Review on Vertical Handover Techniques among Heterogeneous Networks

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---ABSTRACT---

One of the major design issues in heterogeneous wireless networks is the support of vertical handover. Vertical handover occurs when a mobile terminal switches from one network to another (e.g., from WLAN to CDMA 1xRTT). Seamless handover between different access technologies is a great challenge as it needs to obey different performance of QoS and security constraints. Vertical handover decision (VHD) algorithms are essential components of the architecture of the forthcoming Fourth Generation (4G) heterogeneous wireless networks. These algorithms need to be designed to provide the required Quality of Service (QoS) to a wide range of applications while allowing seamless roaming among a multitude of access network technologies. This paper is about the comprehensive survey of the VHD algorithms designed to satisfy these requirements.

Index Terms - Vertical handover;

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1. INTRODUCTION

Growing consumer demand for access to communication services anywhere and anytime is accelerating the technological development towards the integration of various wireless access technologies, nowadays called as Fourth Generation (4G) wireless systems. 4G wireless systems will provide significantly higher data rates, offer a variety of services and applications previously not possible due to speed limitations, and allow global roaming among a diverse range of mobile access networks. In a typical 4G networking scenario, handsets or mobile terminals with multiple interfaces will be able to choose the most appropriate access link among the available alternatives (these include IEEE 802.11 Wireless Local Area Network (WLAN), Future network devices will need to roam seamlessly across heterogeneous access technologies such as 802.11, WiMAX, CDMA, and GSM, between wired networks such as xDSL and cable, as well as between packet switched and circuit switched (PSTN) networks.

Handover 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"), for example, a base station or an access point. Depending on the access network that each point of attachment belongs to, the handover can be either horizontal or vertical. A horizontal handover 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 handover occurs between points of attachment supporting different network technologies, for example, between an IEEE 802.11 access point and a cellular network base station.

The main capabilities of Vertical handovers over Horizontal handovers are:
1. Vertical handovers use different access technology.
2. Vertical handovers use multiple network interfaces.
3. Multiple IP addresses are used in Vertical handovers.
4. QoS parameters can be changed in Vertical handovers and   multiple parameters are used.
5. Multiple network connections are used in Vertical handovers.

2. VERTICAL HANDOVER

The vertical handover process involves three main phases, namely system discovery, vertical handover decision, and vertical handover execution. During the system discovery has, the mobile terminal determines which networks can be used. These networks may also advertise the supported data rates and Quality of Service (QoS) parameters. Since the users are mobile, this phase may be invoked periodically. In the vertical handover decision phase, the mobile terminal determines whether the connections should continue using the existing selected network or be switched to another network. The decision may depend on various parameters including the type of the application (e.g., conversational, streaming), minimum bandwidth and delay required by the application, access cost, transmit power, and the user's preferences. During the vertical handover execution phase, the connections in the mobile terminal are re-routed from the existing network to the new network in a seamless manner. This phase also includes the

authentication, authorization, and transfer of a user's context information.

2.1. *VHO Process:*

A handover process can be split into three stages: handover decision, radio link transfer and channel assignment.

2.1.1. *Handover decision*: This process involves the selection of the target point of attachment and the time of the handover.

2.2.2. *Radio link transfer*: It is the task of forming links to the new point of attachment.

2.2.3. *Channel Assignment*: It deals with the allocation of channel resources. VHD algorithms are useful in the way that they help mobile terminals to choose the best network to connect to among all the available candidates.

2 . LITERATURE REVIEW

In general, most handover trigger algorithms require monitoring and measuring the link quality. They start a network scanning for better link quality whenever the link quality of Current network is below a predefined threshold. Most commonly used approaches to measure the link quality from the MN, on the basis of received signal strength (RSS).

In traditional RSS based scheme, the determination rules are classified by,

- RSS only: If $RSS_{NEW} > RSS_{OLD}$
- RSS with Threshold T: If $RSS_{NEW} > RSS_{OLD}$ and $RSS_{OLD} < T$
- RSS with Hysteresis H: If $RSS_{NEW} > RSS_{OLD} + H$
- RSS, Hysteresis and Threshold: If $RSS_{NEW} > RSS_{OLD} + H$ and $RSS_{OLD} < T$
- Dwell timer: If one of the above conditions is satisfied, then the timer is set to be active. If the timer expires and the condition still holds, the handover procedure is initiated.

(1) "A smart triggering scheme to reduce service interruption during heterogeneous handovers and A. Low in Dependable Systems and Networks with FTCS and DCC".

In this paper, a smart triggering scheme was proposed, which based on Received Signal Strength Indication (RSSI) predication. The RSSI could vary when the MN moves, due to the effect of shadowing and fading. An exponential average of smoothing predication method was adopted to predicate the RSSI. The link status would be recorded and compared with the trend of RSSI. When the predicated RSSI is below the predefined Link Going down (LGD) threshold, and the long-term trend of RSSI is going downward, a Pre-Trigger event will be generated.

Comment: A move out case from WiFi to WiMax was analyzed by the proposed scheme. When the MN moves out of the signal coverage of WiFi, and a Pre-Trigger event was generated to trigger the handover initiation.

(2) "Predictive link trigger mechanism for seamless handovers in heterogeneous wireless networks,"

Here, another RSSI-based predicative link trigger mechanism was proposed. The handover procedure may fail due to too early or too late to trigger. The required handover time is estimated at first, and then a predicative link trigger mechanism is executed once the filtered sample power is less than a predefined predication start threshold. The threshold is determined by the required handover time. If the value is less than the minimum power level, the handover procedure is initiated

Comment: Both the above methods proposed the predicated way to initiate the handover procedure, but do not take into consideration the QoS parameters. In addition, the RSSI is an optional parameter from the value 0 to Max, which is a vendor independent and hard to compare with one another.

(3) "IEEE 802.21 Based Vertical Handover in WiFi and WiMAX Networks" by Ammar A. Bathich, Mohd Dani Baba, Muhammad Ibrahim.

This paper represents SINR based scenario similar to that proposed by Kemeng et al [12] is proposed instead of RSS as the handover criteria for WIFI and WiMAX integration network. The Shannon capacity determines the maximum achievable data rate for a given Signal to Interference and Noise Ratio SINR and carrier bandwidth.

Comment: Efficient algorithm to use SINR based approach instead of traditional RSS based algorithm.

(4) "A Vertical Handover Scheme from WMAN to WLAN by taking into account the Maximum Available Resource" by Hsiu-Lang Wang and Shang-Juh Kao.

In this paper, we propose an efficient handover scheme, from WMAN to WLAN, to make use of the received signal to interference and noise ratio and the information about back-haul bandwidth for the criteria to trigger a handover. The time to start a handover is determined by considering the variations of data rate as the MN moves and the most suitable target AP is selected according to its maximum available bandwidth. The simulation results show that the MN consistently has a better throughput with the proposed scheme, as compared with the RSS-based vertical handover scheme. And among all candidates APs, the MN has the minimum packet delay with the selected AP association.

Comment: proposed scheme consistently has a better throughput, as compared with the RSS-based vertical handover scheme. Furthermore, with the selected AP association, the MN has the minimum packet delay among all candidate APs.

(5) "Media Independent Handover (IEEE 802.21): Framework for Next Generation Vertical Handover Protocols" by Vikas Sharma, Ankit Agarwal, Mohammed Abdul Qadeer.

In this paper review of Vertical Handover Mechanisms (VHM), decision models and IEEE standard 802.21 (also called Media Independent Handover) have been discussed for seamless vertical handover.

Comment: IEEE 802.21 (Media Independent Handover - MIH) is emerging standard which promises a well optimized solution. IEEE 802.21 standardizes the different functions, services and protocols needed to carry out vertical handover seamlessly.

(6) "A Combined Vertical Handover Decision Metric for QoS Enhancement in Next Generation Networks "by Anna Maria Vegni, Gabriele Tamea, Tiziano Inzerilli and Roberto Cusani.

In this proposed combined VHO approach contain both RSS and SINR parameters are in terms of both end-users efficiency, i.e. cumulative received bits, and network performances, i.e. VHO improve quality of service for mobile users, a data rate gain parameter.

Comment: Provides better quality of support and reduce ping-pong effect.

Many VHD algorithms have been proposed in the research literature, most of them have designed their VHD algorithms depending on the signal strength received by the mobile terminal, where handover decisions are made by comparing the received signal strength with the preset threshold values. These algorithms which use signal strength as their basic handover decision indicator are called Received Signal Strength (RSS) algorithms. However, the data rate achieved by a mobile terminal is related to its Signal to Interference and Noise Ratio (SINR), which is a function of the interference in the network, as well as the distance between Base Station (BS) or Access Point (AP) to the mobile terminal. RSS-based VHD occurs when the mobile terminal receiving power approaches the threshold value regardless of the QoS needed, thus rendering RSS-based VHD not to support user's QoS requirement. On the other hand, SINR-based VHD supports multimedia QoS requirement depending on the achievable data rate which leads to seamless vertical handover.

3. PROPOSED SYSTEM

Many numbers of parameters can be taken into consideration other than RSS and SINR for taking handover decision. Some are given below.

i. Network connection time: It indicates the length of time that a user connected to an access point or base station.
Choosing the proper moment is very important to initiate a quality of service handover.
ii. Power consumption: It refers to the MT's battery level, which becomes very important in case need to handover to another network that consumes lower power.
iii. Monetary cost: some algorithms take into consideration the charging policies for different networks in making their handover decision.
iv. Security: Integrity or confidentiality is considered as a critical issue in some applications, where the VHD may be chosen to a higher level of data security.
v. User preferences: a special user requirement or preference could be the issue that decides to initiate the handover.
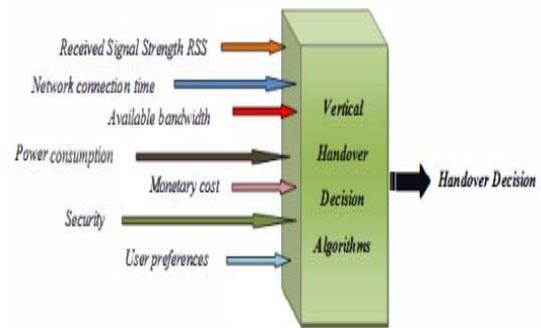

Fig 1. Parameters used for making YHD decision

In this paper a method is proposed which will make use of more than one parameter to take handover decision. A combination of RSS, SINR and data Rate will be used to take handover decision. This approach will be useful in achieving maximum data rate and downloading speed. This will also help to choose the best network among the available services. As the individual parameters approach does not give better downlink throughput, this approach may remove disadvantages of earlier approaches.
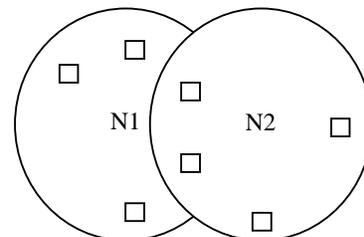

Fig 2. Mobile nodes moving among the Different Networks

Above figure shows the proposed approach of this paper. In the figure above mobile nodes are shown by small squares moving among the two networks named N1 and N2. When the mobile node will be in such point where it is getting the service of both networks access point, it will decide about the parameters which are discussed above. After that calculation node will decide which network to be used.

4. CONCLUSION

Unfortunately currently proposed VHD algorithms either lack a comprehensive consideration of various network parameters or the studies reporting these algorithms lack enough detail for implementation. Research into vertical handover decision algorithms in heterogeneous networks is still a challenging area. The main difficulty is devising an algorithm which is truly useful in a wide ranging conditions and user preferences. One possible solution would be, given that computational power of handsets improves phenomenally every year, to implement several VHD algorithms in a handset and adopt adaptive methods that choose an algorithm intelligently based on conditions and user preferences.

Another important difficulty in implementing vertical handover is to choose the network which will give the best downlink throughput, as today's user doesn't concern about the cost but mainly concern about the uninterruptable downlink throughput.

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