

## Minimizing Latency During Handover Between UMTS, WiFi and WiMAX Networks

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**Abstract:** Applications running on mobile networks have different requirements. Thus it is very difficult to provide best services even during vertical handoff. IEEE 802.21 provides a very good framework using Media Independent Handoff (MIHF). In this paper we have proposed a system for Vertical Handoff by enhancing the capability of Link Going Down event to take decision fast and selecting best interface. The system takes into account the user preferences, application requirements, lower layer network information and make decisions depending on that information. This system will allow the mobile terminals to be always best connected and provide seamless mobility in vertical handoff.

**Key words:** Correspondent node, mobile node

### INTRODUCTION

Emerging technologies have introduced new mobile devices with multiple-interfaces. New technologies will work together to allow mobile users to seamlessly roam between heterogeneous networks. These mobile devices will be able to provide applications with high usability. We need to provide high bandwidth and good resources for these applications to run in a good manner. In wireless communication it is very challenging task to provide multimedia services such as, VoIP, Video Streaming, High data rate connectivity during handover between multiple technology networks.

When a mobile user changes its location from one place to another then it is called handoff. Handoff within a network is called Horizontal Handoff. Handoff between two networks is called Vertical Handoff as shown in Fig. 1.

To achieve seamless vertical handoff, decision making plays an important role. It describes how and when to make a handoff decision. The received signal strength is the main handoff metric in traditional handoff. However, it is not enough to make a handoff decision in case of vertical handoff. These metrics may include available bandwidth, cost of service, and user preferences. An efficient vertical handoff decision algorithm becomes a challenge to develop for optimal resource utilization with diverse QoS support. The vertical handoff can occur any time and may not take place only at the cell edge. It can execute even when the Mobile Node (MN) does not move, depending on the network conditions and user

preferences or in case of network congestion. The main part of this kind of vertical handoff is to make a decision to trigger a handoff according to the application requirements and user preference. Therefore, an effective and efficient vertical handoff decision algorithm in the interworking between 802.11, 802.16 and UMTS is needed to maximize the resource utilization.

In order to allow users to take advantages of multiple interfaces and allow them seamless mobility, IEEE has introduced a standard 802.21 Media Independent Handoff; it allows mobile interfaces to connect to multiple interfaces and providing vertical handoff independently.

### LITERATURE REVIEW

The integration of UMTS, WLAN, WiMAX to provide seamless mobility with minimum delay and merging these technologies to provide continuous communication as all are diverse technologies is very

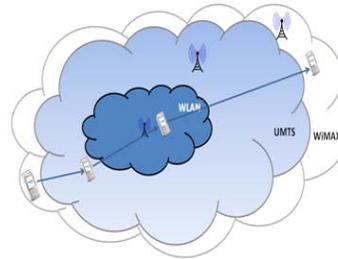


Fig. 1: MN seamless movement between networks.

Table 1: Network link parameters

Static parameters	Dynamic parameters
Interface MAC	Available bandwidth
BSS ID	Link status
Services available	Packet loss rate
Link type	

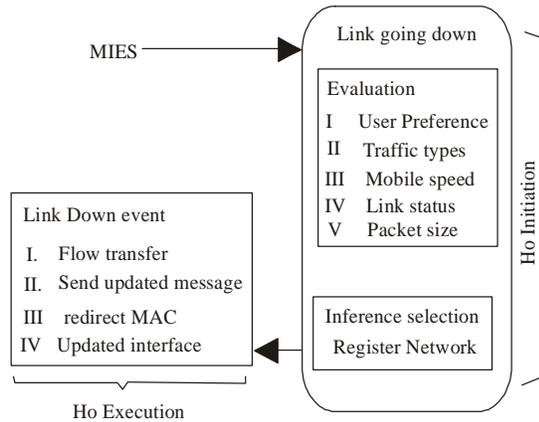


Fig. 2: LGD with proposed system

challenging issue. There are two main types of handoff mechanisms. Network-controlled, mobile assisted handoff and Mobile controlled handoff. In (Nadine *et al.*, 2007) Integration architecture of UMTS, Wi-Fi and WiMAX a middle layer is introduced which is called IDM (Inter-domain Management Module). This IDM handles the vertical handoff between heterogeneous networks and in this architecture WiMAX is set as standby network in any case handoff to any other network fails then IDM will handoff MS to WiMAX network. In (Jean-Marie *et al.*, 2009) architecture Ubique as middle layer is introduced which connect with UMTS, WiMAX and Wi-Fi for seamless handoff and to provide multiple-interface management. In (Ylitalo *et al.*, 2003) describes an architecture which allows to take decision and select interface for each application flow and to balance the load of the traffic. In (Hasina, 2009) added a QoS Fuzzy Logic layer which get crisps values from lower and upper layers and then evaluate to take decisions for handoff. This system is designed under MIHF Layer. (Maaz *et al.*, 2009) proposed a vertical handover mechanism (VHOD). In this approach cross-layer context has been collected and user-centric approach is mainly considered for this work. IEEE 802.21 is designed for Handoff in heterogeneous networks. This architecture allows seamless roaming with continuous session between Mobile User and Network with QoS support for multimedia applications. The main thing in this is that it is media independent. IEEE 802.21 model for network simulator NS2 is provided by NIST for simulation. This model gives WiMAX, WiFi, UMTS, Handoff model for simulation.

**Proposed work:** In order to allow users to take advantages of multiple interfaces and allow them seamless mobility, IEEE has introduced a standard 802.21 Media Independent Handoff, it allows mobile interfaces to connect to multiple interfaces and make decision not based only on signal strength. In this proposed technique we have used Mobile-controlled handoff mechanism as mobile will detect new networks and will trigger for the handoff. As multiple interfaces are of many standards, 802 standards and non-802 (Cellular, 3GPP, 3GPP2) standards. MIH does not depend on media Link layer type.

The system takes into account the following parameters shown in Table 1.

In this study we have used three networks, 802.11, 802.16 and UMTS. The proposed system is explained below step by step.

In this proposed study, Fig. 2, the system gets all the static information of the networks on MIH/Link Detected trigger. The system will also collect dynamic information on every beacon message.

**Information collection:**

**Gathering information comprises of two parts:** Application Layer information and Link Layer information. This information collection procedures works under IEEE 802.21 MIH framework.

**Application layer information:** The system collects information from application layer i.e, User Preferences, Required Bandwidth, Traffic Type, and Packet Size. This information is then used for intelligently take decision on network selection. Required bandwidth, traffic type and packet size may vary from packet to packet so the system takes in to account all the parameters from application layer as well as link layer to select the best interface.

**Link layer information:** From link layer parameters information will be collected for all available network interfaces (e.g., Link Status, Available bandwidth, Link type, BSS Id, Interface MAC). The link layer information is collected on Link Detected trigger this information will be passed to upper layers for evaluation process.

**Evaluation procedure:** This evaluation procedure compare the network information collected above with the information of other available networks in its information stored module. If the new network has better results than the previous connected network then the MN will go for handover execution process else we will remain connected to current network.

This evaluation procedure starts working either on LGD trigger or change in information of the network (bandwidth requirement, load balancing etc). LGD is generated due to Link status or expiration of key. We have set LGD threshold value defined in (Maaz *et al.*,

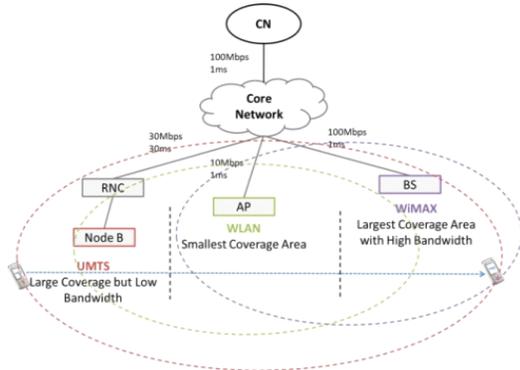


Fig. 3: Simulation scenario

Table 2: Nodes information

	WLAN	UMTS	WIMAX
Nodes	AP	RNC, NodeB	BS
Bandwidth	11Mb	2Mb	20Mb
Coverage	300m	1000m	1000m

2009). Our proposed system evaluates the network parameters to select the best network during LGD trigger before its Link Down trigger generates. We have made changes to MIH Function so that our algorithm can work parallel with MIH Function. This minimizes the packet loss and the handover latency.

**Simulation scenario:** We have used network simulator ns 2.29 for simulation and NIST 802.21 mobility model. The architecture of the network is shown in Fig. 3 and described in Table 2.

Total Simulation time is set to 200sec. The MN is configured to use multiple interfaces, three at a time. UMTS, WiFi, WiMAX. The mobility handover mechanism is mobile controlled and the proposed vertical handover algorithm is installed in MN also the MIH layer is installed on MN as well as on all networks for providing information such as, Network Type, Physical Layer, Bandwidth, Signal Strength. MN will be mobile during the whole simulation between three networks with different moving speeds (1, 2, 5, 10, 15, 20 m/s). As WiMAX is the network with high bandwidth and large coverage area so WiMAX is set as standby network for MN to handover. UMTS has also large coverage area but its bandwidth is very low w.r.t. WiMAX or WLAN. WLAN has the smallest coverage area as shown in Fig. 3. In 802.11 g bandwidth, data rate is set to 11 Mbps.

At  $t = 1$  sec the MN start moving and enter in UMTS and WiMAX coverage area then after 20 sec it enters in Wi-Fi range till 100 sec. We have implemented our proposed work using NIST mobility model and have added the QoS proposed Middle-layer in the defined class. We have tested our simulation with different parameters of traffic packet sizes, different bandwidth requirement, User preferences and MN mobility speed.

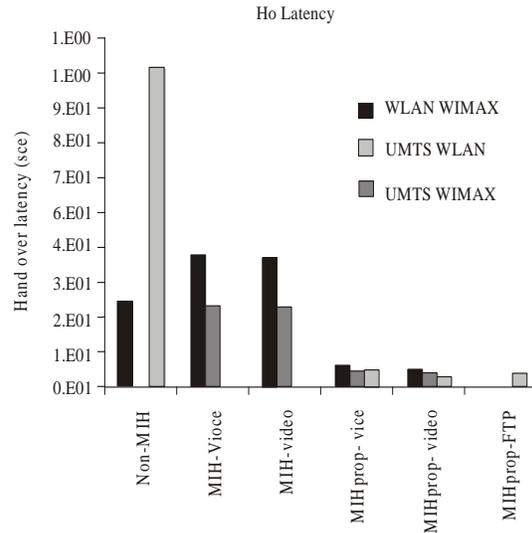


Fig. 4: HO latency result

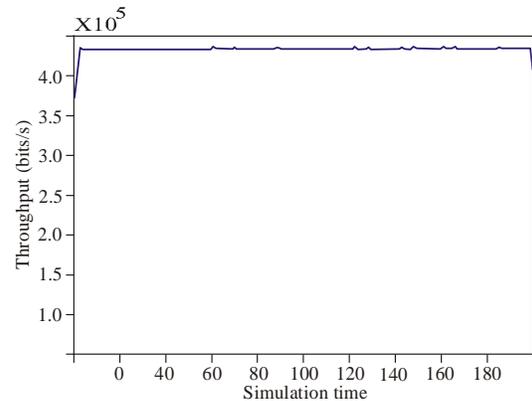


Fig. 5: Total throughput

We have used CBR and TCP traffic source CN and MN is set as sink node. MN will start moving at 1m/s with voice as well as video application running on it. We have changed the MN moving speed up to 20 m/s and tested it on ftp application also to check handover latency from UMTS-WLAN, WLAN-WiMAX and UMTS-WiMAX. We have set the WiMAX network as a standby network and if the MN is moving faster and enters in WLAN network area then it will not handover to WLAN and will remain in WiMAX or UMTS network according to its running application. The MN will also check for User preferred network before connecting to any network in its range. In our proposed work and with different simulation scenarios the MN checks for many parameters (Link Status, Available Bandwidth, Required Bandwidth, Running Application and MN moving speed) when connecting to any network.

**Performance evaluation and analysis:** Performance evaluation and analysis of the proposed work to ensure the new proposed technique has better results than previous work. Our proposed approach has given much better results for handover delay than with default MIH. The following results shown are compared with Non-MIH (Nadine *et al.*, 2007), MIH (Multimedia traffic) default and MIH (Jonathan *et al.*, 2009), MIH-Proposed experiments (Voice Traffic, Video Traffic, FTP Traffic). With our proposed technique we have experimented with three different types of traffic to evaluate results with previous techniques results. The results are shown in Fig. 4 and total throughput of traffic with our technique is shown in Fig. 5.

### CONCLUSION

According to the proposed approach results have shown that if we enhance the LGD event by adding evaluation process as well as interface selection and then re-routing of packets shifted to Link Down event. This can minimize the handover latency in heterogeneous environment. For future work we planned to take into account power factor during handover message exchange.

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