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Handoff Architecture for Heterogeneous Wireless Environment

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***Abstract*-Future wireless networks must be able to coordinate services within a diverse network environment. Next generation wireless network is envisioned as a convergence of different wireless access technologies providing the user enhanced connection any where any time to improve the systems resource utilization. In such converged systems, co-existence of heterogeneous access technologies with largely different characteristics like data rate for cellular network (2 Mbps), WLAN 802.11b (11 Mbps) and HIPERLAN (54 Mbps) results in handoff asymmetry that differs from the traditional intra-network handoff (horizontal handoff). The seamless and efficient handoff between different access technologies (vertical handoff) is essential and remains a challenging problem. In this paper, we are trying to focus mainly on the handoff for the heterogeneous environment.**

Key Words- Heterogeneous Networks, WLAN, Vertical Handoff (VHO), Horizontal Handoff (HHO), Quality of Service (QoS).

I. INTRODUCTION

4G networks is a network of emerging various networks such as CDMA2000, Wireless LAN and WCDMA. 4G technology is a very complex technology of integrating different new techniques, and 4G services for a higher speed wireless internet access. In the near future, wide variety of wireless networks will be merged, and allow users to continue their application with higher degree of mobility. The mobile nodes (MN) will be equipped with multiple access networks cards and users will be able to roam transparently over the network in a seamless manner. To realize this vision, much effort has to be put into standardizations, architecture design and access networks' coverage. One of the main issues for the Future Generation Wireless Networks is the mobility, with which users can benefit of continuous services while moving between networks. While moving mobile user may switch from a network to another, which occurs when the QoS offered by the network, to which the mobile user is connected, decreases under certain predefined quality level, the switch mechanism is known as *handover*.

Handover is the mechanism with which a mobile user redirects its connection from an old network to a new one; the handoff delay must be as small as possible in order to make seamless handover. Moreover, there are two types of handover; Horizontal and Vertical handover as shown in Fig.1 [1]. Horizontal Handover (HHO) occurs when the mobile user is switching between networks supporting the same technology (e.g. UMTS->UMTS, WiMax->WiMax), while Vertical Handover (VHO) is used when the mobile user redirects its connection from a network to another and these networks support different types of technology (e.g. UMTS->WiMax, WiMax->WiFi).

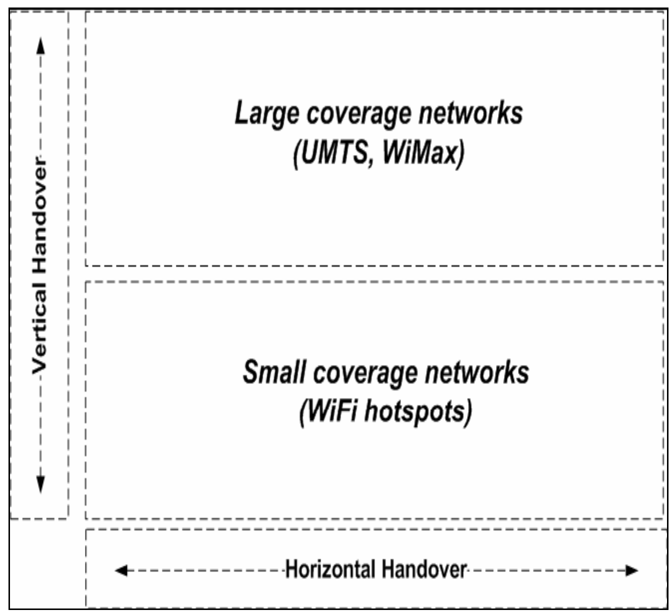

Figure1. Horizontal vs. Vertical Handover

Mainly The handover mechanism consists of four phases: Handover Initiation, System Discovery, Handover Decision and Handoff Execution.

• The *Handover Initiation phase* triggers the handover process basing on modifications of some criteria value, such as signal strength, link quality.

• The *System Discovery phase* is considered as the information gathered phase or preparation phase. In which mobile user discovers its neighbor networks and exchanges information about the QoS offered by these networks.

• The *Handover Decision phase* consists of comparing the offered QoS by neighbor networks and the QoS required by the mobile user, and basing on this comparison the decision maker makes the decision to which network the mobile user has to redirect its connection.

• The *Handoff Execution phase* is responsible for the establishment and release of the connections, as well as the invocation of the security services.

II. HANDOVER CLASSIFICATION

The handover process may be classified as Horizontal handover and Vertical handover systems. The difference between these handover is described in the earlier section. Our scope of research is vertical handover in heterogeneous wireless networks. The vertical handover can be classified in many ways. The first classification is: *upward* and *downward* [2]. An upward VHO occurs from a network with small coverage and high data rate to a network with wider coverage and lower date rate. On the other hand, a downward VHO occurs in the opposite direction. As an example for this classification let's consider the case of two of the most important current wireless technologies: cellular networks and WLANs. The WLAN system can be considered as the small coverage network with high data rate while the cellular system is the one with wider coverage and lower data rate. The natural trend in the literature has been to perform downward VHO's whenever possible.

The second classification is: *imperative* and *alternative* [3]. An imperative VHO occurs due to low signal from the BS or AP. In other words, it can be considered as an HHO. The execution of an imperative VHO has to be fast in order to keep on-going connections. On the other hand, a VHO initiated to provide the user with better performance (e.g., more bandwidth or lower access cost) is considered to be an alternative VHO. This VHO can occur when a user connected to a cellular network goes inside the coverage of a WLAN, even if the signal of connection to the cellular network does not lose any signal strength, the user may consider the connection to the WLAN a "better" option.

A summary of the classifications is shown in Figure 2 [4].

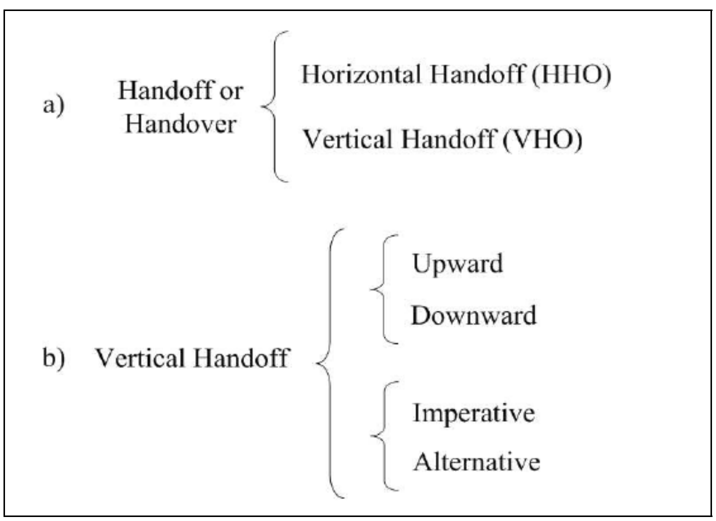

Figure2. Handoff classifications

III. VERICAL HANDOFF DECISION CHARACTERISTICS

Seamless handoff across the different wireless networks is becoming increasingly important [5]. Whereas wired networks regularly grant high bandwidth and consistent access to the Internet, wireless networks make it possible for users to access a variety of services even when they are moving. As a result, seamless handoff, with low delay and minimal packet loss, has become a crucial factor for mobile users who wish to receive continuous and reliable services. One of the chief issues that aid in providing seamless handoff is the ability to correctly decide whether or not to carryout vertical handoff at any given time. This could be accomplished by taking into consideration two key issues: network conditions for vertical handoff decisions and connection maintenance [6]. These two issues need to be tightly coupled in order to move seamlessly across different network interfaces. To attain positive vertical handoff, the network state ought to be constantly obtainable by means of a suitable handoff metric. In multinetwork environments, this is very challenging and hard to achieve as there does not exist a single factor than can provide a clear idea of when to handoff. Signal strength, which is the chief metric measured in traditional horizontal handoffs, cannot be utilized for vertical handoff decisions due to the overlay nature of heterogeneous networks and the different physical techniques used by each network. Thus a natural question arises as to what factors should be considered in the handoff decision. Now we are trying to find out the important decision factors which were considered in the vertical handover. We explain the significance of each and why they are selected in Vertical Handoff Decision Factor (VHDF).

A) Cost of Service:

The cost of the different services to the user is a major issue, and could sometimes be the decisive factor in the choice of a network. Different broadband Wireless Internet Service Providers (WISPs) and cellular service providers may well provide a variety of billing plans and options that will probably influence the customer's choice of network and thus handoff decision.

B) Security:

Risks are inherent in any wireless technology. Some of these risks are similar to those of wired networks; some are exacerbated by wireless connectivity; some are new. Perhaps the most significant source of risks in wireless networks is that the technology's underlying communications medium, the airwave, is open to intruders, making it the logical equivalent of an Ethernet port in the parking lot [7]. Therefore security was chosen as one of the main factors in the vertical handoff decision function.

C) Power Requirements:

Wireless devices operate on limited battery power. When the level decreases, handing off (or remaining connected) to a network with low power consumption can provide elongated usage time. For instance, if a device's battery is nearly exhausted then handing over from a WLAN to WWAN would be a smart decision. This is due to the fact that when operating in a cellular WWAN, the device is idle for most of the time. However, given the unpredictable and erratic nature of transmissions with WLANs, handsets are unable to standby between packet transmission since there is no set time for the arrival and transmission of data and packets arrive sporadically.

D) Proactive Handoff:

By proactive handoff, the users are involved in the vertical handoff decision and have the final decision on whether or not to handoff, regardless of the network conditions. By permitting the user to choose a preferred network the system is able to accommodate the user's special requirements.

E) Quality of Service:

Handing over to a network with better conditions and higher performance would usually provide improved service levels [8]. Transmission rates, error rates, and other characteristics can be measured in order to decide which network can provide a higher assurance of continuous connectivity.

Vertical handoff decisions cannot be based on one or a couple of the factors discussed. The majority of these aspects have a momentous effect on the correct network choice. The above mentioned characteristics are taken into consideration in order to offer seamless vertical handoff across heterogeneous networks.

IV. THE HANDOVER MANAGEMENT SYSTEM

Figure 3 shows a handover management system architecture proposed by Merim Kassar et. Al [9]. The proposed model consists of the following modules:

The ***network interfaces*** module contains the protocol stack of each network. These interfaces are monitored periodically and one of them will be intelligently selected and activated in the handover process.

The ***handover management*** module is responsible for providing transparent switching between networks. So, it encloses the main phases of a handover process.

(*A*) *Handover information gathering (HoIG).*

Collecting all the contextual information, through monitoring and measurements, required to identify the need for handover and to apply handover decision policies.

(B) Handover decision (HoD).

Determining whether a handover is needed (i.e., *handover initiation*) and how to perform it by selecting the most suitable network (i.e., *network selection*) based on decision criteria.

(C) Handover execution (HoE).

Establishing the IP connectivity through the target access network. This will implement protocols such as MIP.

The *upper layers* enable functionalities such as session management services to the application and provide additional information to the HoIG module.

The handover criteria are the qualities measured to give an indication for a context-aware handover decision. It is required to be context-aware in the sense that it should be conscious of possibilities offered by each access network, multi-interface mobile terminal (MT) movements and QoS requirements for the demanding service. In traditional handover decision, only one criterion is used, the received signal strength (RSS). For a vertical handover decision, it is not sufficient. Context information is relevant in a way that they are useful enough to avoid false decisions, therefore, bad performances. They can be relative to the network, the terminal, the service, and the user. Here, we group it into two parts as in [10]: all the information related to the network on one side and all the information that may exist at the terminal on the other. There are the following contexts.

(A) Network context.

QoS parameters (bandwidth, delay, jitter, packet loss), coverage, monetary cost, link quality as RSS, and bit error rate (BER) of the current access network and its neighbors.

(*B) Terminal context.*

User preferences, service capabilities (real-time and non-real-time), terminal status (battery and network interfaces), priority given to interfaces, location, and velocity.

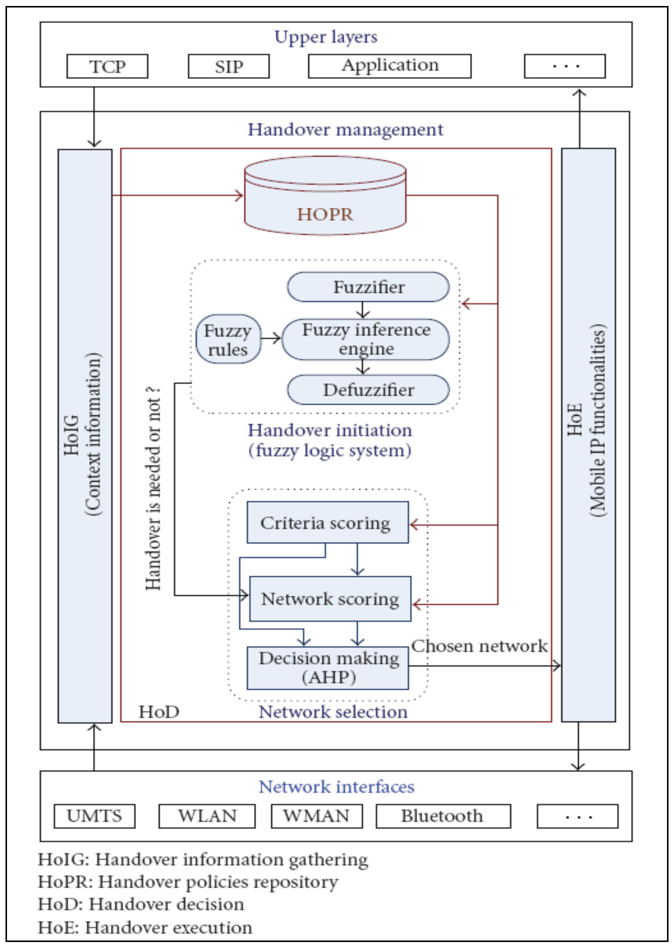

Figure3 Handover management system architecture

These criteria can be classified into *static* and *dynamic*. Typically, static criteria are user preferences and the monetary cost, whereas the MT's velocity, RSS, and access network availability are dynamic criteria. These contextual information is provided by the HoIG module. It is responsible to keep the *handover policies repository* (HoPR) entries up to date. These entries (static or dynamic) are needed as policy parameters to govern the choices in the whole decision process. HoPR stores a set of policies expressing decision rules based on different parameters. A policy rule is a group of if-then rules (if *condition* then *action*).

This combination of a context-aware approach using policies can provide an efficient and flexible vertical handover decision solution. This give more flexibility in a way that the whole handover process is completely controlled by the mobile (MCHO). It reduces the overall complexity in the network, the signaling overhead, and the handover latency than a mobile-assisted handover (MAHO). Most conducted experiments and publications in vertical handovers [10-15], even regarding policies, promote an MCHO decision model in which the MT is responsible for making decisions and to put all the intelligence at the MT.

CONCLUSION

The seamless and efficient handoffs between different access technologies (vertical handoff) are essential and remain a challenging problem. In this paper we have explain the vertical handover system for the heterogeneous wireless networks. The classification of the handovers is also explained. Handover decision characteristics are also explained in one of the sections. The handover management system architecture was also proposed. The proposed model contains two modules network interface and handover management modules. We have also seen that traditional handover schemes can not be used for the heterogeneous wireless networks.

REFERENCES

[1] Rami Tawil, Jacques Demerjian and Guy Pujolle, "A Trusted Handoff Decision Scheme for the Next Generation Wireless Networks", IJCSNS International Journal of Computer Science and Network Security, VOL.8 No.6, June 2008, pp 174-182.

[2] M. Stemm and R. Katz, "Vertical Handoffs in Wireless Overlay Networks," ACM *Mobile Net-works (MONET) Special Issue on Mobile Networking in the Internet*, vol. 3, pp. 335-350,Summer 1998.

[3] W. Zhang, J. Jaehnert, and K. Dolzer, "Design and Evaluation of a Handover Decision Strategy for 4th Generation Mobile Networks," in *Proc. of IEEE VTC'03-Spring*, (Jeju, Korea), April 2003.

[4] Enrique Stevens-Navarro, Ulises Pineda-Rico and Jesus Acosta-Elias, "Vertical Handover in beyond Third Generation (B3G) Wireless Network", International Journal of Future Generation Communication and Networking, vol.1, no. 1, pp 51-58.

[5] S. Kim, J. Copeland, "TCP for seamless vertical handoff in hybrid mobile data networks", *IEEE GLOBECOM Conference*, Vol. 2, San Francisco, CA, December 2003, pp. 661–665.

[6] Chuanxiong Guo, Zihua Guo, Qian Zhang and Wenwu Zhu, "A seamless and proactive end-to-end mobility solution for roaming across heterogeneous wireless networks", *IEEE Journal on Selected Areas in Communications,* Vol. 22, No. 5, June 2004

[7] Karygiannis, Tom, and Les Owens. "Wireless network security 802.11, bluetooth and handheld devices", *National Institute of Standards and Technology*, Special Publication 800-48, November 2002.

[8] Qian Zhang, Chuanxiong Guo, Zihua Guo, and Wenwu Zhu, "Efficient mobility management for vertical handoff between WWAN and WLAN", *IEEE Communications Magazine*, Vol. 41, No. 11, November 2003, pp. 102-108.

[9] Meriem Kassar, Brigitte Kervella, and Guy Pujolle, "An Intelligent HandoverManagement System for Future GenerationWireless Networks", EURASIP Journal on Wireless Communications and Networking, Volume 2008, Article ID 791691.

[10] T. Ahmed, K. Kyamakya, and M. Ludwig, "A context-aware vertical handover decision algorithm for multimode mobile terminals and its performance," in *Proceedings of IEEE/ACM Euro American Conference on Telematics and Information Systems (EATIS '06)*, pp. 19–28, Santa Marta, Colombia, February 2006.

[11] P. M. L. Chan, R. E. Sheriff, Y. F. Hu, P. Conforto, and C. Tocci, "Mobility management incorporating fuzzy logic for a heterogeneous IP environment," *IEEE Communications Magazine*, vol. 39, no. 12, pp. 42–51, 2001.

[12] Manoj Sharma, Dr. R.K. Khola "An Intelligent Handover Decision System for Multi Network Environment", Journal of Electrical & Electronics Engineering Vol. 9, No. 2 pp 1067-1072.

[13] Manoj Sharma, Dr. R.K. Khola, "An Intelligent Approach for Handover Decision in Heterogeneous Wireless Environment", International Journal of Engineering Vol.4, No. 5 pp 452-462

[14] Manoj Sharma, Dr. R.K. Khola, *"Pre Decision Based Handoff in Multi Network Environment"* Advances in Intelligent and Soft Computing Vol.167, 2012, pp 609-616. D.O.I 10.1007/978-3-642-30111-7_58. (A Springer Berlin Heidelberg Publication).

[15] Manoj Sharma, Dr. R.K Khola "Intelligent Approach for Seamless Mobility in Multi Network Environment," International Journal Communication Vol. 2, No. 2, pp 43-47 (ISSN 2158-7558) U.S.A. (D.O.I 01.IJCOM. 02.02.6)

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