RESEARCH ARTICLE

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Handover Management using IEEE 802.11 and IEEE 802.16 Standards in MANETs

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ABSTRACT

As the technology is advancing, heterogeneous wireless networks are becoming more dominant; therefore the integration and interchangeability of various wireless access networks need to be addressed. Adhocs networks are collaborated with WLAN and WI-MAX architecture to create an economically viable solution for wide deployment of high speed, scalable and ubiquitous wireless Internet services. The proposition is to design an inter-working architecture of wireless mesh with horizontal handover. In today's distributed environment and changing technologies, there are certain issues; which need to be taken care of viz.-a-viz. operability of 4G+ devices and its incompatibility, requirement for the handover of devices with different architectures, challenges of adhoc networks and its solutions. Simulation results demonstrate the performance of the handover using metrics like throughput, average End-to-End delay and average jitter for uni-cast transmission. Comparative analysis is made for homogeneous architecture using different protocols to understand the requirement of mobility and handover.

***Keywords*: Homogeneous network, Heterogeneous network, WLAN, Wi-MAX, Horizontal and vertical handover, PS.**

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INTRODUCTION

Mobility management is a widely used approach in distributed environment, catering to handover and location management. The proposed scenario is designed to demonstrate the handover of access points and base stations using IEEE 802.11 to IEEE 802.16 standards respectively. The approach is simulated by configuring at the Physical and MAC layer using mobility support 802.11e protocol. As the mobile stations move with high speed, the interoperability issue arises; which is taken as a challenge and many attempts were made to overcome this problem. A correspondent node is being added to the distributed network along with mobile stations connected by a subnet to monitor the ongoing communications for 802.16 standard and by adding a router and a hub in case of WLAN. The handover decisions are based on radio signal, QOS, security support, economic cost, and user personal preferences. Both IEEE 802.11 and 802.16 have integrated MIH (media independent handover) functionality in the MAC layer. The parameters used to design these scenarios are listed in fig. 1. The architecture in fig. 1 shows a correspondent node (labelled as node 9), node 1 and node 5 acting as base stations. Node 3 acting as a mobile node and a subnet (internet) to connect the nodes for a network. Blue colored lines represent the wired connectivity, and dotted links represent wireless connections. The CBR traffic is represented with a green colored line, connecting a source in one access point to a server at another access point. The Qualnet architect and its model

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are shown in figure 2. The features of different IEEE standards that are used to design the scenario are depicted in figure 1. Handover mechanism aims at reducing the changeover and dis-connectivity, when the devices are in mobility and requires to change the base station because of low receiver signal strength (RSS). Other types of IEEE standards can also be used in order to perform changing of the station because of RSS or Signal to Noise ratio depending on the architectures in demand. The Wi-MAX forum focus is on IEEE 802.16 standard to promote and certify interoperability and compatibility of broadband wireless products for large network. Wi-max are designed for transmission of multimedia services (voice, Internet, email and others) at high data rates. These standards are targeted for line-of-sight channel conditions, works in a spectrum of 10 to 66GHz with a bit rate of 32-134 Mbps. The primary task of the IEEE 802.16 Wi-MAX MAC layer standard is to provide an interface between the higher transport layer and the lower physical layer. The 802.16 MAC is designed for point to multipoint communication based on collision sense multiple access transmission with collision avoidance (CSMA/CA) and used for metropolitan broad band wireless access systems with wide variety of applications.

802.11		802.16		Their common properties	
Parameter	802.11	Parameter	802.16	Parameter	Value
Phy Layer-Radio Type	802.11 b	Phy Layer - RadioType	802.16 Radio	Simulator	7.4
Data Rate	2Mbps	Packet Reception model	802.16 Reception model	Terrain Size	1500m, 1500 m
Packet Reception model	802.11 Reception model	FFT size	2048	Network Protocol	IPv4
Frequency band	2.4 GHz	Transmission power	20dBm	Routing Algorithm	AODV
Transmission power	15dBm	Channel BW	20MHz	IP fragmentation unit	2048
Max. Transmission power	15dBm	Max. Transmission power	50 dBm	Mobility model	Random Way point
Channel BW	6 GHz	Routing protocol	AODV	No. of Channels	2
MAC protocol	802.11	Network Diameter(hops)	35	Application traffic	CBR
Routing protocol	AODV	Station type	BS and MS	Simulation Time	60 minutes
Station Association type	Dynamic				

Figure 1 : Scenario Parameters

The 802.16 Wi-MAX band is split into three different radio frequency bands of 2.5GHz ,3.5GHz for licensed bands with channel bandwidth of 1.75, 3.5, 7,14 and 28MHz and 5.8 GHz used for unlicensed with channel bandwidth in 5, 10 and 20 MHz. The selection of 802.16 is most flexible and reconfigurable across large area of frequency and bandwidth therefore is being used in configuration .The IEEE 802.16 PHY specification uses OFDM and uses the following modulation and encoding combinations: QPSK 1/2, QPSK 3/4, 16QAM 1/2, 16QAM 3/4, 64QAM 1/2, 64QAM 2/3, and 64QAM 3/4. MAC Layer: QualNet models two QoS-capable MAC protocols: IEEE 802.11e MAC and IEEE 802.16.

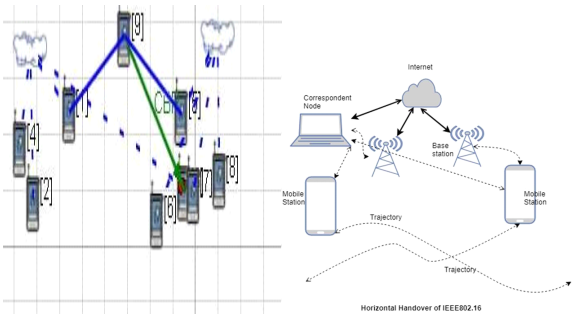

Figure 2: Network architecture for IEEE 802.16

Horizontal handover between two subnets of IEEE 802.11 is shown in fig. 3. When the signal quality degrades, the mobile station communicating with the correspondent node moves to a new neighbor through the trajectory towards a reachable access point.

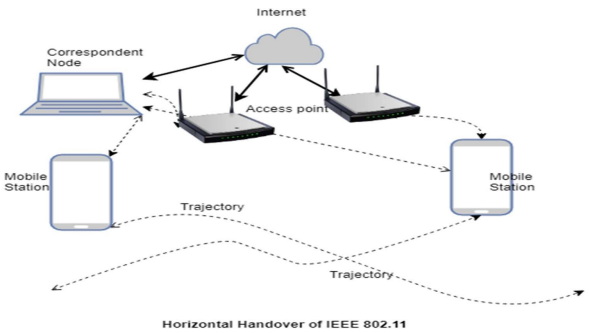

Figure 3 : Network architecture for IEEE 802.16

EXISTING RELATED WORK

The existing work is based on the vertical and horizontal handover, inter and intra network handover and collaboration of handover formed using different IP versions. A detailed list of surveys is depicted in table 1 with some suggested enhancement that can be incorporated to extend the exiting approaches.

MATERIALS AND METHODS PROPOSED

Proposed IEEE 802.11 Handover characteristics and prerequisites

In 802.11, the data exchange is initiated by associating an access point with a wireless host. The access point is located by the host using active and passive scanning. In active mode, the host transmits a probe request frame, and access point respond to it with "probe response frames", where as in passive, host locates access points through "broadcast beacon messages" sent via access points.

Table 1: Surveyed Details in context of references quoted

Ref. .No	Proposal	Enhancement
[1]	The inter-working simulation and analysis of the results for 802.11 interface used for WLAN and 802.16 interface used in WIMAX was demonstrated with the graphical justification.	Implementation is done using sensor networks and with a case study using test bed could be an enhancement.
[2]	The proposal is to find the delay and throughput for ipv4 and ipv6 protocols with the demonstration of horizontal and vertical handovers.	Checking the performance using mobility model for both the scenarios can be used as an extension of the proposal.
[3]	The proposal is to define a of a new network selection algorithm based on a different formulation of the technique, which is to determine the Radio access network (ran) that a mobile node (mn) has to use among several available RANS.	Enhancement can be done using six performance metrics to evaluate the network Selection algorithms: 1. Received signal strength indicator (RSSI) expressed in [dbw] 2. Capacity (c), in [bps], that is assigned to the mobile nodes for transmitting the UDP traffic flow. 3. Monetary cost paid For transmission. 4. Power consumption (p) of the network, expressed in [w] 5. Packets delay (d) calculated as the difference between the packet transmission and Number of handover executed.
[4]	Analyzes the performance parameters of immh, including the mobility handover cost and the mobility handover delay. The analysis is made for intra and inters handover.	Future work is to further study the mobility handover scheme for ipv6-based Vanet.
[5]	Generates handover messages which alert the source nodes about a route failure in advance. A novel mechanism which uses Heuristics for predicting connectivity period TTL of a local link in a Route).	To enhance, the soft state maintained at intermediate nodes can be extended to implement the resource reservation protocol (RSVP) by including tear down messages.
[6]	The rationale behind using CDMA at the physical layer between the RS and BS is that, CDMA being a spread spectrum technology provides efficient protection against the band limited noise, even in high mobility conditions, its performance is better than the other access methodologies. The power consumed and battery utilization is calculated to show that the net power consumed is reduced at the mobile station.	Working with a heterogeneous network using CDMA-of DMA links for different IEEE standards.
[7]	The aim of the proposal is to measure performance metrics using IEEE standards 802.11 and 802.16 using delay and non-delay in transmission.	The proposal can be integrated using the handover approaches.
[8]	The classification of adhocs networks into homogenous and heterogeneous along with its comparison is given. The main difference pointed out by the author was that the homogenous nodes consist of nodes of same type in terms of battery power and functionality whereas heterogeneous network consist of different nodes in the network. This approach of classification is used for creating the network architecture.	Extending work for different IP versions.
[9]	The work is implemented using SINR algorithm.	Comparative study of SINR and RSS.

The aim is to demonstrate handover mechanism in between both APs including beacons, active scanning, authentication and association processes. After discovering available APs, host decides which AP to join, thereby initiating an authentication and association of frame exchange. The agreement on encryption type is carried out in association phase. The final phase is to grant host an access to the network for beginning the data exchange process. Once the host is handed over to other AP using authentication and association process, it retains this connectivity till APs depart. Since base station are not available in 802.11, access points are used for communication with respect to subscriber stations. The "scan type" needs to be activated to set the "scan-channel-time" , so that the station waits for the probe response on the channel for a maximum of 1024 micro seconds (time unit) and the handover Receiver signal strength can be activated. In 802.11 b, the threshold is estimated to be a sum of signal strength and RSS margin. If the RSS of the serving base station is less than the threshold, then STA needs to scan and reassemble for a new access point.

802.16 Handover characteristics and prerequisites

IEEE 802.16e adds mobility support to IEEE 802.16 and supports mixed, fixed and mobile broadcast wireless access networks. In the 802.16e specification, Subscriber Stations (SS) are also referred to as Mobile Stations (MS). Under 802.16e, the MS can handover from one BS to another BS. The fig.2 shows the steps which are the prerequisites for conducting handover. The phases that are used to do handover include Neighbor BS

information advertisement, Neighbor BS scanning, Handover, Sleep or Idle mode, Paging, Authentication, Service Authorization server and Backbone functionalities as depicted in the algorithm in figure 4 .The initialization method of MAC layer is used to begin the scanning, thereby registering all the neighboring reachable and available base stations. The configuration and detailed algorithm to perform handover in 802.11 and 802.16 is depicted in fig. 5 and fig. 6 respectively.

Algorithm for 802.16 Handover

Step 1: The serving BS periodically transmits information about neighboring BSs, which helps MS to guide the neighbor BS scanning. The BS gives an indication to MSs the thresholds which initiates BS scan or handover.

Step 2: When the signal quality/QoS of the serving BS degrades below a certain threshold, MS initiate discovering neighbor BS scanning, exploring available BSs and checking their suitability as targets before handover.

Step 3: MS may perform handover under two scenarios, if the signal quality of the serving BS is below the threshold of RSS, or when the QoS of the serving BS cannot satisfy the norms. (Both MS and BS can initiate the handover.)

Step 4: Sleep mode: When MS is inactive, it enters the sleep mode to optimize power usage

Idle mode: MS enters idle mode periodically listen, without ranging and registration to the Down Link (DL) broadcast traffic, hence it requires more power when compared to sleep mode.

Step 5: Paging is used to reach an inactive MS.

Step 6: Authentication and Service Authorization (ASA) server: This helps in providing Access control to MS's.

Step 7: Backbone functionalities: BS uses backbone to communicate with each other for services such as network/BS assisted handovers.

Figure 4: Algorithm

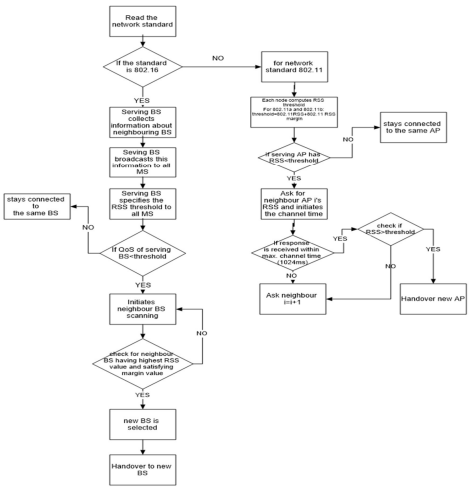

Figure 5: Phases used to perform handover

Procedure For Paper Submission

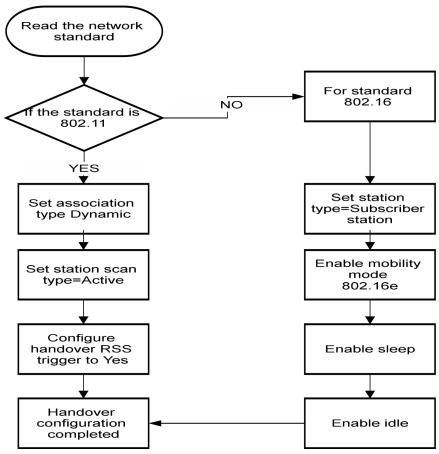

Figure 6: Configurations for handover

RESULTS

The evaluation metrics that have been considered for inspecting our proposed work are as follows:

1. Throughput 2. Average end to end delay
3. Average jitter

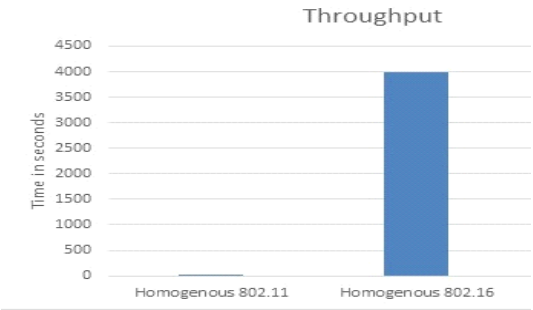

Figure 7: Throughput for WLAN and WiMAX

Throughput for homogenous networks are depicted in fig. 7 with an anticipation that it is more in case of IEEE 802.16 standard, which can be credited to good delivery rate. This further helps to proof that the performance is good for the delivery rate in Wi MAN w.r.t WLAN.

In the fig. 8, the graph clearly illustrates that the average delay exponentially decreases in heterogeneous architecture. A network created with different characteristics at the node level is treated as hetero otherwise homo. The average jitter for WLAN scenario executed for 60 seconds is 2.6E-4 while 802.16 is 2.4 E-4.

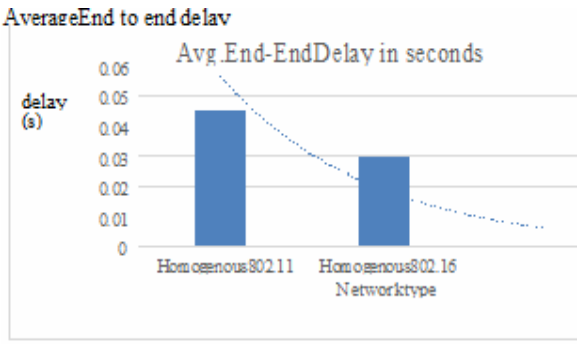

Figure 8: Average end to end delay

After comparing the mobility support protocol with power saving (PS) in fig. 9 a conclusion can be drawn that in PS mode the average end to end delay for unicast transmission is less, since the major concern lies with reducing the power consumptions of the signals transmitted at the physical layer. The protocol IEEE 802.11e shows negligible amount of delay because of support to mobility.

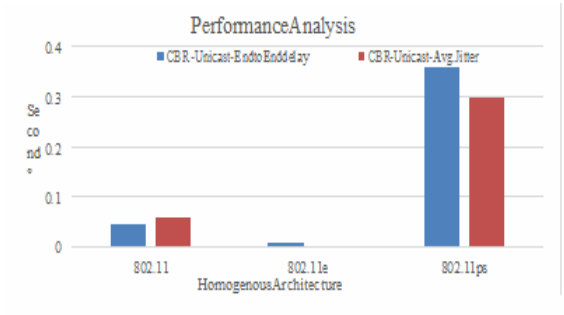

Figure 9: Different scenarios of 802.11 with two metrics

Fig 10 depicts the Wi MAX architecture with no relay and two relays added to observe the effect of using a node to cache the data. The end to end delay and average jitter is less in case of more cached nodes as data availability increases the delay exponentially decreases.

DISCUSSION

In our findings, it is observed that the addition of IEEE 802.11e or IEEE 802.16e increases the mobility support for the nodes. There is a possibility of an Intra base station handovers in 802.16 architecture.

The vertical handover occurs when there is a difference in the signal strength and reception level, i.e. when the connectivity is created from WLAN to Wi MAX as shown in fig. 11.

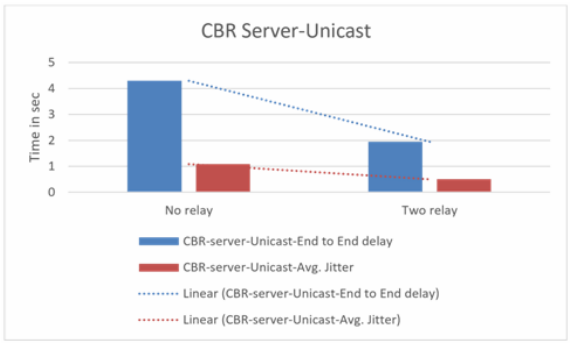

Figure 10: : Different scenarios of 802.16 with relay

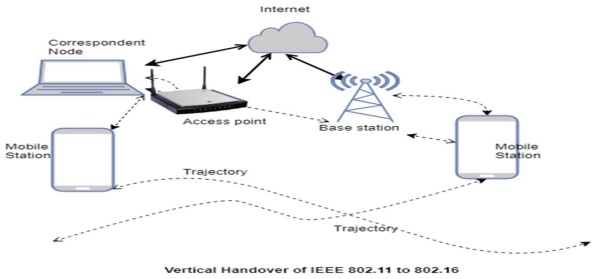

Figure 11: : Vertical handover of IEEE 802.11 to 802.16

CONCLUSIONS

The horizontal handover between 802.11 and 802.16 wireless access networks are investigated. The configuration consist of a homogenous network of IEEE 802.11 with a handover of Access points, a homogenous network of 802.16 with a handover from one Base station to other demonstrating horizontal handovers and finally a heterogeneous network for handover from access point to base station for vertical handover is taken as an enhancement. The handover decision algorithms, combined with admission control can guarantee QoS support to the existing traffic flows in WLAN, by transferring new calls to the other network whenever necessary providing an un-interrupted communication with interoperability. The simulation results show that Wi-MAX out performs in many parameters with respect to Wi-Fi, therefore the integration of these two technologies can benefit WiMAX operators through a low cost service deployment provided by Wi-Fi. In the designed scenario, if the mobile node move at a high speed using 802.11e or 802.16e, then it is preferred to continue in a larger coverage area to avoid frequent disruptions due to handover, while moving across smaller WLAN coverage. The futuristic scope is to explore MIH support for multi-hop heterogeneous networks, resource allocation and appropriate

routing algorithm to be applied for the generation of optimal results for different IP protocols.

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