

QOS Oriented Vertical Handoff for Wimax/Wlan in Overlay Network

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Abstract- Vertical Handoff (VHO) scheme is designed based on the interworking architecture of WLAN/WIMAX which aims to provide always the best Quality of Service (Qos) for users. The performance of applications and network conditions are considered in the handoff process. The handoff procedures are normally initiated when the stations move across the border of WLANs. As a result, both the fixed station and the mobile stations within overlapped areas cannot benefit from VHOs. VHO could be initiated by two factors: mobility when a station moves out of the coverage of its connected WLAN and QoS when the connected network cannot satisfy the requirements. The whole handoff process is achieved by Vertical Handoff Manager (VHOM), which works on the Medium Access Control (MAC) layers of WiMAX and WLAN. VHOM uses the VHO decision algorithm to control smooth handoff between the WIMAX and WLAN. Moreover, evaluation algorithms to estimate the conditions of both WIMAX and WLAN networks in terms of available bandwidth and throughput. A simulation has demonstrated that schemes can keep stations always being connected.

Keywords- WIMAX, WLAN, vertical handoff.

I. INTRODUCTION

Various Wireless access networks are deployed. Examples include wireless cellular networks, WLANs (Wireless Local Area Networks), and wireless PANs (Personal Area Networks). An emerging trend that the mobile devices are equipped with multiple network interface cards, are capable of connecting to different wireless access networks. Users with multimedia-enabled wireless devices are expected to obtain both real-time services (e.g., voice, video conferencing), and non-real time services (e.g., Simple Message Service (SMS), Multimedia Message Service (MMS)). The next generation wireless networks provides a service that allows a user to launch multimedia Internet applications anywhere at any time from diverse networks over an IP (Internet Protocol) backbone. It is foreseeable that users may want to maintain the connections when they switch from one network to another (e.g., from WIMAX to WLAN network, and vice versa). This is known as *vertical handoff*. Vertical handoff is different from conventional horizontal handoff where the mobile devices move from one base station to another station within the same network. Within the 3GPP (Third Generation Partnership Project) and 3GPP2 standardization groups, proposals are describing the interconnection requirements with the 3GPP systems and WLANs [1], [2]. Within the IEEE, the 802.21 Media Independent Handoff (MIH) Working Group is working towards a standard to facilitate vertical handoff

between IEEE 802 technologies and 3GPP/3GPP2 networks [3]. In fourth-generation wireless networks (4G) is the coexistence of heterogeneous technologies. Mobile worldwide interoperability for microwave access (Mobile Wimax) networks become a fast growing technology over long range transmission with Quality of Service(Qos). In the design of heterogeneous overlay systems, one of the most important issues is vertical (intersystem) handoff (VHO) support. The traditional horizontal (intrasystem) handoffs are initiated only by mobility to maintain the connectivity of the station. However, more metrics may be considered in VHOs especially when more than one network is available. These metrics can be classified into two categories [4]. One category is QoS. For the better performance the station can switch to another network and it satisfies the requirements. The special requirements like price, power are the other preferences required by the user. Therefore, VHO plays a important role in achieving the main goal of 4G networks— allowing users to profit always best connected (ABC) service. For VHO schemes, “seamless” and “proactive” are two desirable features [5]. A proactive handoff means that the handoff process (i.e., initiation, decision, and execution) is controlled by the stations. Hence, if QoS metrics such as throughput and packet delay are considered in a VHO scheme, the stations should be able to detect network conditions for a handoff decision. The network condition detection algorithms are used to be tightly integrated into QoS oriented VHO schemes [6]. On the other hand, a seamless handoff denotes that the handoff execution is transparent to upper layer applications. Handoff depends on the interworking architecture of heterogeneous networks. In the overlay network, there are two types of interworking architectures: tightly coupled and loosely coupled where the networks are deployed differently in the network layer. Comparably, a more seamless VHO can be expected in the tightly coupled networks, where the handoff execution follows the protocols of cellular networks and Mobile IP is not necessary while which is commonly deployed in the loosely coupled networks [7]. As a result, undesirable signaling cost induced by Mobile IP can be avoided in the tightly coupled cases.

The paper is organized as follows: Section II describes Overview of Handoff processes and Vertical handoff by the proposed model. The details of system Setup for a proposed algorithm are explained in Section III. Section IV gives the Performance evaluation and simulation results are presented, and Section V concludes the work.

II. VERTICAL HANDOFF

A. Overview of Handoff processes and Vertical handoff

Handoff is the process of maintaining a user's active sessions when a mobile terminal changes its connection point to the access network (called point of attachment) [8]. Depending on the access network that each point of attachment belongs to, the handoff can be either horizontal or vertical [9]. A horizontal handoff takes place between points of attachment supporting the same network technology, for example, between two neighboring base stations of a cellular network. On the other hand, a vertical handoff occurs between points of attachment supporting different network technologies, for example, between a WLAN access point and another network base station. A handoff process can be split into three stages: handoff decision, radio link transfer and channel assignment [8]. Handoff decision involves the selection of the target point of attachment and the time of the handoff. Radio link transfer is the task of forming links to the new point of attachment, and channel assignment which deals with the allocation of resources.

VHD algorithms help mobile terminals to choose the best network to connect to among all the available candidates. For improving the efficiency of VHD process compared with the horizontal handoff decision algorithms mainly considers the RSS and only decision criterion, for VHD algorithms, such as cost, consumption of power and speed of the mobile terminals may need to be taken to maximize user satisfaction [8].

B. Setup Criteria for VHD

Several parameters have been proposed in this VHD algorithm. Received signal strength (RSS) is used because it is easy to measure and is directly related to the service quality. There is a close relationship between the RSS readings and the distance from the mobile terminal to its point of attachment. Majority of existing schemes horizontal handoff algorithms are used in RSS as the main decision criterion and RSS is an important criterion for VHD algorithms. Network connection time refers that the duration of mobile terminal remains connected to a point of attachment. The network connection time is very important for choosing to trigger a handoff so that the service quality is maintained. The network connection time is determined for reducing the number of superfluous handoffs, as handing over to a target network with potentially short connection time should be discouraged. Both the distance from the mobile terminal to its point of attachment and the velocity of the mobile terminal affects the RSS at the mobile terminal. The variation of the RSS determines the time for which the mobile terminal stays connected to a particular network. Connection time of network is especially for VHD algorithms because heterogeneous networks usually have different sizes of network coverage. Available bandwidth is measured based on available data communication resources. Power consumption is a critical issue if a mobile terminal's battery is low. In these situations, it would be preferable to handoff to a point of attachment which would help extending valuable battery life [9].

Network cost: Different networks may have the different charging policies, in some situations the cost of a network service should be taken into consideration in making handoff decisions.

Preferences: A user's personal preference towards an access network leads to the selection of one type of network over the other candidates. RSS and network connection time are based on decision criteria are widely used in both horizontal and vertical hand-over decisions.

To achieve a proactive handoff techniques design a VHO Manager (VHOM) to control the whole handoff which works on the Medium Access Control (MAC) layers of WiMAX and WLAN interfaces at the station. The basic operations for the QoS-triggered VHOS.

C. Service Evaluation and Handoff Initiation

The transmission direction of the application should be taken into account. For an uplink (UL) application, the main work of the VHOM is to record the arrival of packet at the MAC layer of the station and also records the moment that the packet is successfully transmitted by the connected network. Therefore, the calculated throughput and packet delay reflects the performance of the local connected network (WiMAX or WLAN). If an UL application violates the QoS requirements for a given period, the handoff decision will be started. For the downlink (DL) traffic, the station cannot obtain the time information that the packet arrives at base station (BS) or access point (AP), and then an end-to end delay will be calculated in this case rather than the delay purely introduced by the local connected network. If it is in DL traffic throughput or packet delay violates the QoS requirements the local connected network or other networks on the path may introduce the poor performance between two nodes. VHOM needs to evaluate the conditions of the connected network to avoid an unnecessary handoff within the local network. When the connected network working in a bad condition, the handoff decision can be started.

D. Handoff Detection

The main work is to decide whether the conditions of the other network that is not serving the station can satisfy the QoS requirements. The available bandwidth of the network is evaluated. If the calculated result is larger than the threshold and a real-time application is running on the station, the packet delay of the network will be estimated. If the other network is WLAN, the network conditions are estimated based on the total radio resource the medium of WLAN is contended by all stations including AP. But in WiMAX networks, the radio resource is allocated into a DL portion and an UL portion, which allows the network conditions to be evaluated. Therefore, when both the DL and UL network conditions satisfy the requirements, a handoff to WiMAX can be made. To make an effective handoff process, it is required that the conditions of the target network must be good. This is guaranteed by accurately estimating the network conditions and setting suitable thresholds.

III. PROPOSED ALGORITHM

The difference between total capacity and the traffic load over the link is equal to the available bandwidth of a link. When the modulation and coding methods are known, the capacity can be calculated.

A. Estimation in WLAN

The fundamental access method is Distributed Coordination Function (DCF) known as Carrier Sense Multiple Access with Collision Avoidance (CSMA/CA). Network Allocation Vector (NAV) is the main scheme used to avoid collision by setting a busy duration on hearing frame transmissions from other stations. Utilization of the WLAN channel is well reflected by NAV [10].

The bandwidth availability has been derived from

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

where B_o is the bandwidth, L is the frame size, T_n is the NAV duration for a successful frame transmission, $T_{n,c}$ is the NAV duration for a collision, and N is the average number of trials of a transmission.

B. Estimation in WiMAX

The bandwidth is allocated in the form of data bursts where an integer number of slots are included. The main work of BS to determine the number of DL and UL slots that a station obtains in one frame, and the resource allocation results through DL-MAP and UL-MAP messages at the beginning of each DL sub frame.

$$\left\{ \begin{array}{l} B_d = \left(1 - \frac{AS_d}{s_d}\right) \frac{s_d}{T_f} \\ B_u = \left(1 - \frac{AS_u}{s_u}\right) \frac{s_u}{T_f} \end{array} \right.$$

The stations can easily obtain the utilization of WIMAX link by aggregating the number of allocated slots stated in DL-MAP/ UL-MAP messages. The available bandwidth in DL and UL can be calculated by AS_d and AS_u . Where AS_d and AS_u denotes the number of allocated DL/ UL slots in one frame. T_f Denotes the duration of a frame.

C. Receive signal strength by back propagation

Received Signal Strength (RSS) is used to help a mobile node to know whether it moves closer to or away from the monitored network. By using the future values of each target network, the mobile node can determine which target network is nearer. By comparing the strength of the predicted RSS of each neighbor network, it can assist to find the target network that the mobile node is moving in the overlap area. By knowing RSS of neighbor networks ahead of time, if the current RSS of the serving network is lower than the threshold, then the mobile node can perform handoff earlier.

IV. PERFORMANCE EVALUATION AND SIMULATION

RESULTS

A. Network Throughput

Throughput used to find whether data packets correctly delivered or not, to the Destinations. The maximum number of packets made, by using each protocol in a finite Simulation time is analyzed. The throughput is defined as the total amount of data a receiver actually receives from the sender divided by the time it takes to get the last packet.

$$\text{Throughput} = \frac{\text{Receiving packets}}{\text{End time}}$$



Fig.4.1 Network Throughput

Fig.4.1 illustrates the network throughput for vertical handoff and network with some theoretical values, as a function of mobile nodes' speed for Ad-hoc networks of 25 nodes, respectively Average network throughput for vertical handoff using overlay network with mobile nodes moving with a maximum speed of 20 m/s and for a pause time of 30. At the speed variation from 0 to 20 m/s, protocol attains improved throughput performance of vertical handoff. If result is analyzed, note that even if the throughput of first reference is lower than that of vertical handoff for a maximum mobile node speed inferior to 20 m/s it monotonically increases for higher maximum speeds until it reaches approximately 19,000 bits/s at 40 m/s. Hence, the lower throughput found at 10 m/s is largely compensated by the throughput in the 20–40 m/s interval. This increased performance can be attributed to the Link quality, security and stability mechanism of the protocol used. The network becomes more stable because of the high pause time.

B. Bandwidth Efficiency

The bandwidth is allocated in the form of data bursts where an integer number of slots are included. The Base Station determines the number of Downlink (DL) and Uplink (UL) slots that a station obtains in one frame, and then broadcasts the resource allocation results through DL-MAP and UL-MAP messages at the beginning of each DL sub frame. Variation in Bandwidth as a function of Time and the station can easily obtain the utilization of WIMAX link by aggregating the number of allocated slots stated in DL-MAP/UL-MAP messages. The Bandwidth efficiency of

network can be compared with the overlay network as shown in the Fig 4.2

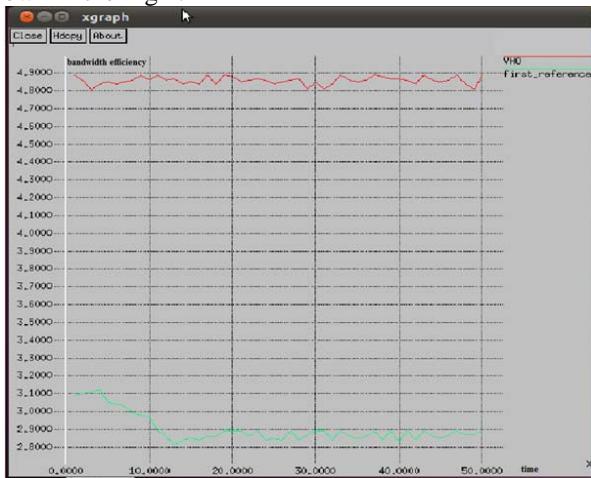


Fig: 4.2 Bandwidth Efficiency

V. CONCLUSION

To predict a node is moving away from the monitored networks, the PRSS is obtained by the back propagation neural network. When a mobile node stays in WLAN/WiMAX networks with different handoff process. We proposed a seamless and proactive VHOM scheme for stations to control the vertical handoff operations in the interworking networks. In order to make stations be able to proactively evaluate network conditions for making handoff decisions, we developed an algorithm to estimate the available bandwidth and packet delay in WiMAX and WLAN. The simulation results have proven the feasibility and effectiveness of our proposed schemes.

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