AN EFFICIENT AND RELIABLE VERTICAL HANDOVER BETWEEN WiFi AND WiMAX NETWORK

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ABSTRACT

WiMax and WiFi technologies are the high speed networks. These type of technologies are the telecommunications technologies that offers transmission of wireless. In such kind of networks each mobile user is controlled by its owner base station. As a node move outside the coverage area of its base station, this process is called handover. To keep the uninterrupted communication between two nodes during the handover process is a challenging task. In case of vertical handover this process is more critical. To perform the effective handover process the parametric changes are suggested here to perform the selection of Base Station. The obtained results shows the proposed work has improve the network throughput during vertical handover process.

Keywords*: *Handover, Throughput, Vertical Handover, WiFi, WiMax

I INTRODUCTION

A Wireless network is the world wide open adhoc network in which any user can participate any time. As the environment is open, it consist different networks in it. These networks differ in terms of their individual architecture, protocol, parameters and the communication approach. A wireless network can be a hybrid network that can include personal area network, wimax, wifi, broadband network etc. Because of this hybrid nature of the network, the network can have number of complications in terms of data transmission, voice transmission etc. The problem becomes more complex when the situation of handoff occurs in such hybrid scenario. The handover is the mechanism when a node moves from its coverage area to the outside world. In the outer open environment there can be more then one network that are eligible to get the grant over that node. If these networks differ in terms of their architecture and the communication specifications then the decision to take control over that node becomes more critical. In this paper we have discussed the same problem in case of hybrid network with wimax and wimax architectures. The paper has suggested the parameter analysis to take the effective and reliable decision about the selection of network when the handover occur over the network. WiMAX (based on IEEE 802.16 standards) is a broadband wireless access technology designed for metropolitan area networks. WiFi (based on IEEE 802.11 standards) is a wireless access technology for local area networks. A WiMAX base station (BS) covers an area whose radius is of the magnitude of several miles. A WiFi access point (AP) covers an area whose radius is about 100 meters. WiMAX performs better, but WiFi is more cost efficient. WiMAX and WiFi networks can be deployed considering their complementarities in terms of performance, cost, and coverage. WiMAX can guarantee user mobility in a large area, while WiFi is selectively deployed in hot spots with a concentration of mobile users and heavy network traffic. WiFi can also be deployed indoor or in tunnel to extend the coverage [3].

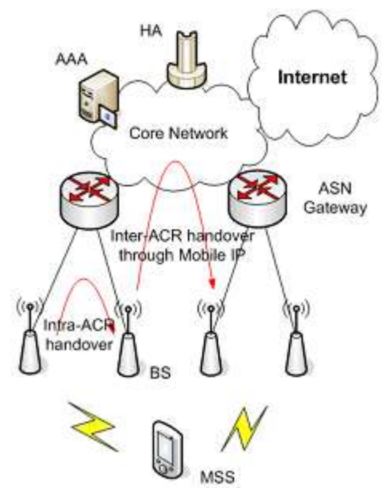

Fig 1: Wimax Architecture

Here Fig 1 shows the architecture of mobile WiMAX network in terms of the network elements and their functions. There are four main components in the architecture: MSS (Mobile Subscriber Station), BS (Base Station), ASN (Access Service Network) Gateway, and core network communicates with the BS using IEEE 802.16e wireless access technology. The MSS also provides the functions of MAC processing, mobile IP, authentication, packet retransmission, and handover. The BS provides wireless interfaces for the MSS and takes care of wireless resource management, QoS support, and handover control. The ASN Gateway plays a key-role in IP-based data services including IP packet routing, security, QoS and handover control. The ASN Gateway also interacts with the AAA (Authentication, Authorization, and Accounting) server for user authentication and billing. To provide mobility for the MSS, a ASN Gateway supports handover among the BSs while the mobile IP provides handover among ASN Gateways [6].

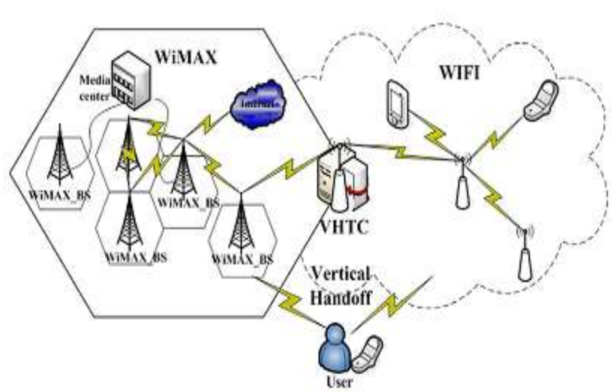

Fig 2: WiMax-WiFi Network

WiFi proposes HCF (Hybrid Coordination Function) in the PCF (Point Coordination Function) mechanism of MAC layer. In HCF, it defines two modes: EDCA (Enhanced Distributed Channel Access) and HCCA (HCF Controlled Channel Access). EDCA is applied to DiffServ flow control and HCCA is applied to IntServ flow control [8].

II OVERVIEW

With the advancement of the Mobile Networks the number of users over the network is increasing very fast. Because of this each network base station has to handle a vast number of mobile users. Because of this it is challenge to provide the effective communication to the mobile users. Because of this sometimes to share the load on a network with other the handover mechanism is performed where the control of one mobile user pass on to the other base station. Now here the main challenge is to select the new base station that will take charge of the mobile node. The challenge is to perform the task of handover effectively, efficiently and reliably. A handover protocol may sit at a single layer of communication protocol stack or across several layers. Session Initiation Protocol is an application layer handover solution. Cellular SCTP (Stream Control Transmission Protocol) is a handover approach at transport layer. Mobile IP has been proposed as a handover solution at network layer. Fast BS Switch has been proposed as link layer handover protocol in WiMAX networks [14].

According to different researchers the complete handover mechanism is divided in three phases [2]:

a) Information Collection

In this phase different parameters based on which the decision about the handover process will be taken place. These parameters may include the distance, cost, energy, throughput etc.

b) Handover Decision

It is one of key factor or the decision control using which the decision will be taken about the handover. The effective decision must return the maximum throughput and the minimum loss over the network.

c) Handover Execution

As the final process the handover process is executed. Here the execution process is the implementation of presented approach.

There are number of approaches and parameters are present based on which the handover can be performed. One of such approach is movement based handover mechanism. This handover analyze the node movement periodically respective to node movement and the velocity. The maximum benefit base station will be selected as undertaking network [1]. The approach is the location based handover. Location information is very important for fast handover, especially in handover from a large scale network to a small scale network since a visit to small scale network is more likely short and a short visit may result in Ping-Pong effect. Location can be used to reduce network probing time, estimate connection time with candidate network, and select proper target network. The connection time can be used to avoid the Ping-Pong effect [3].

III COMPARISON

In the proposed HO scheme we will evaluate maximum effective capacity and idle capacity of a BS in a Point to Multipoint (PMP) WiMAX network. We will then add the effective idle capacity as the HO trigger and a decision factor for the selection of HO target cell. The algorithm steps are as follows:

3.1 BS Maximum Capacity Evaluation

To evaluate the BS capacity we will calculate total number of OFDM (Orthogonal Frequency Division Multiplexing) symbols and number of overhead symbols in WiMAX MAC (Medium Access Control) frame. Here we consider Time Division Duplexing (TDD) where every frame is divided into DL and UL sub frames. Fig. 1 shows the MAC frame structure [8] where the overheads are marked in bold and italic.

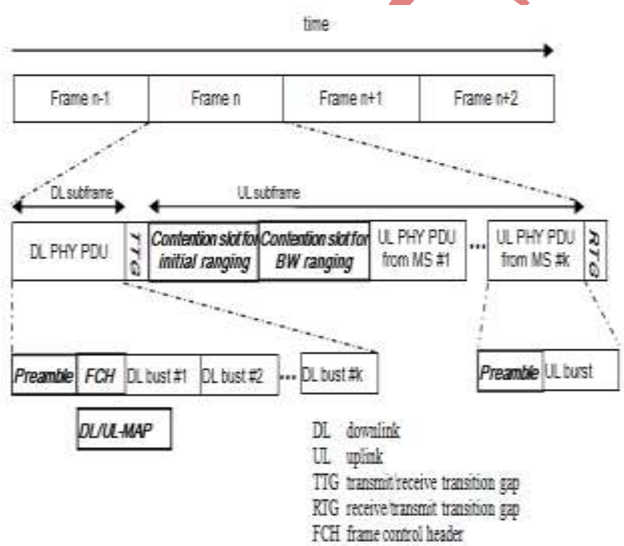

Fig 3: WiMAX MAC Frame

To calculate total number of OFDM symbols transmitted per frame, first we have to calculate OFDM symbol duration which is given as:

TD_{OFDM} = useful symbol time + guard time

TD_{OFDM} = useful symbol time + G * useful symbol time

$$\mathbf{TD_{OFDM} = [1 / (f_s / N_{FTT})] * (1 + G)} \qquad - (1)$$

Where N_{FTT} is total number of subcarrier for OFDM PHY which is 256. G is Cyclic Prefix (CP) ratio=1/4.

fs is Sampling factor = (Bandwidth * 144/125). Here we have taken 5MHz channel bandwidth. This gives TD_{OFDM} = 55.5 µs. We can compute total number of symbols as

$$\mathbf{N_{symbol} = T_{frame} / TD_{OFDM}} \qquad - (2)$$

Where T_{frame} is the frame duration and if assumed 20 ms gives N_{symbol} =360.

To calculate overhead symbols we start with preamble. Every preamble occupies first 2 OFDM symbols of DL sub frame. The FCH occupies 1 OFDM symbol. The size of DL-MAP and UL-MAP [9] is given as:

DL-MAP size = (64 + 32 * n) / 96,

UL-MAP size = (56 + 48 * n) / 96

Where n is number of active SSs that are served in the current frame. 96: represents the number of useful bits carried by an OFDM symbol for BPSK 1/2 scheme. 32 and 48: represent the number of bits carried by a DL-MAP Information Element (DL-MAP IE) and UL-MAP Information Element (UL-MAP IE), respectively.DCD/UCD overhead can be neglected as they are used for synchronization purpose only. Initial ranging message occupies 7 OFDM symbols and Bandwidth request slot 2 OFDM symbols. The TTG/RTG gap occupies 1 OFDM symbol. So, total overhead symbols can be given as [10]:

$$\text{Or, } \mathbf{N_{symbol\_overhead} = 13 + (120 + 80*n)/96} \qquad - (3)$$

Assuming number of active MS at present = 5 gives $N_{symbol\_overhead}$ = 18. Now we can calculate effective capacity as:

$$\mathbf{C_{effective} = ((N_{symbol} - N_{symbol\_overhead}) * 96)/T_{frame}} \qquad -(4)$$

Using the values computed above gives

$C_{effective}$ =1.64 Mbps

3.2 Idle Capacity Advertisement via MOB-NBR-ADV message

The BSs periodically broadcast Mobile Neighbor Advertisement (MOB_NBR_ADV) control messages. These messages contain both physical layer and MAC address information. By means of such broadcasts, the MS becomes aware of the neighboring BSs. Each BS can also broadcast the idle capacity information of itself and of the neighbor BSs to the connected MSs via the MOB NBR-ADV messages, together with the DCD/UCD information [11]. To calculate idle capacity each BS can estimate its maximum effective capacity on a real-time basis. Through statistics a BS is also aware of the current data traffic throughput. Therefore, each BS could obtain the effective idle capacity as:

$$\mathbf{C_i = C_{effective} - C_{throughput}} \qquad \mathbf{- (5)}$$

3.3 Target Cell Decision

In our decision algorithm the decision factor for each candidate BS depends on both factors: idle capacity and signal strength. We have combined the two factors into a weighted target cell decision function. Here P denotes the signal power. Based on the decision function, MS selects the candidate BS_K with the lowest value of D_k as the target cell to switch. W_1 and W_2 are the weights assigned to the two criteria.

3.4 Algorithm

The basic steps of this proposed approach is given in the form an algorithm

a) Define the Hybrid Network with N Number of Clusters. Some networks are Wifi networks and some are Wimax network

b) Define the initial parameter for each node of network such as bandwidth, transmission rate etc.

c) perform the random selection of source node and the cluster that will perform the handover call ClusterI and NodeJ

d) for i=1 to Length(Neigbours(ClusterI))

{

Calculate Distance(i)= DistanceBetween(Node(i),Cluster(i))

Calculate Throughput=ThroughputOn(Cluster(i))

Calculate IdleTime=IdleTimeOn(Cluster(i))

}

e) find clusterN such that Distance(i) is Minimum, Throughput(i) is Maximum and IdleTime(i) is minimum

f). return cluster N

}

IV OBJECTIVE AND DISCUSSION

In this present work we have perform the vertical handover between the Wifi and the WiMax networks. We have defined some decision vectors based on which the handover can be performed on both the WiFi and the WiMax network. The work is implemented in NS2.35 under ubuntu environment. The results driven here are compared in terms of packets transmitted and received over the network.

Fig 4: Packets transmitted (Proposed Vs. Existing)

As in fig 3, the number of packets transferring in Proposed Handover approach is more as compared with existing. As time increases WiMAX dark line shows increment in packet transferring. Here the yellow line represents the packets transmission over the network with proposed approach and pink line shows the packet transmission in case of existing approach. As we can see the proposed approach has increased the data transmission over the network.

As in fig 4, bit rate is high in Proposed Handover as time increases as compared with Existing Handover. The bit rate of the proposed approach is represented by yellow line and in case of existing approach it is represented by pink line. As we can see the bit rate is increased in case proposed approach.

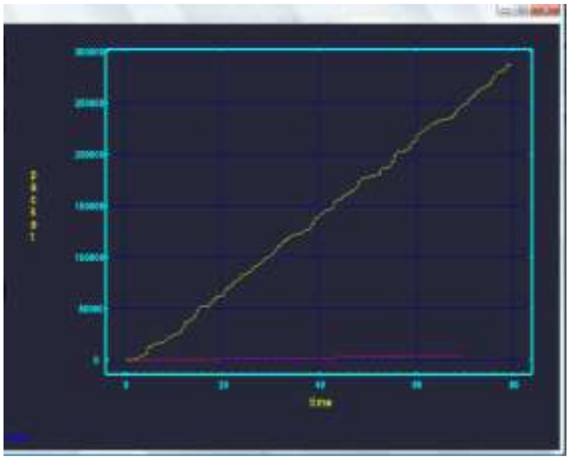

Fig 4: Bit Rat

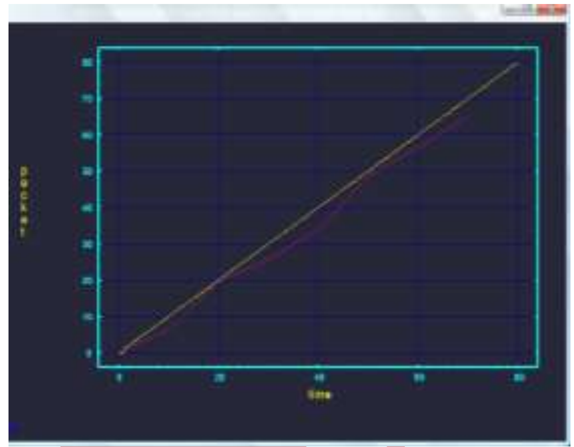

Fig 5: Packet Loss

In fig 5, this shows that Proposed Handover shows a somehow constant line but Existing Handover line shows high packet loss. As we can see the packet loss is reduced in proposed approach as compared to the existing approach.

In fig 6, as time increases the packet is start transferring as compared with existing Handover. But in case of Existing Handover it shows the constant line. So where the packet transfer packet loss is also there. Here we can see the proposed approach can also handled the delayed transmission efficiently.

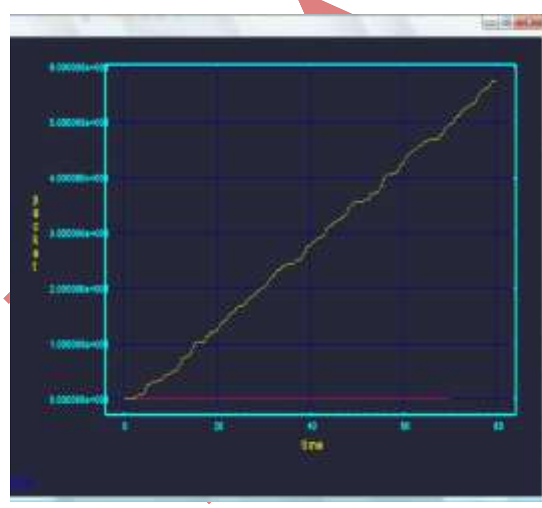

Fig 6: Last Packet Time

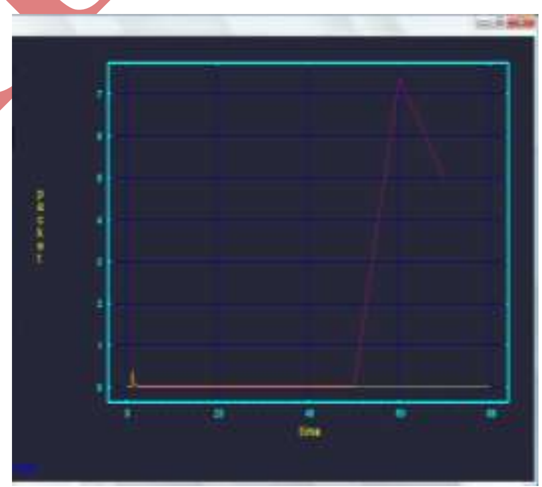

Fig 7: Delay Time

In this fig 7, shows that delay time is less in Proposed Handover Approach in fact very constant as compare to Existing handover Approach. As we can see in existing approach the delay time is increased as the handover performed. But in proposed approach the delay time is constant.

V CONCLUSION

The paper introduced an optimized handover scheme for WiMAX network. The method is based on effective capacity estimation of a BS and advertising idle capacity information through neighbor advertisement messages as per the IEEE 802.16 specifications. More parameters we have taken for decision making are transmission delay and the network throughput. The obtained results shows the presented work is quite effective to performed the proposed work.

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