Middle-East Journal of Scientific Research 23 (12): 2855-2861, 2015
ISSN 1990-9233

DOI: 10.5829/idosi.mejsr.2015.23.12.22873

Performance Analysis of Mobility Management in IEEE 802.21 Based Handover Techniques Using NS2

[1]M. Manimaran and [2]S. Duraisamy

[1]MCA Department, Nehru College of Engineering and Technology,
Tirumalaiyampalayam, Coimbatore, Tamilnadu 641105, India
[2]MCA Department, Sri Krishna College of Engineering and Technology,
Kuniamuthur, Coimbatore, Tamilnadu 641008, India

Abstract: In multi technology-enabled terminals most of the resources have become available in the Internet. Such multi-mode terminals have new challenges to mobility management in IEEE 802.21. In order to address some of these challenges in the network, the IEEE is mainly working on a new specification on media-independent handover services (IEEE 802.21 MIH). The main aim of these specifications is to improve user experience of mobile terminals by enabling handovers between heterogeneous technologies while optimizing session continuity. The IEEE 802.21 MIH is purely focused on handover easier between various wireless networks in heterogeneous environment. In order to simulate MIH standard, National Institute of Standards and Technology (NIST) developed a add-on module works with ns2 version 2.29. In this, the performance of node uses, Simulation result of vertical handover in between Wi-Fi and WiMAX networks using IEEE 802.21 MIH standard. This simulation is carried using ns2 simulator with NIST's add-on module for IEEE 802.21 MIH standard. The Performance of IEEE 802.21 MIH standard is analyzed in several things like Average throughput, handover latency, packet drop and end to end delay using ns2.29.

Key words: Network · IEEE 802.21 · Vertical Handover · Media Independent Handover · ns2 Simulator

INTRODUCTION

Wireless Network technology has gained popularity due to its ability to provide several information accesses to users on the move. However, there is no single wireless network technology like WiFi and WiMAX that is capable of at the same time providing a low latency, high bandwidth and wide area data service to a large number of mobile users in the network [1]. In the New Generation wireless Network, Mobile users are connected to the available networks that are best fit to their service requirements and switch over between different networks based on their service requests. Mobility management protocols were required to support mobility across their heterogeneous access networks. This next-generation wireless system of Heterogeneous environment in IEEE 802.21 called Vertical networks with different access networks technologies which are different in bandwidth, latency time or cost. In this kind of environment, mobility management is the very essential issue which supports the roaming of users from one system to another system. Handover management controls the changes of Mobile Terminal's point of attachment (POA) during active communication [2]. Handover in wireless networks result in performance degradation to their applications of these handover protocols. Handover management issues mainly include mobility scenarios, metrics, decision algorithms and procedures. Mobility scenarios can be classified into horizontal (which is between different cells of the same network) and vertical (which is between different types of networks). In several homogeneous networks, horizontal handover were typically required when the serving access router becomes unavailable due to the Mobile Terminal's movement. In heterogeneous networks, the need for Vertical Handover is to be initiated for convenience rather than connectivity reasons (e.g., according to user selection for a specific service).

Corresponding Author: M. Manimaran, MCA Department, Nehru College of Engineering and Technology, Tirumalaiyampalayam, Coimbatore, Tamilnadu 641105, India.

This paper is to evaluate the performance using media independent handover, network simulator-2 (ns-2.29) tool which is used in simulating multiple vertical Handovers under the scope of IEEE 802.21. Currently the IEEE 802.21 functionality can be incorporated in ns-2.29 by using external add-on modules developed by the National Institute of Standards and Technology (NIST) that are based in IEEE 802.21. This explains the current implementation of IEEE 802.21 in ns-2.29. It provides a general description for signaling involved in a handover between WiMAX and Wi-Fi technologies and presents a message sequence chart of the correspondent events in ns-2.29. It also describes simulation scenario to determine the expected number of handovers in an ns-2.29 and also presents simulation results.

Related Work: The release of the mobility package by NIST, as a part of their work with IEEE 802.21 and the IETF, several research studies have been used these modules [3]. It evaluates the performance of an adaptive channel scanning algorithm for IEEE 802.16 and a past version of the WiMAX module that is used in this paper. In [4] the handover latency of these cases where UDP & TCP carry MIH signaling messages which is compared and some of the design tradeoffs were presented. The evaluation states the performance of a vertical handoff scheme between 802.11 and 802.16 wireless access networks with signaling cost, handoff delay and QoS support which can be found in [5]. Reference [6] evaluates a proposed cross-layer mechanism which makes intelligent handover decisions in FMIPv6 in handover latency, packet loss and handover signaling overhead and which evaluates a new enhanced Media Independent Handover Framework (eMIHF) that can be allowed for efficient provision and activation of QoS resources in the target radio access technology during the handover phase.

The use of ns-2 with NIST modules have been used to propose new implementation guidelines to the new security extension for IEEE 802.21 that is yet to come as a latest techniques as IEEE 802.21a. Reference compares different authentication techniques, namely, re-authentication and pre-authentication, that may be used in order to be reducing the time and resources which is required to perform a vertical handover. Reference measures the performance analysis of the authentication processes in media independent handover techniques and considers the impact of using IEEE 802.21 link triggers to achieve seamless mobility and which proposes an extension to current network selection algorithms which takes into account of security parameters and policies and compares the handover performance with and without the proposed extension.

Vertical Hanover: Handover process is the process of maintaining a user's active sessions when a mobile terminal changes its connection point to the access network. In the heterogeneous networks, handoff techniques took place in two ways according to the radio access technologies namely

- Horizontal handover and
- Vertical handover techniques respectively.

Horizontal handover technique is between Base Stations (BS) or Access Points (AP) which is used the same radio access technology, so called intra-technology handover. Vertical handover is between BSs or APs which uses different radio access technologies, so called inter-technology handover technique.

The main difference between the horizontal handoff and vertical handoff is very symmetrical. Because of the different characteristics of different access technologies which are used in the networks, the vertical handoff is asymmetrical. The vertical handover is a very important capability in the future wireless communication technologies, where an integrated network grouping multiple technologies which try to offer a global broadband access to the mobile users. When compared with horizontal handover, vertical handover decision which depends on many parameters.

Due to this reason the signal strength metric is not well suited and not sufficient to appropriately trigger the vertical handover. Heterogeneous networks have different system characteristics, their performance which cannot be simply compared with using the signal strength of two cells. In case of horizontal handover technique, handover occurs only when the received signal strength becomes in weak position, whereas in case of vertical handover, the handover will occur depending on behalf of user decision. The vertical handover process is a three-stage process which takes a finite amount of time to complete the process. The first stage is so called as Network Discovery stage, whereas the user's mobile device identifies all the possible underlying networks which can use to access the Internet. The next stage is Handover Decision stage, whereas the mobile device selects the network to switch to and the time to do. The last stage is the Handover Execution stage which the mobile device switches over from its current network to the other

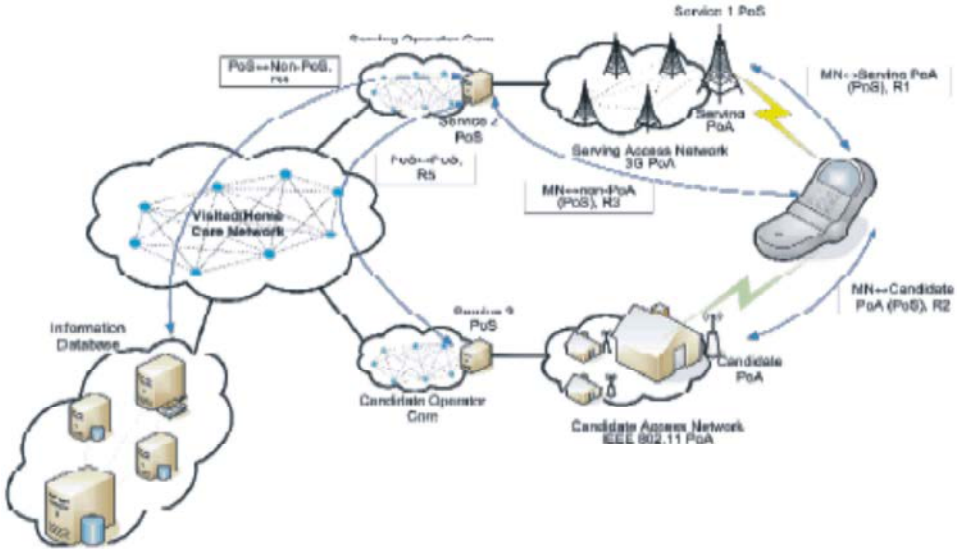

Fig. 1: Overview of 802.21

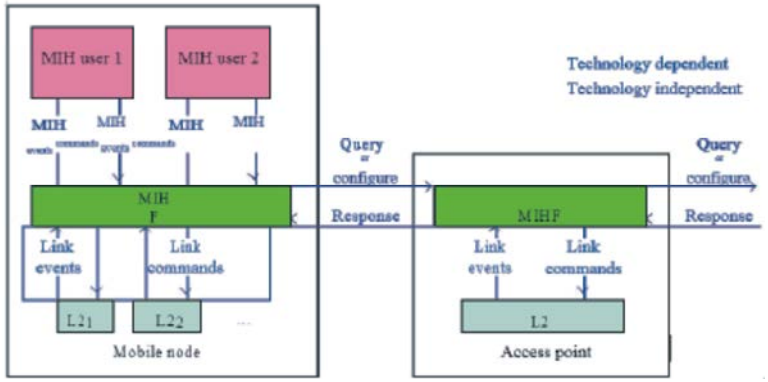

Fig. 2: MIH Implementation in ns-2.29

etwork. For seamless handover techniques, all these stages have to be completed prior to mobile terminal leaving the coverage area of the access point to which is currently connected to, or if not connection is down. Handover decision algorithms must be intelligent way to decide the best target network considering many parameters and hence they are very complex to design.

Heterogeneous Handovers in ns-2: The support for vertical HO scenarios is available, but limited, in ns-2 through the use of NIST add-on modules. These modules were developed for version 2.29 of ns- 2. NIST added and changed numerous files in the standard release of ns-2 in order to support mobility scenarios.

IEEE 802.21 Supporting ns-2: The 802.21 add-on module contains an implementation of the Media Independent Handover Function (MIHF) based on IEEE 802.21 specification. An overview of the MIHF interaction with the different components of the Mobile Node (MN) is shown in Fig. 1.

The MIHF and MIH Users are implemented as Agents. An Agent is a class defined in ns-2, extended by NIST, that allows communication with both the lower layers (i.e., MAC) and the higher layers (i.e., MIH Users), providing the mapping between the media independent interface service access point (MIH SAP) and the media-dependent interface (MIH LINK SAP and mediaspecific primitives). Because of this, the MIHF can send layer 3 packets to remote MIHF and MIH User can register with the MIHF to receive events from local and remote interfaces. The

MIHF is also responsible of getting the list and status of local interfaces and control their behavior. The MIH User class is hierarchy organized according to Fig. 2. From Fig. 1, we can see that MIH Users make use

of the functionalities provided by the MIHF in order to optimize the HO process. MIH Users typically will send commands to the MIHF and receive events or messages.

The Interface Management class (IFMNGMT), depicted in Fig. 2 and provides flow management functions which facilitate the HO module in finding the flows that need to be redirected. The IFMNGMT also receives events from the Neighbor Discovery (ND) agent when a new prefix is detected or when it expires. The MIPV6 Agent adds the redirection capability to the MIH User. When a flow needs to be redirected, a message can be sent to the source node to inform it of the new address or interface to use. The Handover class provides a template for HO modules and computes a new address after a successful HO.

802.21 Supported Technologies in ns-2: Currently ns- 2 support the following technologies in IEEE 802.21 scenarios: WiMAX (802.16), Wi-Fi (802.11) and UMTS and Ethernet (802.3).

Implementation of Nodes with Multiple Interfaces in ns- 2: Supporting nodes with multiple interfaces is not intuitive in ns-2, because external packages do not necessarily follow the same no restructure as the one defined in the basic model (i.e., routing algorithms are different). To resolve this issue, NIST created the concept of multi Face node, which is a node who links to other nodes. The other nodes are considered interfaces for the multiFace node and the multiFace node can be viewed as a "supernode". This concept is illustrated in Figure 3. The interface nodes trigger events and send them to the multiFace node. The MIH Users on the multiFace node can register to receive these events. Additionally each of the interface nodes will also run an instance of the Neighbor Discovery (ND) agent, detailed in Section 3.2.5, in order to detect layer 3 movements.

Integration of WiMAX: The WiMAX module was developed entirely by NIST, the supported features are shown in Table 1. A limitation of the implemented WiMAX model is that, when using WiMAX cells, at the beginning of the simulation there must be at least one MN within each cell range in order for the BS to function correctly. Due to this condition, a WiMAX simulation scenario has to include "phantom" nodes.

Simulation Setup: The Simulation result is carried using ns2.29 with modified NIST's add-on module. To demonstrate the performance, we have configured WiMAX, WiFi combined networks for the simulation. WiMAX is one of the network with high bandwidth and large coverage area with WiFi has the smallest coverage area. In our simulation WiMAX having coverage area of about 500m and WiFi coverage area is of about 20m. Simulation scenario was shown in the following figure. In simulation results WIFI has one of Access Points AP (802.11) and of two 802.16 base station (BS) and one MN in the network. The MN is configured using one or two multiple interfaces called super node with WiFi and WiMAX interface respectively. AP and BS has been connected to network as shown in the figure. The bandwidth between node and Router 1 is set to 100 Mbps. Similarly bandwidth of WiFi access point and Router is set to 100 Mbps and of WiMAX base station and Router 1 is set to 100 Mbps.

Total Simulation time is set 500 sec. CBR video traffic was created between CN and Multi Face node in the network. At the beginning, MN is connected to BS and starts regularly moving towards WiFi network. When it was detected from WiFi network, then it generates Link_Detected trigger. The NIST handover algorithm which selects a new network based on the Radio Signal Strength only and thus WiFi is considered a better network than WIMAX. Therefore MN switches WiFi network. But when it reaches the boundary region of WiFi network signal strength decreases and hence generates Link_Going_Down trigger. At this point of time MN needed to make a HO to another network in order to continue the session. This has only choice to handover to WIMAX and hence MN connected to WiMAX network. To study the performance analysis of the MIH, MN velocity was varies from 0 m/s to 30 m/s. The simulation result is repeated number of times and average value is taken to improve the accuracy of the result.

RESULTS AND DISCUSSION

The performance analysis was carried out in terms of handover latency, average throughput, end-to-end delay and packet drops. Handover techniques between WIFI and WIMAX (2BS and 1AP) there was a TCP connection between the router and MultiFaceNode (Super Node).

In this, Mobile Node Enters Into Network Area:

- Firstly, Node initially enters into 802.16 networks, connected to BS1 of 802.16
- Second, Node redirects to new network of BS2 of 802.16

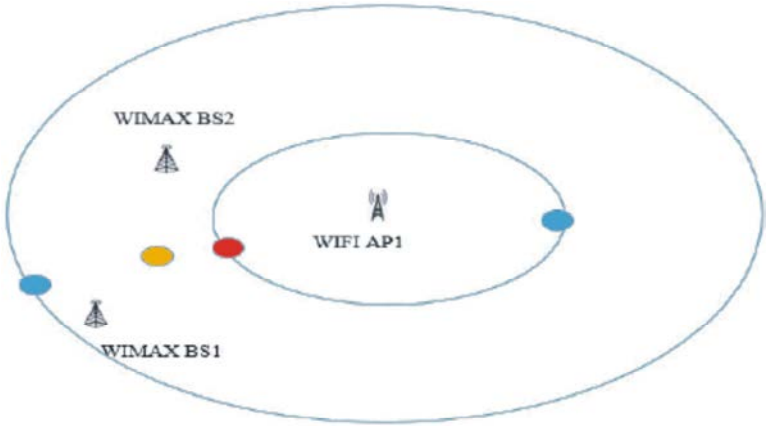

Fig. 3: Scenario-1 Showing Mobile Node Entering In Different

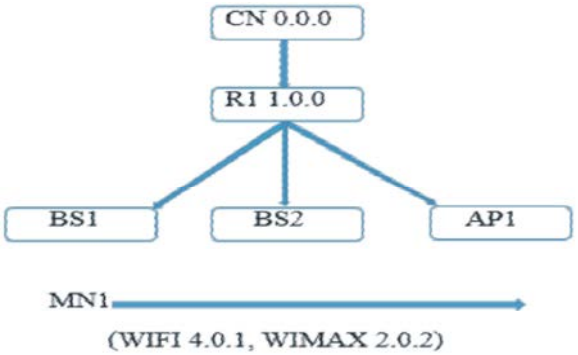

Fig. 4: Topology for Scenario-3

- Then, Node enters into 802.11 and redirects to new network
- Finally, Node leaves 802.11 and switched back to BS1 of 802.11

Networks Range:

- First of all, Blue node indicates mobile node is attached BS1 OF WiMAX network.
- Node while travelling in WiMAX network coverage area it detects strong signal from BS2 of WIMAX, blue node is handover to BS2 and now yellow mobile node is connected to BS2.
- At this stage, While travelling red mobile node which detects strong Beacon signal from WIFI network of AP1, it will handover to WIFI.
- Once the yellow mobile node moves away from WIFI region i.e., on WIFI border region, it will Handover to WIMAX BS2.

A simulation result was carried out for 500 sec with seed value of 5555, CBR traffic was created and packet size was defined as 500 and it was attached to UDP. Mobile node starts from every node moving after 10sec, initially mobile enters in WIMAX area and connected to BS1 then it also detects BS2 and Handover to BS2. Suddenly mobile node receives a strong beacon signal handover technique to AP1 of WIFI. When mobile node reached to the border of WIFI area and it did not get a strong signal, Mobile node will handover to previous WIMAX BS2.because WIMAX stations has larger network range than WIFI.

Handover Latency: The handover latency is one of the duration from handover initiation to handover completion that is equal to amount of time from which, when the mobile is disconnected from the existing base station and switching over to new base station and the mobile receives the first packet service from the new base station. In the context of MIH standard, it is nothing but the time interval between the first Link_Going_Down trigger generations and also the Handover_complete link generation triggered the network. The Handover latency occurs due to two delays i.e., L2 handover delay and L3 Handover delay. The L2 Handover delay occurs due to the delay in new network scanning and entry procedure. The L3 Handover delay results from various stages of new access router discovery and route information updated. The following fig. shows the graph drawn Handover latency against velocity..

End to End Delay: End to end delay which can be calculated as the total time taken by the packet to reach from source network to destination network. This is also defined as a sum of transmission delay, propagation delay and processing delay. The graph display of end to end delay was shown in the following figure. Due to network continuity offered by MIH is very less end to end delay is seen.

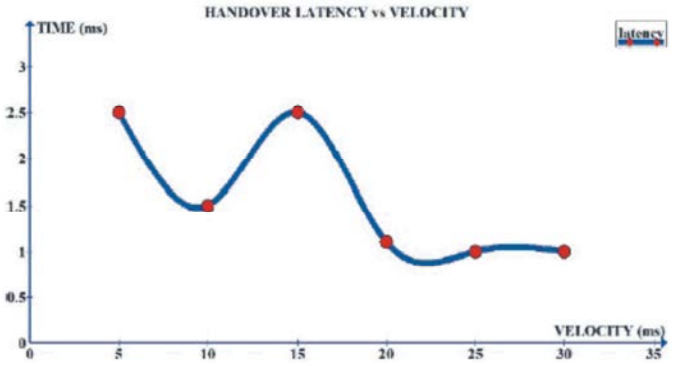

Fig. 5: Handover Latency vs Velocity

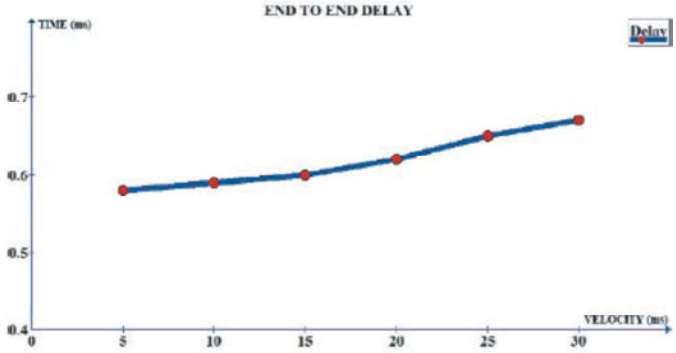

Fig. 6: End To End Delay

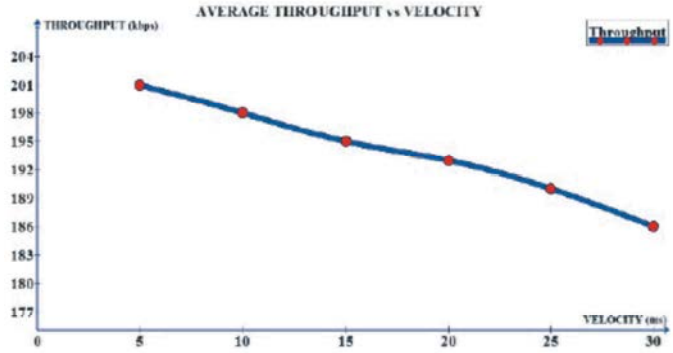

Fig. 7: Average Throughput

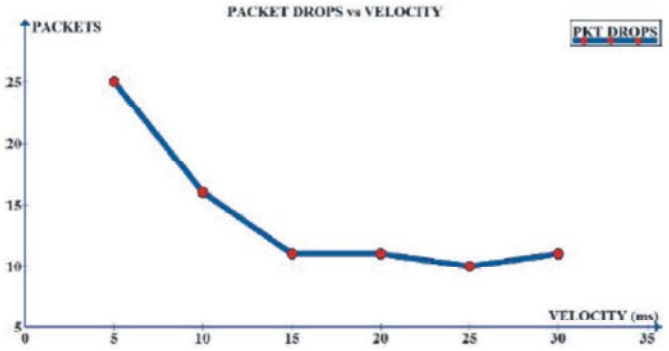

Fig. 8: Packets Dropped

Average Throughput: Throughput is the basic average rate of successful message delivery over a communication channel. The throughput was usually measured in terms of kilobytes per second. The graph of average throughput against velocity was shown in the following figure. In the following graph it is clear that throughput obtained was high when the simulation result was performed using MIH. This is because; the MIH standard supports seamless or continuous vertical handover between different networks.

Packet Drop: In this simulation, packet drops were calculated versus different velocity. Since MIH standard enables switching over between different technologies, MN always connected to the network. Hence packet drop is low in case of simulation with MIH. The graph is as shown in following figure.

CONCLUSION

There was a vast increase in multi-interface technologies, the enabled terminals becomes more popular due to these In future heterogeneous access networks, network detection and handover decision procedures will play a vital role in achieving efficient mobility solutions.

The title of the paper investigates performance by using NIST modified add on module, achieves seamless service continuity vertical handover techniques between heterogeneous networks. To achieve a goal IEEE 802.21 defines a media independent handover which provides a generic interface between the different heterogeneous networks. This paper gives an overview and analysis of the IEEE MIH based Handover techniques using Ns2.

REFERENCES

1. Rouil, R. and N. Golmie, 2006. Adaptive channel scanning for IEEE 802.16e, In Proceedings of IEEE Military Communications Conference (MILCOM ’06).
2. Griffith, R. and Rouil, N. Golmie, 2005. Performancemetrics for IEEE 802.21 media independent handover (MIH) signaling, Wireless Personal Communications, 52(3): 537-540.
3. Zhang, Y., W. Zhuang and A. Saleh, 2008. Vertical handoff between 802.11 and 802.16 wireless access networks, In Proceedings of IEEE Global Telecommunications Conference (GLOBECOM’08), pp: 584-589.
4. Mussabbir, Q.B., W. Yao, Z. Niu and X. Fu, 2007. Optimized FMIPv6 using IEEE 802.21 MIH services in vehicular networks, IEEE Transactions on Vehicular Technology, 56(6 I): 3397-3407.
5. Neves, P., F. Fontes, S. Sargento, M. Melo and K. Pentikousis, 2009. Enhanced media independent handover framework, In Proceedings of the 69th IEEE Vehicular Technology Conference, Barcelona, Spain.
6. Izquierdo, A., N. Golmie, K. Hoeper and L. Chen, 2008. Using the EAP framework for fast media independent handover authentication, In Proceedings of the Wireless Internet Conference (WiCON ’08), Maui, Hawaii, USA.