A Framework to Maintain Space Connection For Vertical Handover

S.M. Rawoof [1] P. Naga Prasad[2] Narsaiah Putta[3]

[1]Department of Computer Science, AUCOPH, Hyderabad, TS, India
[2]Department of Computer Science, NSAKCET, Hyderabad, TS, India
[3]Department of Computer Science, VCE, Hyderabad, TS, India

ABSTRACT

The Challenge of integration of wireless network is pervasive wireless access ability and seamless handover for mobile communications between different types of technologies such as UMTS, WiMAX, Wi-Fi and LTE. This Challenge is difficult as Mobile Users are demanding more for services in spite of difficulty of the technological complexities associated with them. This paper suggests a framework to offer solution to the above problem. This frame work is helpful in specifying the Seamless handoff requirements and to build up protocols to meet them.
Keywords: Vertical handoff, Radio Access Technology (RAT), VHO interworking, Media Independent Handover (MIH), Heterogeneous wireless access networks,

1. Introduction

The handoff is one of the essential issues in Wireless Communications and Heterogeneous Networks. The vertical handover is getting difficulty while quickly growing and demanding market of wireless communication. Handover is an essential factor in uphold space connection to base station even in high speed. A framework is available to support Vertical Handover Process that deal with both internal and external challenges.

2. Background of Vertical Handover Techniques

The Wireless Communications will consist of heterogeneous wireless access networks such as, Wi-Fi, UMTS, LTE and WiMAX. These different Radio Access Technologies have significant different capabilities in terms of coverage area, supported data rate for services, cost, etc [1]. For example, the UMTS provides high coverage area, high cost and data rate from 384 Kbps to 2 Mbps at 10 Km/h to maximum 500 Km/h depending on propagation channel condition while Wi-Fi provides low coverage area, low cost and high data rate from 54 Mbit/s to 600 Mbit/s (e.g., for 1 Mbps maximum the rate indoor is 100 m and outdoor is 450 m, for 54 Mbps the rate is 30 m indoor and 100 m outdoor) [1]. hence, complementarily to these technologies through Vertical Handover interworking architectures is essential to provide ubiquitous wireless access ability with high coverage area, high data rate and low cost to Mobile Users. To fulfill these requirements for seamless Vertical Handover many techniques were suggested for integration between the aforementioned technologies: interworking architectures, frameworks and mechanism are discussed as follows:

3. Interworking architecture

The interworking relationship includes connecting two or more different Radio Access Technologies (3rd Generation Partnership Project (3GPP and non-3GPP)) such as Wi-Fi, UMTS, WiMAX and LTE to allow Mobile Users to access these interworked networks and to maintain their ongoing sessions. VHO interworking architectures can be classified into two main approaches: loose coupling and tight coupling.

3.1 Loose Coupling

In loose coupling architecture, each of the existing access wireless networks such as UMTS, Wi-Fi and WiMAX is independently deployed [6]. Both of WiMAX and Wi-Fi data do not pass through 3GPP core network [9]. This in turn means there is no need to modify current architecture, no additional cost and the interworking point occurs after 3GPP core network in particular, follow Gateway General Packet Radio Service Support Node (GGSN) with internet [9]. The networks interconnection in this architecture also based on Mobile IP while for roaming service the AAA server connects between different Radio Access Technologies which allow the Wi-Fi and WiMAX data go directly to the internet without requiring for direct link between their components and 3GPP core network [9]. Figure.1 shows an example of loose coupling between UMTS and WiMAX.

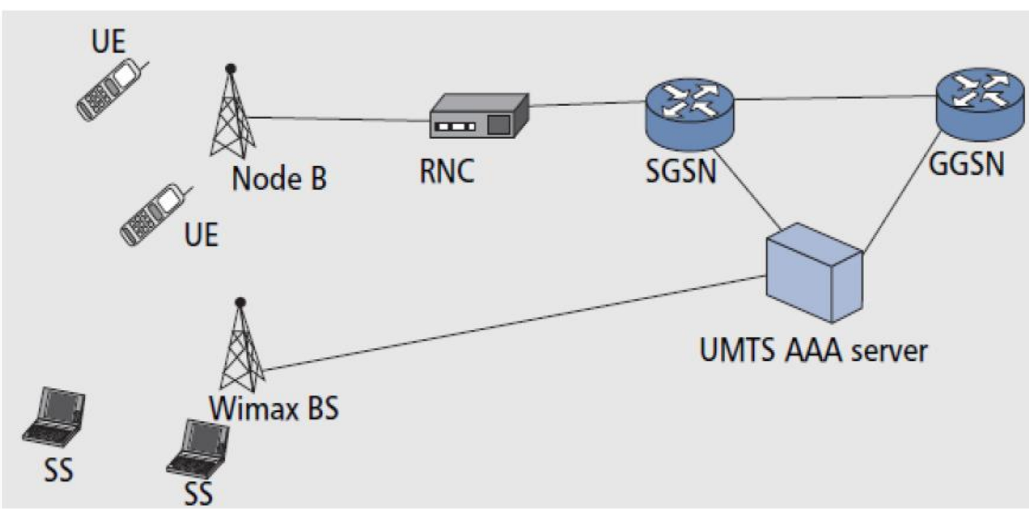

Figure 1: Loose Coupling Integration

3.2 .Tight Coupling

In tight coupling architecture, the Wi-Fi and WiMAX data pass through 3GPP core network before going to the internet and significant modifications of existing access wireless networks are necessary for providing seamless service to the Mobile user to move from one network to another [9]. This in turn impacts 3GPP core network performance in terms of complexity, congestion and packet loss due to overload [2]. The networks interconnection in this architecture is based on existing 3GPP core network functionalities (e.g., core network resources, subscriber databases and billing systems) that ensure Mobile User to continue their ongoing sessions when moving within different RATs [2]. There are two types of tight coupling [2, 9]:

3.2.1 Tight Coupling Integration at GGSN Level

In this architecture, all of Radio Access Technologies are connected together by Virtual GPRS Support Node (VGSN) which is responsible to exchange subscriber information and route packets between the wireless access networks, the handover duration (latency) is equivalent with loose coupling where Mobile IP is used (no need of Mobile IP functionalities) and it requires less complexity modification in 3GPP core network [7], this is shown in Figure.2
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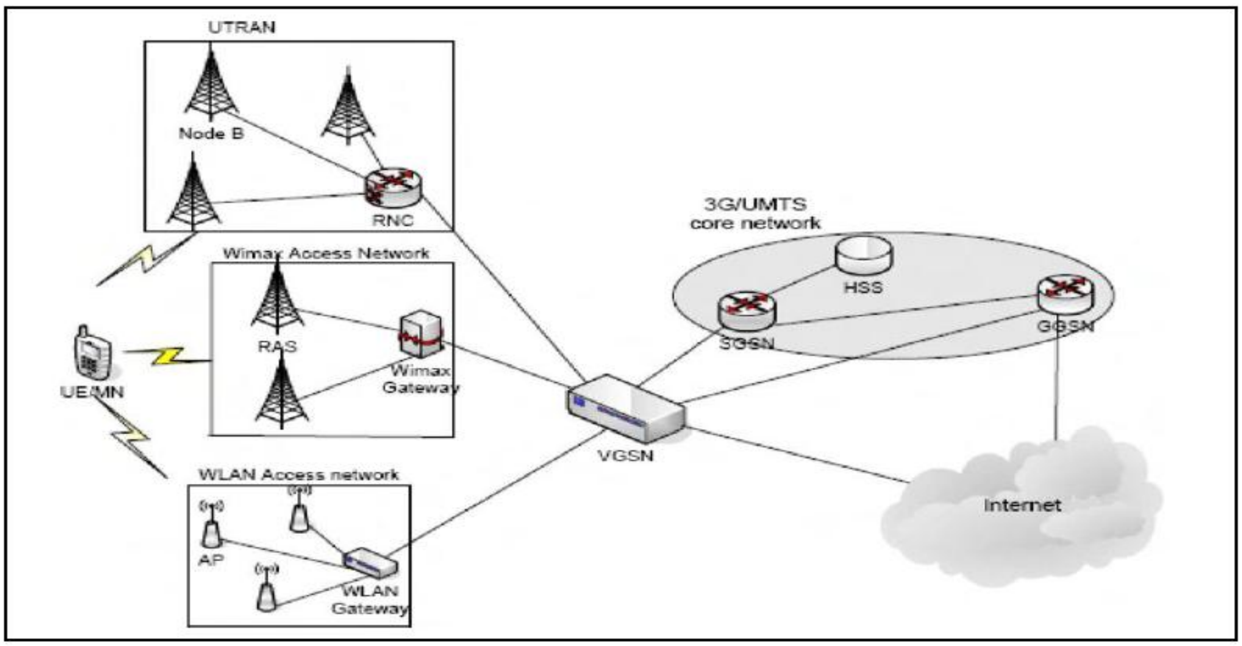

Figure 2: Tight Coupling Integration at GGSN Level

3.2.2 Tight Coupling Integration at RNC Level

In this architecture, the AP and BS in Wi-Fi and WiMAX respectively are connected with Radio Network Control (RNC) by Interworking Unit (IWU). The IWU main functionality is to translate protocol and signaling exchange between RNC and another RATs interface such as AP and BS [2], this is shown in Figure.3..

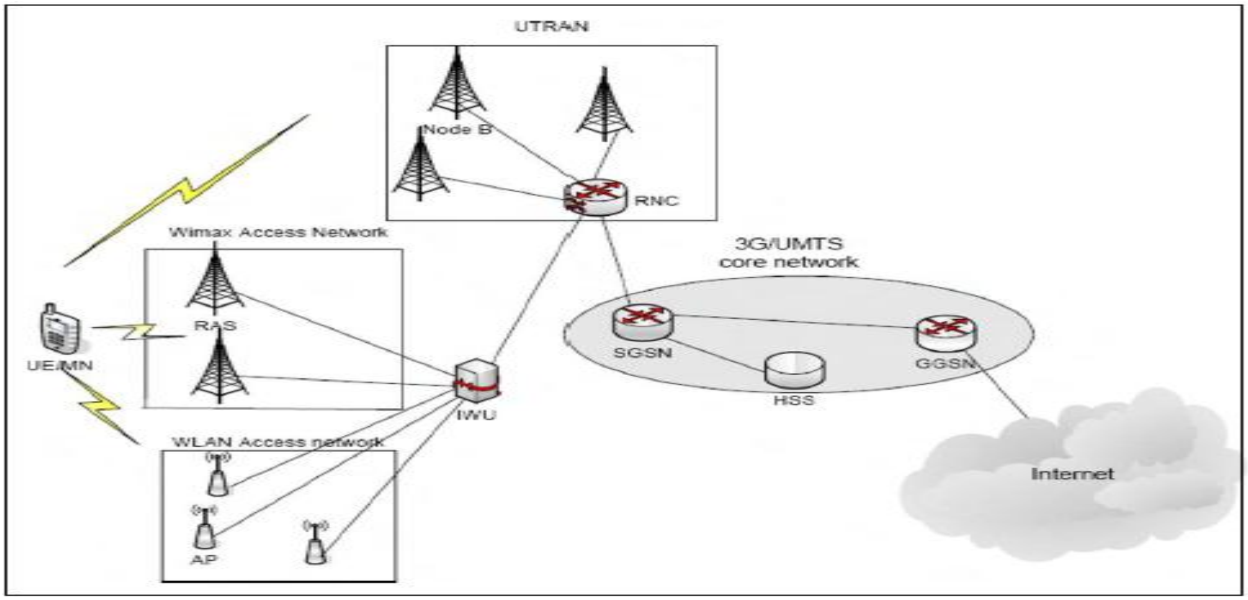

Figure 3: Tight Coupling Integration at RNC Level

4. Handover Techniques

As mentioned previously, heterogeneous wireless networks consist of multiple RATs; not one RAT only. Besides, there is no RAT that can provide simultaneously high data rate, high coverage area, low service cost and low latency to a large number of MUs. It is beneficial for MUs to switch their connections between different RATs in order to maintain their connectivity without interruption according to their preferences. To fulfill these requirements for seamless handover, many techniques were proposed for integration between different RATs and interworking frameworks.

5. THE APPROACH

Interworking Frameworks

One challenge of wireless networks integration is to provide ubiquitous wireless access ability and seamless handover for mobile communication devices between different types of technologies such as Wi-Fi, WiMAX, UMTS and LTE. This challenge is critical as MUs are becoming increasingly demanding for services regardless of the technological complexities associated with them. To fulfill these requirements for seamless VHO two main interworking frameworks were proposed by IEEE Group and 3GPP for integration between the aforementioned technologies; namely, Media Independent Handover (MIH) and IP Multimedia Subsystem (IMS) where each of them requires mobility management protocol to complement its work such as Mobile IP (MIP) and Session Initiation Protocol (SIP), respectively.

5.1 Media Independent Handover (MIH) Framework

The IEEE Group released IEEE 802.21 standard Media Independent Handover (MIH) in 2009 to provide seamless VHO between heterogeneous wireless networks that include both wireless (3GPP and non-3GPP) and wired media [10, 11, 12, 13, 14, 15, 16, 17, 18 and 19]. The IEEE

802.21 defines two entities; the first one, Point of Service (PoS) which is responsible for establishing communication between a network and the MU under MIH and the second one, Point of Attachment (PoA) which is Radio Access Technology (RAT) access point. The MIH also provides three main services: Media Independent Event Service (MIES), Media Independent Command Service (MICS) and Media Independent Information Service (MIIS) [20] such that the MIH relies on the presence of mobility management protocols (e.g., MIP and SIP), this is shown in Figure.5.

A. Media Independent Event Service (MIES)

It is responsible for detecting events and reporting them between the MU and the network (e.g., link up on the connection (established), link down (broken) and link going down (breakdown imminent)).

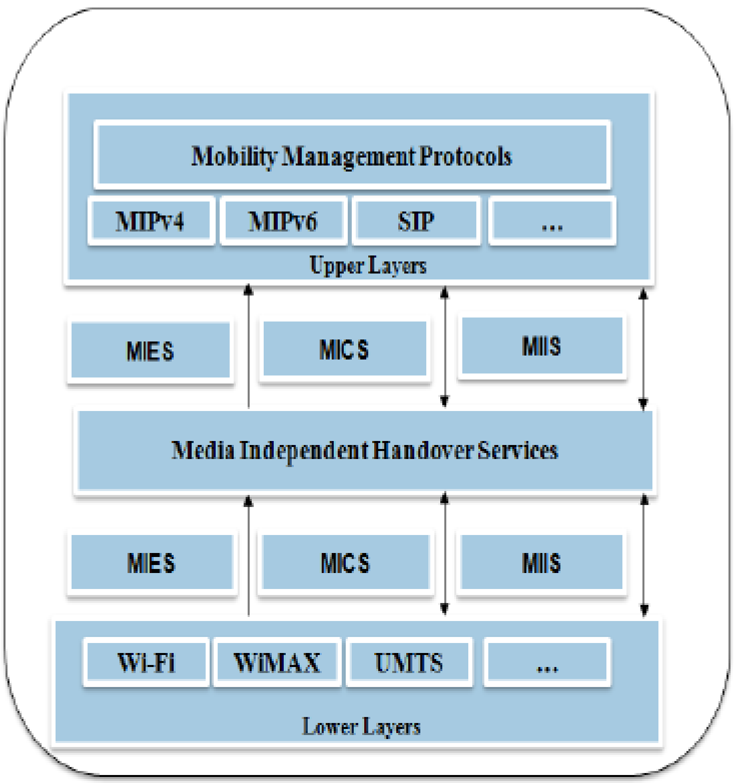

Figure 5: Media Independent Handover (MIH) [21]

B. Media Independent Information Service (MIIS)

It is responsible for collecting all information required to identify if the handover is needed or not and pass the information to MUs (e.g., available networks, locations, capabilities and cost), this is shown in Figure.6.

C. Media Independent Command Service (MICS)

It is responsible for issuing the commands based on information which is gathered by MIIS and MIES (e.g., MIH handover initiate, MIH handover prepare, MIH handover commit and MIH handover complete).

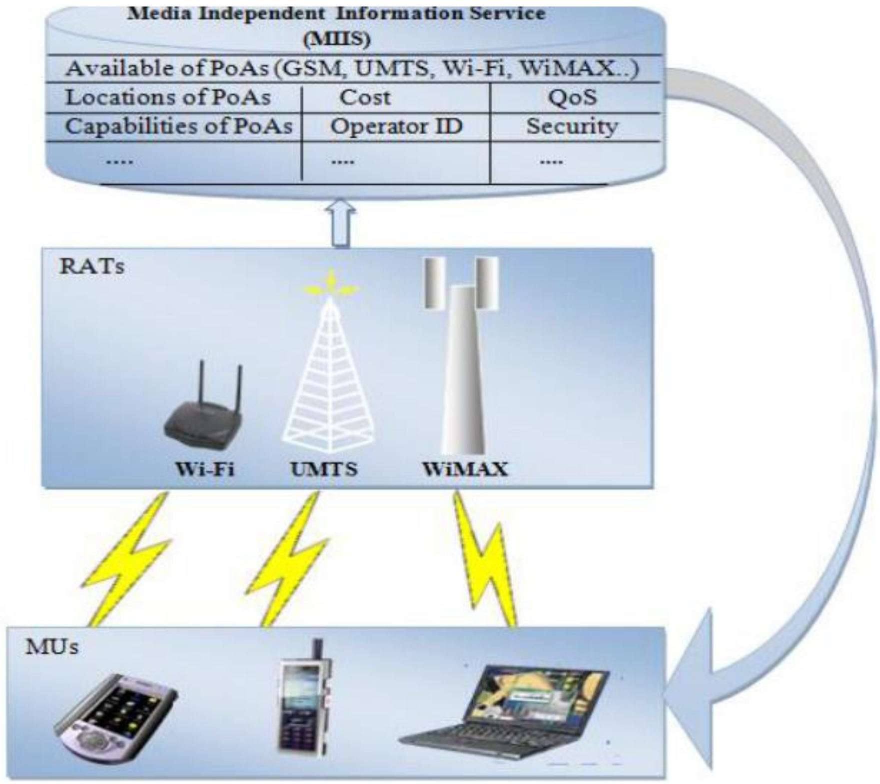

Figure 6: Media Independent Information Service (MIIS) Passing Information about Radio Access Technologies (RATs) to Mobile Users (MUs) [9]

However, no handover decision is made within MIH [2], "the actual algorithms to be implemented are left to the designers" [8] and the security for re-authentication at a target network and implementation of the decision algorithm are out of the scope of MIH [13].

5.2 IP Multimedia Subsystem (IMS) Framework

The IP Multimedia Subsystem (IMS) was introduced in 2002 by 3GPP (Released 5) to support multimedia services in UMTS [3, 4, 5 and 23] and provides access security to IMS. However, it started supporting multimedia service for both wireless (3GPP and non-3GPP) and wired networks in Release 7 [4]. The IMS is defined as a 3-layer architecture consisting of transport layer, control layer and application layer, this is shown in Figure.7.

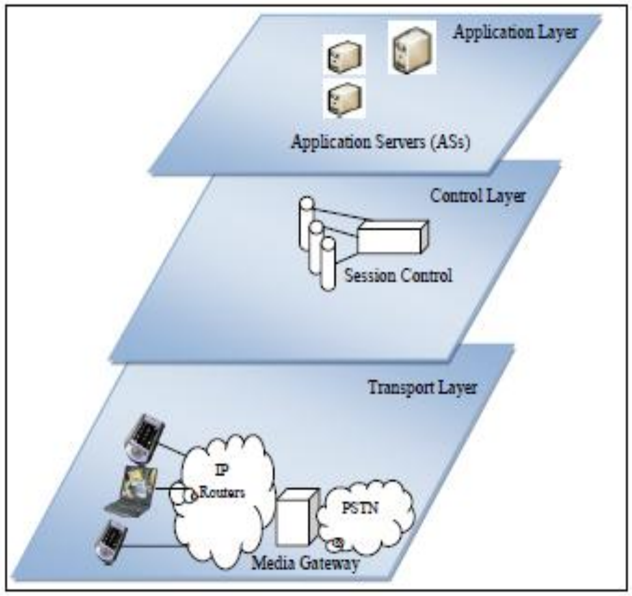

Figure 7: Application, Control and Transport Layers of an IP Multimedia Subsystem

A. Transport Layer

It includes all the entities for the supported access networks which allow IMS devices and MUs connect the IMS through many types of access networks (e.g., Wideband Code Division Multiple Access (WCDMA), UMTS, Wi-Fi, WiMAX, Ethernet and DSL). It also allows the IMS device to receive/send call either through PSTN or the Media Gateway (MGW) [5].

B. Control Layer

This layer includes three SIP signaling servers that are known as Call Session Control Functions (CSCFs) which are responsible for establishing, managing and terminating media sessions. It also includes other entities (i.e. HSS, Breakout Gateway Control Function (BGCF), Media Gateway Control Function (MGCF), Media Resource Function Controller (MRFC) and Multimedia Resource Function Processor (MRFP)) [5].

C. Application Layer

In this layer, the Application Server (AS) is responsible for hosting and executing all the services offered by IMS. However, in this framework, handover decision is out of its scope and unlike the MIH framework the MU obliges to discover neighbor cells with no assistance by periodically conducting a radio scanning in the background which results in [6]:

- Limited information is discovered.
- The MU needs two receivers work concurrently one for scanning and another for ongoing session while one receiver may be incurred probability of missing data from serving cell.
- High MU power consumption.

- Upgrades legacy cells (2G/3G) due to broadcast information about 4G neighbor cells such as WiMAX and LTE.

6. The Seamless Vertical Handover Requirement Analysis

Mobile Computing Requirements have no unnecessary handoffs , Small delay and packet loss **.** The focus of Vertical Handoff is to identify issues related to handoff between WLAN and WWAN. Handoff delay was about 600ms when switching from WWAN to WLAN. Handoff delay was about 1040ms when switching from WLAN to WWAN. Handoff delay-time elapsed between the last packet received on the old connection to the first packet received on the new connection. Minimum size cell sectors are $60^{0.}$. If we reduce size than 60^{0}, we require more antennas and more handovers. Sometimes your call drop or disconnect because unsuccessfully handoff. This comes as a part of quality of service.

More handoff are required if larger number of base stations are used. When a mobile moves into a different cell while the call is in progress, the MSC automatically transfers the call to a new channel belonging to the new BS. The handoff operation involves identifying a new BS and the allocation of voice and control signals associated with the new BS. Handoffs must be performed successfully, as infrequently as possible, and must be imperceptible to the user.

Handover requires co-operation between the mobile node and the network .A source of performance degradation needs to be carefully handled to be successful. If travel very fast, handoff time is very little as call might drop during handoff.
Handoff is made when the received signal at the BS falls below a pre-specified threshold. In deciding when to handoff, it is important to ensure that the drop in the signal level is not due to momentary fading. In order to ensure this, the BS monitors the signal for a certain period of time before initiating handoff. The length of the time needed to decide if handoff is necessary depends on the speed at which the mobile is moving

Handoff would happen between every cell and channel. Decision to handoff is based on the received signal strength or S/I ratio. Soft handoff is make before break means at the same time you should get the signal more than one base station .Care should be taken that you do not drop a call .Handover is a serious operation.

Handover is principally a technical issue: how to provide continuity of service as the service layer changes. As infrequently as possible means if each time I do handoff, I use overheads. In fact, there are overhead channels use for handoff alone .So it requires computation on the part of mobile switching center and two many mobile stations trying to do handoffs at the same time. The mobile switching center is down by number of computations it has to do.

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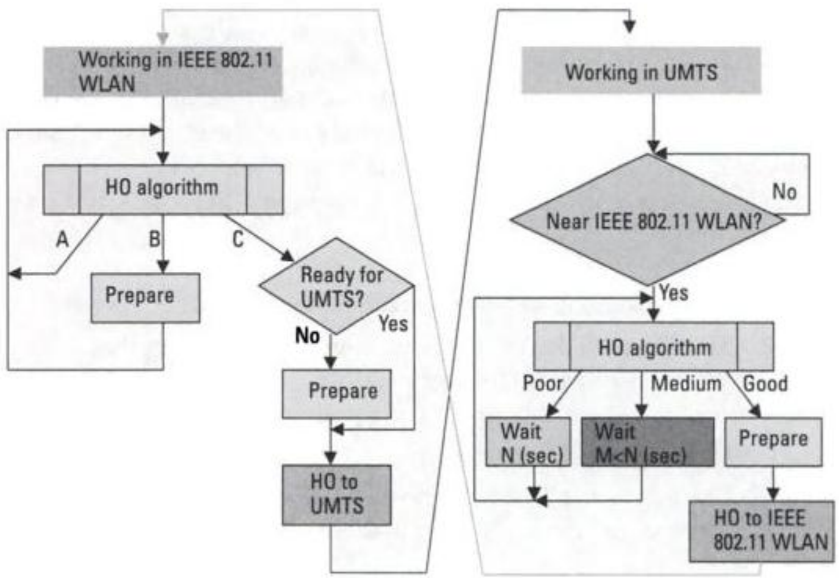

WLAN

Figure 8: Handover procedure between WLAN and UMTS

7. Conclusion

In this paper, we have first shown that techniques for integration between different Radio Access Technologies. We proposed the VHO interworking architectures in order to identify the research problems accurately. The loose couple VHO interworking architecture is more suitable to work with MIH and enhance its vital role in heterogeneous wireless network environment while the tight coupling with MIH requires future work improvements in terms of probability of packet loss, congestion, complexity, overload, additional modification and additional cost. We evaluated the impact of Framework for vertical handover. Mobile Users are becoming increasingly demanding for services regardless of the technological complexities associated with them. To fulfill these requirements for seamless VHO two main interworking frameworks were proposed.

8. Future Work

One difficulty of wireless networks integration is to provide ubiquitous wireless access ability and seamless handover for wireless communication devices between different types of technologies such as Wi-Fi, WiMAX, UMTS and LTE. This challenge is critical as MUs are becoming increasingly demanding for services regardless of the technological complexities associated with them. To fulfil these requirements for seamless VHO two main interworking frameworks were proposed by IEEE Group and 3GPP for integration between the aforementioned technologies; namely, MIH and IMS where each of them requires mobility management protocol to complement its work such as MIP and SIP respectively.

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