunication services. A seamless Vertical handover between Wi-Fi and WiMAX wireless networks are possible solutions for the advanced generation wireless systems. The decision making algorithm is using the parameters like RSS and Motion are very important while making the decisions about the handover process to become efficient and seamless. Improvement in this algorithm is possible by doing research in the given context.

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