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Enhanced Soft Vertical Handover Scheme For Heterogeneous Networks

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***Abstract* — A seamless vertical handover between heterogeneous networks without interruption to the on-going services is very important in next generation wireless networks which aim at the provision of uninterrupted network connections anywhere and at any time. This paper provides a new algorithm for vertical handover mechanism by using mobility prediction and Call Admission Control Algorithm CAC. We use IEEE 802.21 standard Media Independent Handover as a layout for implementing the algorithm among heterogeneous wireless networks Wimax and Wi-Fi. The CAC is implemented using PMIPV6 protocol. The implementation of our handover algorithm enhances the throughput, reduces the handover delay and avoids unnecessary vertical handover. The result shows that the proposed algorithm improves the vertical handoff latency, packet loss and average throughput of the mobile users.**

***Index Terms*— Call Admission Control (CAC), Media Independent Handover (MIH) Function, Mobility Prediction, Proxy Mobile Internet protocol (PMIPV6), Vertical Handover.**

I. INTRODUCTION

Handover management is one of the most important tasks under the wireless communication. Various algorithms have been proposed with the aim to transfer sessions between heterogeneous networks without losing connection and data. A handover process starts by a mobile node (MN) when it receives weak RSSI from a BS/AP. The MN starts searching for available networks after getting weak signals from the current BS/AP [6]. The handover time is mainly dependent on the scanning delay of the network availability. Furthermore, an optimum network can be selected for handover from the available networks on the basis of price, security, transmission rate, Grade of service (GoS) and quality of service (QoS) [6].

Transfer of on-going process between different technologies for wireless communication leads to different problems such as selection of best network for handover, incompatibility among different networks, and handover delay. To overcome problem of moving across different network topologies, an efficient handover management scheme is need as mandatory. When an MN leaving from one BS to another, it first executes a discovery mechanism for searching nearby BSs and makes a connection to the new BS.

As wireless users constantly demand for more mobility and bandwidth, a solution was needed that allows their mobile devices to use “any network at any time” in range in order to get coverage or better service. The IEEE 802.21 standard is a first step in order to allow mobile devices to successfully make a handover (HO) between networks of different technologies.

TABLE I
Difference between Wimax and Wi-Fi

Parameters	Wi-Fi (b)	Wimax
Standard	802.11b	802.16
Frequency (GHz)	2.4	2.66
Speed Mbps	11	99
Range	100m	50km
Advantages	Low Cost	Speed Range
Disadvantages	Speed	Cost
Radio Access	DSSS	OFDM
Primary Application	Wireless LAN	Broadband

II. LITERATURE SURVEY

Recently, researchers have shown much interest to enhance the data rate by minimizing handover delay in wireless networks for fast handover. A border between two BSs or APs is a region where the probability of handover is high. As the networks are growing rapidly, load on a single server is increased. This problem is identified in with a solution of dividing the network in different mobility zones [1]. Each mobility zone is connected to a zone MIIS server which is further connected to a local MIIS server. And further, it is connected to a global MIIS server. This technique reduces access load on the MIIS server by dividing MIIS server functionalities into a sub-MIIS servers [1]. However, frequent handovers in overlapping region from multiple MNs can lead to overflow of MIIS server cache and breaking of connection from an AP.

A scheme based on finding point of attachment (PoA) for efficient network selection has been analyzed. In that scheme selection is based on RSSI and SINR of available networks. A BS obtains the information of RSSI and SINR and then passes it to the resource manager. The resource manager decides the best available network by generating a report called Report Best PoA. The report is sent to the MN for handover [2].

Another scheme based on adding a new entity called "added entity" (AE) has been proposed this new entity can enable MIPv6 to support two connections at the same time. When an MN is going to handover from one network to another, then one of its connections is attached with current network and another makes a connection with the new network with the help of proposed AE [6].

The handover across HetNets is performed by collecting information of link layers and maps to a generic one by providing compatibility of an MN from one link layer device/interface to another link device/interface. A media independent handover function (MIHF) is responsible for processing and modifying information obtained from different events and passes it to the upper layers. This exchange of different events is carried out by different media independent handover services. These services are called service APs (SAP) [1].

All of the techniques available in the literature enable handover routine when an MN crosses a particular threshold of RSSI. There are other cases when the probability of handover in a particular area is high. In such situations, handling handover is difficult for an access network (AN).

III.PROPOSED SCHEME

In our scheme handover is initiated with mobility prediction by means on increasing position value in XY axis. Then the BS communicate with MIH server to get information about the neighbor AP, It is followed by CAC to get access into new network with prior channel allocation and enhanced traffic control.

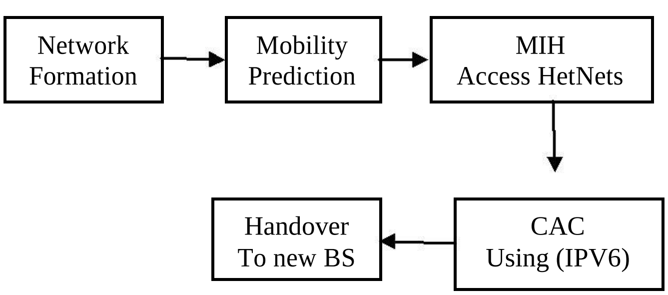

Figure 1. General layout best

A. Mobility Prediction

In this project we are presenting the new algorithm where handover initiation based on mobility prediction. A method of mobility prediction, i.e., predicting a mobile node's next location based on movement along XY axis, it accurately estimates the next location to be visited by a mobile node, when the current historical movement information is available [5]. In this prediction method, it has been assumed that the MN is moving and its physical position is continuously traced by BS. Once the MN position has been determined, if a MN is likely to perform a handover, the serving BS triggers the Handoff decision control process, This case always happened in the heterogeneous networks like UMTS, Wimax, Wi-Fi.

A proactive handoff technique has been developed in which the Handoff decision controller (HDC) collects the information current network load, strong RSS and Power consumption of using the network access device. A combined weight value has been calculated. Based on these values the priorities are assigned to networks and MS can handoff to a higher priority network via MIH [5].

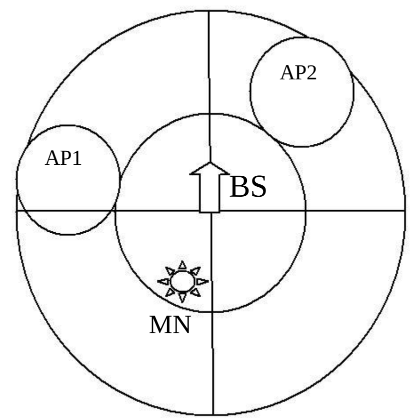

Figure 2. Zone based Mobility Prediction

B. MIH IEEE 802.21 STANDARD

The IEEE 802.21 standard specifies a media independent handover (MIH) framework that facilitates handover in heterogeneous access networks by exchanging information and defining commands and event triggers to assist in the handover decision making process [1]. Specifically, the standard consists of media independent handover function (MIHF) that enables service continuity while a MN transitions between heterogeneous link-layer technologies [1]. The MIHF also provides three primary services

:

1. Event services
2. Command services and
3. Information services.

The media independent event service (MIES) is responsible for detecting events at lower layers and reporting them from both local and remote interfaces to the upper layers (the MIH users). These events may indicate changes in state and transmission behaviour of the physical data link and logical link layers or predict state changes of these layers.

The media independent command service (MICS) refers to the commands sent from MIH users to the lower (physical data link, and logical link) layers in order to control it. MIH users may utilize command services to determine the status of links and/or control the multimode device for optimal performance.

The media independent information service (MIIS) provides a framework and corresponding mechanisms by means of which a MIHF entity may discover and obtain network information existing within a geographical area to facilitate the handovers [1].

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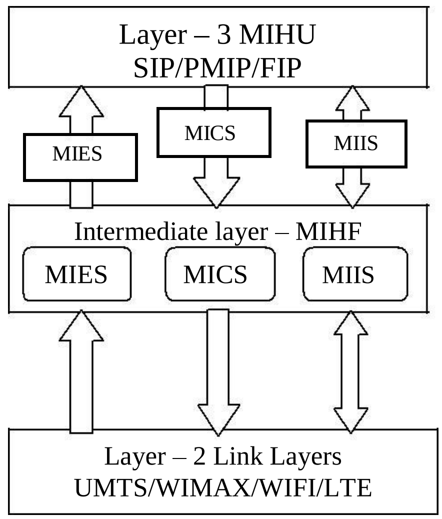

Figure 3. MIH Standard

C. CAC

The purpose of call admission control algorithm is to avoid the interference by control the number of incoming call accepted in the network. CAC need to perform separately for uplink and downlink transmissions as the traffic load offered by the uplink transmissions and downlink transmissions is different from each other. The uplink and downlink call admission control requirements must be fulfilled by each new user while entering into the system. CAC becomes much more complicated in wireless Heterogeneous networks due to users mobility [3]. The call dropping happens in the network when accepted call that has not completed in the current cell may have to be handed off to another cell. During the process, due to the limited resource in wireless networks, the call may not be able to gain a channel in the new network to continue its service. Thus, the new calls and handoff calls have to be treated differently with priority in terms of resource, bandwidth and channel allocation [3]. Since users tend to be much more sensitive to call dropping than to call blocking, handoff calls are normally assigned higher priority over the new calls. Handoff priority-based CAC schemes can be classified into two broad categories [3].

This CAC algorithm gives preferential treatment to high priority calls, such as soft handoff calls, by reserving some bandwidth margin (soft guard channel), Power consumption, no. of users (load) to reduce handoff failures. In addition, queuing is also used to enhance the service quality. The algorithm uses the effective load as an admission criterion and applies different thresholds for new calls, handoff calls, bandwidth requirement, and power consumption [3]. Use of CAC algorithm indicates that this algorithm reduces the drop of handoff calls and increases the total system capacity and performance; hence the Grade of Service (GoS) of the system can significantly be improved especially in case of high mobility environments.

D. PMIPv6:

PMIPv6, Proxy Mobile Internet Protocol Version 6. There are two types of protocol that support mobility management in Heterogeneous Networks. They are,

1. MIPv6 – Node based protocol
2. PMIPv6 – Network based protocol

It is the only network based mobility management protocol for building a common access technology independent of mobile core nodes. PMIP can change the Point of Attachment to the Internet without changing the IP address. Different network domains that support individual mobility support needs PMIP to interact between each other. The Call Admission control Algorithm can be implemented using this protocol. It consist of Local Mobility Anchor (LMA) and Mobile Access Gateway (MAG) to perform authentication key exchange and layer information. The LMA is connected to the core network. All MAG's are connected to the LMA. The Moving node is accessed by the MAG via BS/AP.

FLOW CHART

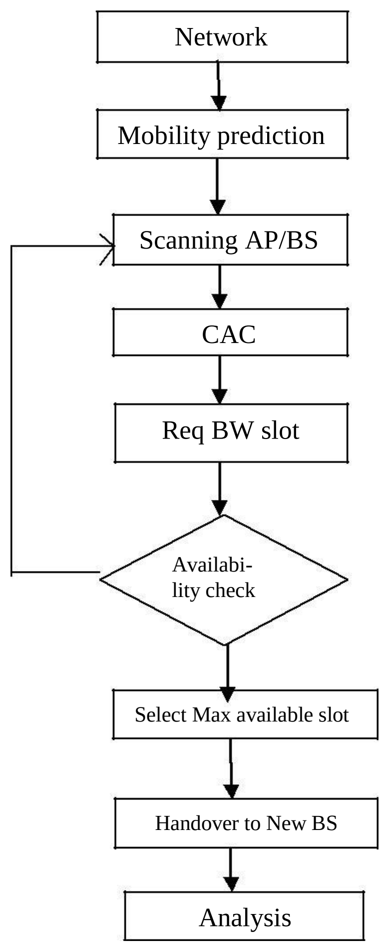

Figure 4. Flow chart

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It is designed that each MAG contain its corresponding BS/AP authentication details along with information such as bandwidth , Slot availability, QoS details and number of MN attached with it. Hence while performing handover between HetNets CAC condition is introduced by means of checking the requirements at the LMA. Since all MAG are linked with LMA, it can able to check the requirements like bandwidth availability, Channel allocation slot and QoS requirements. Once the condition is satisfied the call is permitted else queuing sate is evolved and the call is handover to the another bes Point of Attachment.

ALGORITHM : *Implementation of CAC using PMIPv6*

Step 1: Connect a number of nodes to two different access technologies say Wi-Fi and Wimax
Step 2: PMIP is defined using LMA-MAG variable pairs **Step 3:** All the PoA is attached to each MAG by using different variable
Step 4: Each MN is attached to its corresponding MAG variable through its access point PoA
Step 5: Each MAG contains the detailed list of it PoA such as number of nodes attached, Bandwidth availability, Channel allocation and QoS details
Step 6: When a MN initiates a handoff, it reaches LMA via MAG
Step 7: Since LMA can able to access with all MAG's it checks the requirements of MN in its neighbor AP/BS.
Step 8: Once the condition is satisfied the call is allowed else queued by set the offset value to 1.

IV. SIMULATION SCENARIO

The simulation scheme for seamless handover is carried out by creating a network topology consisting of one Wimax base station, three Wi-Fi access points with a variable number of MNs was created. As we know that in ns-2 tell script is frontend and C++ is backend tool. The pre-defined standard 802.21/16/11b along with AODV/NAOH routing protocols PMIPV6 are kept as inbuilt core package in C++ code. The simulation of handover between heterogeneous networks is coded in tcl-script by defining the network scenario.

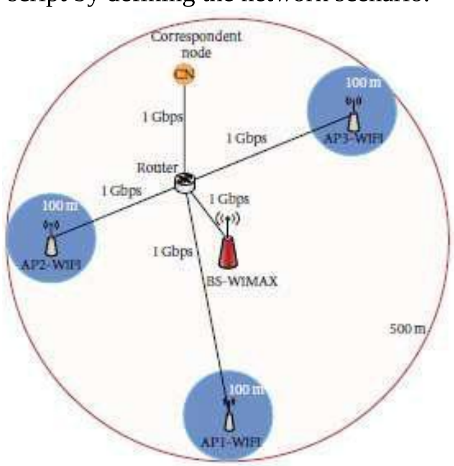

Figure 5. Simulation scenario

1. Create a new simulation with flat grid topology
2. Set the physical coverage area optimal parameters for wireless networks
3. Define the 802.16/802.11 at MAC layer and Wimax control agents with corresponding BS/AP.
4. Set three MN with random mobility form specific start and end point.
5. To enhance the MIH, we use PMIPV6, where each BS/AP is associated with MAG
6. CAC is performed by means of LMA-MAG data routing
7. The color change in the MN indicates the handover form one BS to another AP
8. Create the trace file tf/bf for further performance analyzing

The Wimax coverage range is about 500m and it consists of one BS and 100 MN. The Wimax region is divided into CSN, ASN Gateway and BS; The MN is in direct access with the BS via SS to the core network. The Wi-Fi coverage area is about 100m and consists of one AP and 10 MN. Three such Wi-Fi zones are created All AP's are wired connected to the core server.

TABLE II
Simulation Parameters

Number of mobile nodes	1 to 50 (say 5)
Mobile Movement	Rectilinear movement at 50Km/hr
Propagation channel model	Two ray Ground model
Wired links	CN - GW - SS – BS/AP (connect)
Wireless links	MN – BS/AP (attach)
Wimax coverage	500m
Wimax parameters	Technology :- 16QAM (10mbps) BS Tx Power:- 15W (41dBm) @ 3.5 GHz RX Thresh:- $1.215e^{-9}$W (-60dBm) CS Thresh:- 80% of RX Thresh
Wi-Fi coverage	100m
Wi-Fi parameters	Technology :- 802.11b (11Mbps) AP Tx Power:- 100mW (20dBm) @2.417GHz RX Thresh :- $0.989\ e^{-9}$W (-60dBm) CS Thresh:- 80% of RX Thresh

For our simulation a randomly moving MN is made to bind/attach from one BS to another AP and coloured to depict the handover. The mobility of that MN is predicted first which initiates handover. Then followed by scanning of available networks the handover is triggered to MIHF. Heterogeneous handover processes take place from Wimax to Wi-Fi by means of MIH which act as interface between two different technologies in MAC layer.

This is followed by Call Admission Control Algorithm to enhance the load balance of the network also to provide fairness for the subscribers. The CAC algorithm promotes the channel allocation prior to call initiation. When the MN send CAC request to a particular BS which checks the bandwidth availability and then admit the connection. It selects the network based on the type of data to be accessed. For video data Wimax is usually preferred and for voice data Wi-Fi is preferred. Thereby it controls the number of call admitted to particular BS hence enhance the load balance.

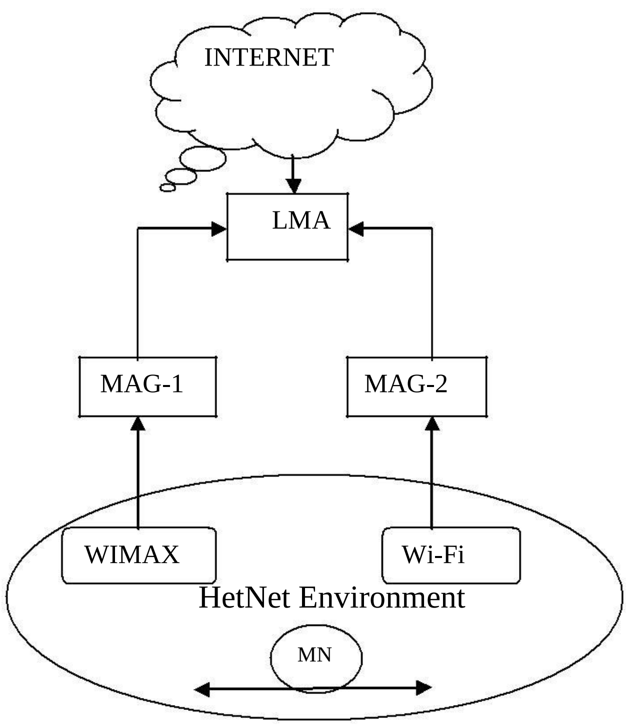

Figure 6. CAC using PMIP

V. SIMULATION RESULTS

Perform the Simulation scenarios in ns-2 with a variable number of nodes with random start and end positions. Handover delay, Handover time (constant) and Throughput in the proposed system is compared with the existing system in ns-2 simulation. It indicates the success rate of VH as the number of MNs increases with handover time in the simulation. Since ns-2 provides a new innovative way of determining throughput by means of creating desired wireless technologies and it supports the mobility of the nodes in random manner.

For performance Evaluation of the proposed system we trace the handover time and handover delay for each node. The handover time is usually kept constant for each node and the graph shows that handover time increases with the number of mobile nodes due to traffic. It is observed that handover delay is reduced ,hence it enhances the data rate thereby the increase in the throughput is shown in the graph.

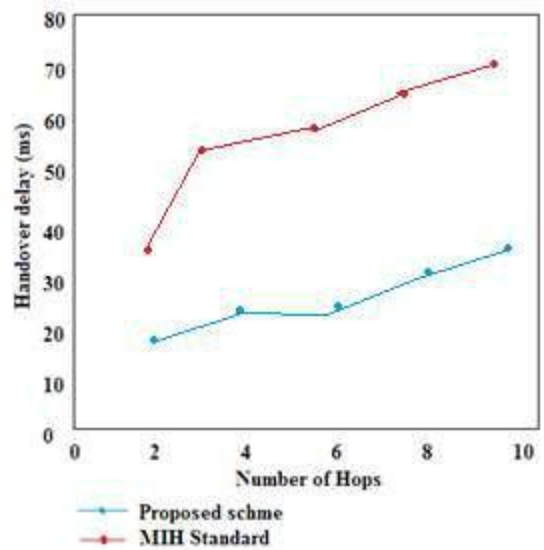

Figure 7. Handover delay vs. no. of hubs

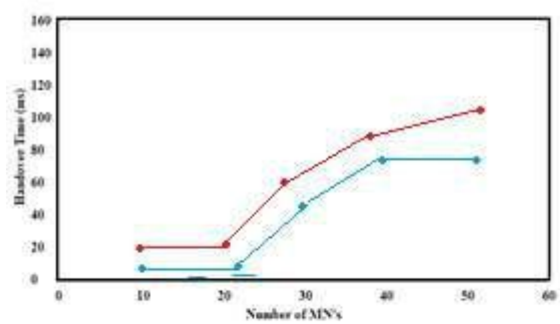

Figure 8. Handover time vs No. of hubs

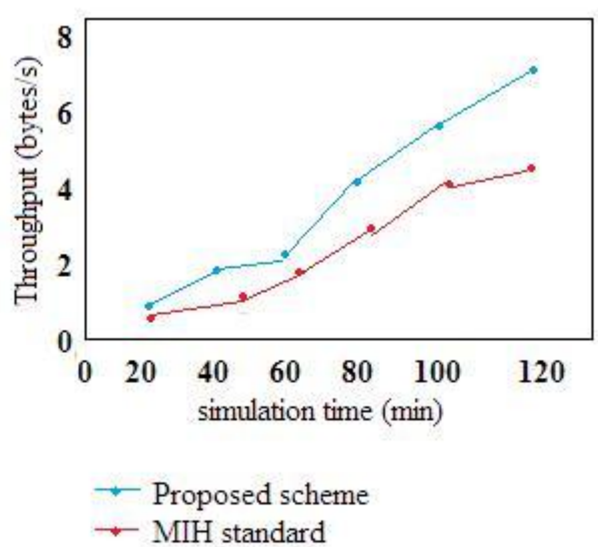

Figure 9. Throughput analysis

TABLE III

Comparison of Packet loss with and without CAC with MIH

MIH MODULE		MIH WITH CAC MODULE	
No. of Handover	Packet drop	No. of Handover	Packet drop
1	168	1	160
1	162	1	142
2	156	2	109

TABLE IV
Comparison of Handover Latency in Existing and Proposed System

Parameters for Handover Measurement	Handover Latency in standard MIH Module	Handover Latency in MIH with CAC Module
Time to add new PoA	0.67959	0.692478
Time to delete old PoA	0.614689	0.654933
Handover Latency	1.294279	1.347411

VI. CONCLUSION

In this paper, we have studied the problems associated the vertical handovers. This approach is based on use of Mobility prediction and CAC model. The mobility prediction accurately estimates the next location of a mobile user, given current the received signal strength values of the MNs. The information about the selected APs, are sent to the mobile user so that the user can move to that particular AP. We concluded that an effective seamless handover is stated by means of mobility prediction and CAC; it results in enhanced date rate with reduced handover delay.

Considering that add-on modules, such as Wimax, Wi-Fi, UMTS, Bluetooth, FMIPv6, amongst others, are constantly being added and updated by the ns-2 community, the importance of ns-2 for 802.21 simulations becomes clear. It will not only allow simulating complex vertical handover scenarios, prohibitive to do in a real test bed, but also allow modifying such modules in order to model missing primitives and better predict results for a real scenario. As shown by our experiments, both Wimax and Wi-Fi modules need improvements in the scheduling mechanisms and the contention resolution/avoidance for the shared medium in order to better reflect the technology's real behavior.

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