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MODIFIED VERTICAL HANDOFF DECISION ALGORITHM FOR IMPROVING QOS METRICS IN HETEROGENEOUS NETWORKS

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ABSTRACT

In 4G networks, the meshing of WiMAX and WLAN has been a tough task. Issues regarding intermeshing of WIMAX and WLAN networks during vertical handoff have to be analyzed. Two interconnected networks such as WIMAX and WLAN has been proposed. Our proposed scheme provides better connectivity between fixed and mobile stations. In our proposed framework, two heterogeneous networks have been interconnected with each other and vertical handoff occurs between the two networks. A modified vertical handoff decision algorithm has been designed to calculate the bandwidth in WLAN and WIMAX networks. Packet delay is also calculated in modified algorithm. By calculating the bandwidth and packet delay, QOS metrics have been achieved by increasing the bandwidth and reducing the packet delay. Ad hoc network is the combination of wireless nodes without any infrastructure. It follows decentralized. Our proposed system improves the bandwidth and packet delay.

Keywords: *Mobility, Adhoc Network, Bandwidth, Access Point, Base Station, Packet delay.*

1. INTRODUCTION

Mobility is the process in which the movement of nodes takes place from one radio cell to another. Handoff is the process in which the connectivity of an active call of the mobile user of one base station from one radio cell has to be transferred to the other base station of another radio cell. This has to be achieved in nanoseconds. Mobility and handoff are the two important aspects of mobile communication. Existing system achieved handoff by transferring the connectivity. During the process of handoff, a mobile user or mobile station has to cross several radio cells. Crossing the boundary between cells has to be achieved within fraction of seconds. In handoff process, the active call has to be transferred between the radio cells. Handoff has to be requested to occur when the process is called as Handoff Initiation. Handoff decision is based on the RSS of base stations.

Handoff is widely classified into four types based on the MS (Mobile Station) movement between the types of networks. It is horizontal, vertical, soft and hard handoff.

Horizontal handoff is the handful that occurs between two same types of networks. It occurs between two access points also. Vertical handoff is the handoff that occurs between two different types of networks. Hard handoff or break-before-make handoff is the handoff in which the connectivity of MS from one base station will cut during the transformation of connectivity. Soft handoff or make-before-break the handoff in which the connectivity occurs in both BS (Base station simultaneously).

In soft handoff the connectivity of MT (Mobile Terminated) is connected simultaneously to BS (Base Station), so they won't be any connectivity issues. But In case of hard handoff MT (Mobile Terminated) is connected to only one BS (Base Station). Here the connectivity issue is very high.

Adhoc networks for mobile are vital networks in which nodes can freely move. The main issue depends upon the packet loss, packet delay, path loss and collision in multipath. Each node is responsible for the reliability of packet transmission on the path. In our proposal, the nodes itself calculate the distance between the AP (Access Point) and the BS (Base Station). All nodes know their location and position. In our proposal, the bandwidth is related to the number of users. If the number of users increases the bandwidth will reduce. We are setting a maximum of 4 users in

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which we are increasing the QOS (Quality of Service) such as bandwidth, packet delay, packet loss.

2. RELATED WORKS

In the previous vertical handoff methods, Bandwidth was considered as the QOS parameter. Two different networks have been interconnected with each other. When the mobile station is moving from one network to another handoff occurs. Therefore the overlapped region having fixed and mobile station will not be receiving the highest signal strength. [1] Dong Ma and Maiode Ma proposed two interconnected networks in which, vertical handoff schemes provide high QOS (Quality of Service) based on its architecture. But the disadvantage of this system is the signal strength is very less in the overlapped region. Another disadvantage is when the nodes are in out of range the communication is not feasible.

Improvement of features in various access network techniques for the fulfillment of any service needs of the mobile users has been considered by the Overlay Network, however setting a particular network is much more complex and expensive for access network and also Security can be the complex issue for the bigger network [2]. Guo et al. [3] demonstrated a handoff scheme in an effective manner to provide the quality of service and mobility to the mobile and fixed users. In 4G network handoff related issues have been discussed.

In [4], mobility management for active roaming among heterogeneous networks has been achieved. Various networks have been proposed which has various advantages such as maintaining the connection continuously across handoff failure and delay. Lampropoulos et al. [5] defines the research area of managing the handoff in cellular networks. Interface problems have been identified in the cellular networks to increase the bandwidth at geographical areas. To increase the metrics such as speed, reliability author used UMTS technology. In [6], the author determines a handoff algorithm such as Movement-Aware Vertical (MAV) between different heterogeneous networks by providing access in seamless procedure. In [7], the QOS metrics have been demonstrated by the author in IEEE802.11b network. The probability of maximum call dropping has been reduced in the real-time traffic.

In [8], the author defines the bandwidth link between sequences of successive bandwidth links. Author clearly determines the estimation of availability of bandwidth, but the main disadvantages is the bit rate and packet loss has not been considered. In [9], a scheme called as recycling of bandwidth has been proposed by the author. The main aim of the scheme is Subscriber stations utilize the bandwidth which is unused. He also worked on improving the throughput. In [10], the historical patterns of handoff for mobile devices have been proposed by the author. Based on the tracing of mobile devices by their relative signal strength and movement speed energy can be conversed and consumed. Power usage in handoff operation has been reduced to improve the QOS metrics. The efficient classification of relevant and irrelevant images predicted suing hybrid technique [11] and the QoS web services are predicted by using web service composition [12].

3. PROPOSED WORK

In our proposal, we are implementing cognitive radio network in the Adhoc environment. In our proposed model, the communication is created by the primary user when the node is in the overlapped region. The primary user acts as the secondary device which is responsible for making the communication.

Proposed model has been designed in such a way that vertical handoff occurs between two heterogeneous networks. To increase the rate of data transferred between two network bandwidth has been calculated by using modified vertical handoff algorithm. Packet delay has to be reduced during the handoff process and this can be achieved by calculating the packet delay. Both WIMAX and WLAN networks have been initialized with the station that has mobility. Traffic has to removed from the path between networks. Availability for mobile nodes has been checked and the communication takes place between the networks by selecting the best network.

Cognitive radio is the network that has the capability to detect the channels automatically based on the availability and allows implementing two communications concurrently. It detects the channels based on the location, radio channels, time delay and other parameters. This helps in providing precedence communication and efficient use of spectrum. Users are classified into two types in Cognitive radio. Those users are primary and secondary user.

The major advantage of our proposed system is QOS (Quality of Service) is efficient because both the MS (Mobile Station) and the Fixed Station can

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be benefited in the overlapped region. Another advantage of our system is the communication takes place when the node is in out of range. In our proposed work bandwidth, packet delay and packet loss are taken as the main issue that has to be solved. The main goal of our proposal is to increase the bandwidth, reduce the packet delay and packet loss. The proposed architecture is shown in Fig 1.

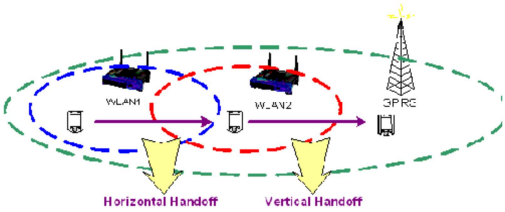

Fig. 1 System Architecture

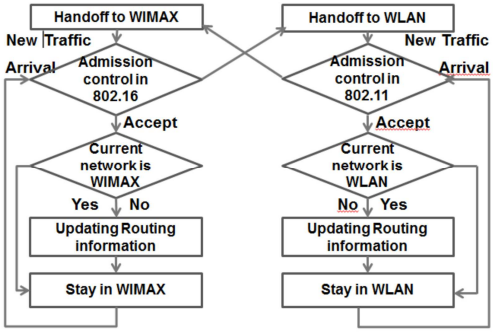

Fig. 2 Dataflow Diagram

4. ALGORITHM

We are proposing a modified Vertical Handoff decision algorithm in which Vertical Handoff has performed stand on bandwidth, packet delay and packet loss which is calculated in our proposed system. The handoff decision is taken based on the availability of bandwidth and reduced packet delay and packet loss.

B_d/B_u	Bandwidth for downlink/uplink connection.
AAS_d/AAS_u	Number of allocated DL/UL slots in one frame.
S_d/S_u	Total slots in DL/UL frame.
δ_d/δ_u	Number of bits transmitted in a DL/UL slots.
T_f	Duration of a frame.
NAV	Network allocation vector.
$T_{n,c}$	NAV duration for collision.

Table 1: Notations used in the algorithm

Algorithm 1: Modified Vertical Handoff Decision Algorithm

Step 1: Initialize a mobile station that can manage both WIMAX and WLAN.
Step 2: Create a new path with no network traffic.
Step 3: Initialize both WIMAX and WLAN networks simultaneously.
Step 4: Mobile node checks whether the network is available or not.
Step 5: if (network available) then
if (only one network) then
Get communication
from that network.
else
For(each node)
Checks which one is the best network.
End if
Theoretical Calculation,
Bandwidth calculation for WIMAX

$$\begin{cases} B_d = \left(\frac{1-AAS_d}{S_d}\right)\frac{\delta_d S_d}{T_f} \\ B_u = \left(\frac{1-AAS_u}{S_u}\right)\frac{\delta_u S_u}{T_f} \end{cases}$$

Delay calculation for WIMAX

$$t = t_s + t_q + t_m + t_t$$

Bandwidth calculation for WLAN

$$BW=B0-L\frac{NAV}{T_n+\frac{1}{2}T_{n,c(N-1)}}$$

Delay calculation for WLAN

$$t = t_q + t_a = \frac{\lambda t_a^2}{1-\lambda t_a} + t_a$$

Step 6: Comparison takes place between WIMAX and WLAN by both networks.
Step 7: VHOM (Vertical Handoff Manager) selects the best network.
Step 8: If no BS OR AP detected
The availability of the nearest mobile station with AP and BS connection which has enough bandwidth limits is checked by the VHOM

If the mobile station is discovered with enough bandwidth limits, then the communication is made by that mobile station.

Step 9: Else No communication.

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5. EXPERIMENTAL RESULTS AND DISCUSSION

NS2 is the simulation tool that is used for the purpose of analyzing and to show the prototype model of VHO and enhancing the property of ad-hoc. Bandwidth and packet delay is calculated using X-Graph.

In Figure 3 shown the VHO output window model of WIMAX and WLAN has been implemented. In this output model, there are totally 15 nodes which have both WIMAX and WLAN mobile nodes. If a mobile node is out of the range of WIMAX and WLAN the communication between the AP (Access Point), BS (Base Station) and the mobile node is not possible.

In Figure 4 shown our enhanced proposed model VHO with the ad-hoc property has been implemented. Whenever the mobile node is out of coverage area of BS (Base Station) and Access Point (AP) or overlapped region the mobile node can search for another mobile node which is having additional bandwidth. The node which has additional bandwidth acts as the primary user and the node search for another node act as the secondary user. If the secondary user finds the primary user mean secondary user can make communication through the primary user.

6. PERFORMANCE EVALUATION

We are analyzing the performance of the mobile node through X graph. From the above graph, we can view that the packet delivery performance is high for VHO (Vertical Handoff) with ad-hoc network when compared with the normal VHO operation. There are two X graphs shown in Figure 5 shown the left (A), Right (B).

"A" graph is showing the quality of VHO performance"B" graph is showing the quality of VHO performance with Ad-hoc property. Comparing the two graphs we came to a conclusion that "B" graph performance is higher than "A" graph.

The utilization of the medium is denoted by $AAS_d(AAS_u)$ which equals to $AAS_d/S_d(AAS_u/S_u)$ Simulated resulted bandwidth is shown in the Figure 6 and Figure 7.

From the Figure 8 and Figure 9, When there is an increase in AAS_d Occupation the delay in DL delay can be seen.

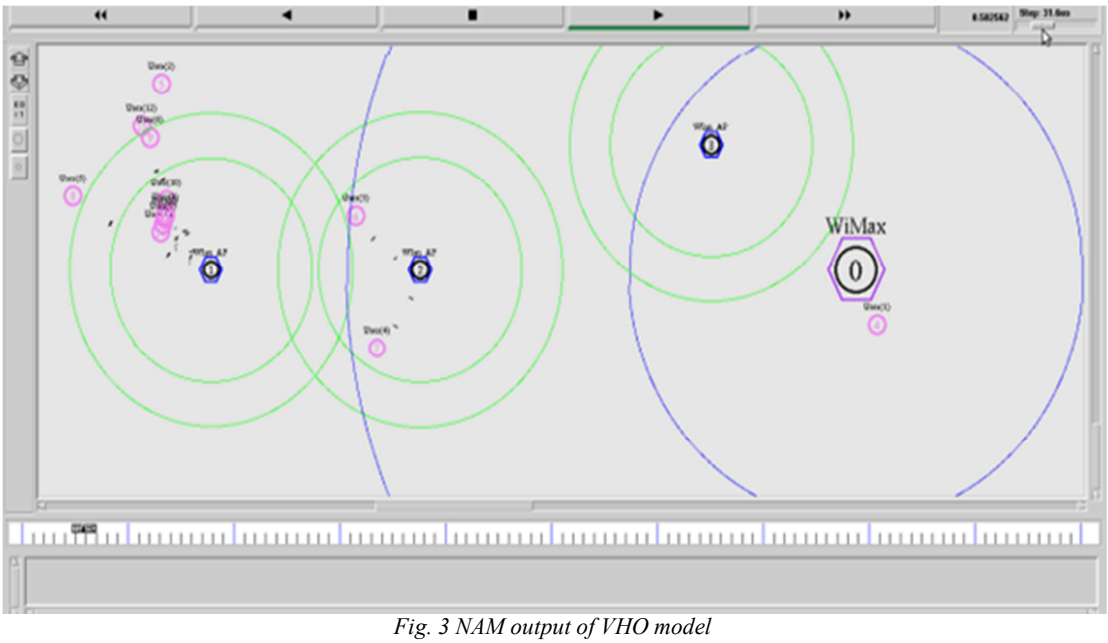

Fig. 3 NAM output of VHO model

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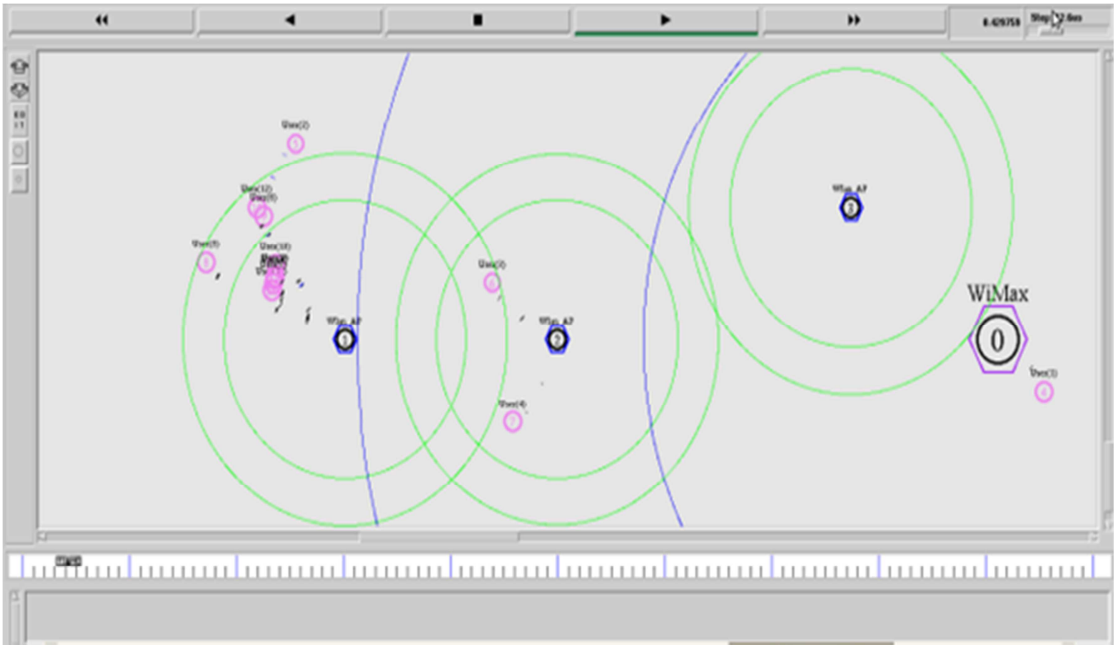

Fig. 4 NAM output for VHO-with ad hoc type

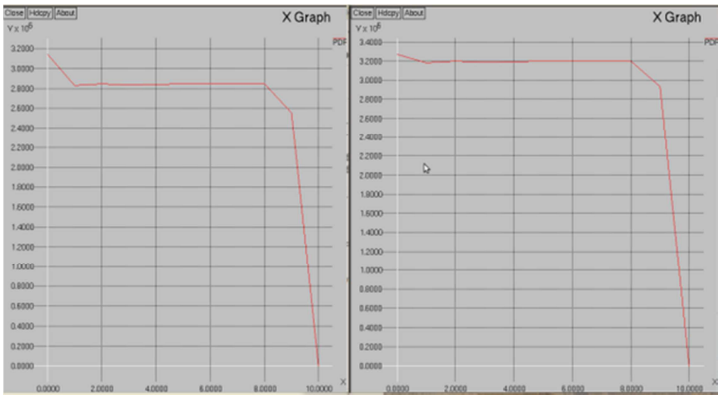

Fig. 5 X graph output for VHO and VHO with ad-hoc

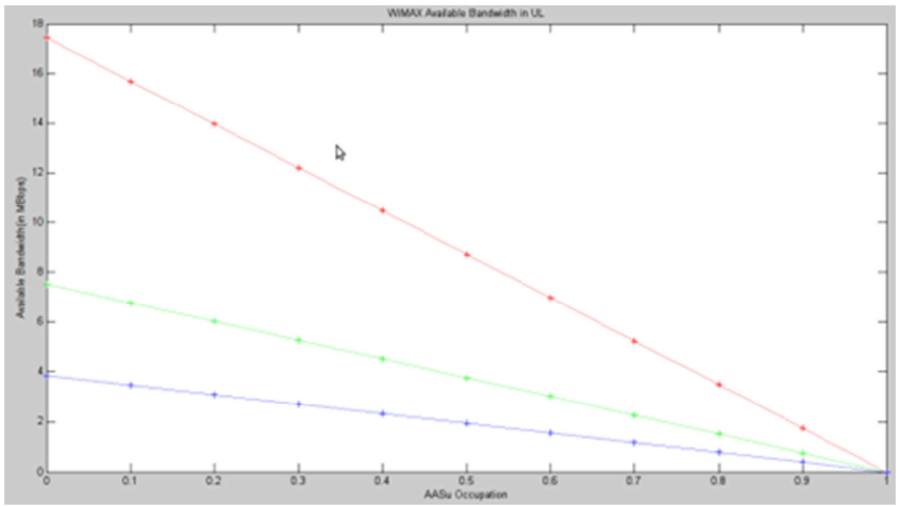

Fig. 6 Bandwidth available in UL

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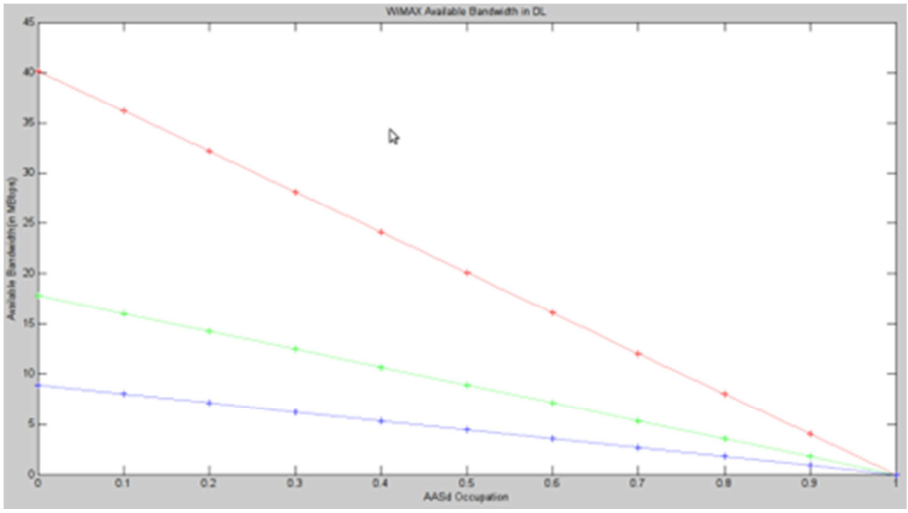

Fig. 7 Bandwidth available in DL

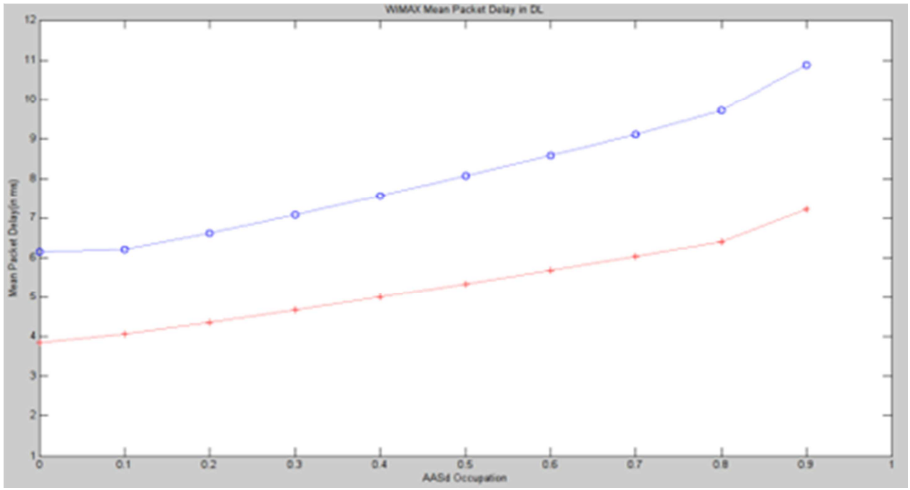

Fig. 8 Delay in WIMAX UL

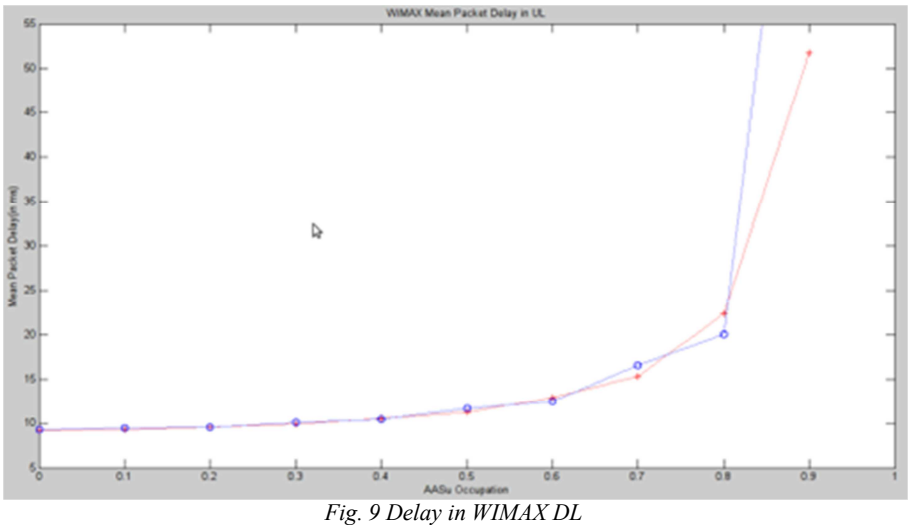

Fig. 9 Delay in WIMAX DL

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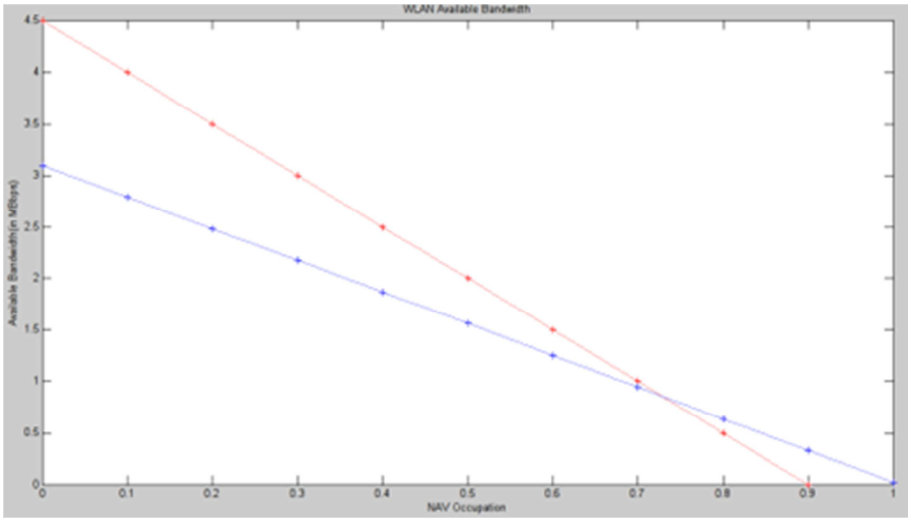

Fig. 10 WLAN Available Bandwidth

In the Figure 10, the bandwidth availability for WLAN has been shown. Therefore, the bandwidth increases if NAV is reduced.

7. CONCLUSION

In our proposal, a modified vertical handoff decision algorithm has been proposed. Our proposed work considers the duration of connections, QoS metrics such as bandwidth and packet delay, mobility information about the connection, network cost for accessing both networks, and load balancing for vertical handoff decision algorithm. The algorithm is based on the theoretical calculation of bandwidth and packet delay for both the networks. The main objective is to increase the QOS metrics such as packet delay and bandwidth. Future work can do by designing an algorithm to reduce the packet loss during vertical handoff in heterogeneous networks.

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