A Survey of Vertical Handover Decision Algorithms in Fourth Generation Heterogeneous Wireless Networks

Mahmood Adnan, Hushairi Zen and Al-Khalid Othman
Faculty of Engineering, Universiti Malaysia Sarawak, Kota Samarahan, 94300 Sarawak, Malaysia

Abstract: Vertical Handover Decision (VHD) algorithms are indispensable components of the forthcoming fourth Generation (4G) heterogeneous wireless networks architecture so as to provide the requisite Quality of Service (QoS) to an assortment of applications anywhere at anytime while allowing seamless roaming in highly dynamic scenarios (i.e., multitude of access network technologies) using terminals enabled with multiple access interfaces. This study intends to present a comprehensive overview/survey of the VHD algorithms designed to satisfy these requirements, along with the main algorithms, protocols and tools proposed in the literature. To offer a systematic comparison, the survey categorized the algorithms in 4 groups based on the main handover decision criteria used. The survey revealed the need for devising an efficient algorithm which is truly useful in a wide ranging conditions, network parameters and user preferences.

Key words: Wireless networks, 4G, vertical handover, Decision algorithms, network selection

INTRODUCTION

The exploitation of numerous wireless communication technologies (2G, 3G, IEEE 802.11 WLAN, IEEE 802.16 WiMAX, etc.) in combination with unfolding of Mobile Terminals (MTs) with multiple network interfaces and the development of IP-based applications (both real time and non-real time) has allowed users to seamlessly access the IP services anywhere at anytime (Kassar *et al.*, 2008; Zhu and McNair, 2004). One considerable stride driven by this universal wireless access is 4G wireless communication which represents the heterogeneous wireless environment possessing disparate/diverse access network technologies that vary in bandwidth, latency and cost (Akyildiz *et al.*, 2004). In such sort of environment, mobility management is the critical issue maintaining the roaming of users from one system to another. Handover management, one of the mobility management components, controls the change of MT's point of attachment during active communications. The hierarchy of mobility management in heterogeneous network environment is depicted in Fig. 1.

In typical 4G networking scenario, MTs with multiple interfaces are able to opt for the appropriate access links among most accessible substitutes (these included IEEE 802.11 WLANs, IEEE 802.16 WiMAX, satellite systems, bluetooth, etc.) in addition to traditional cellular telephony networks which are almost universally accessible today (Yan *et al.*, 2010). For a satisfactory user experience, MTs
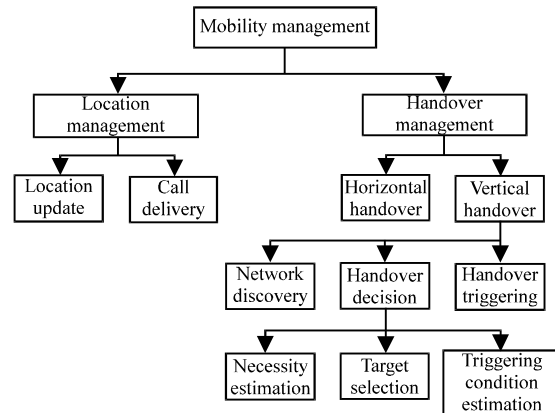

Fig. 1: Mobility management in a heterogeneous network environment

should be able to seamlessly transfer to the 'Always Best' access link among pertinent candidates with no perceived interruption to an ongoing video/voice conversation. This capability to handover among the heterogeneous wireless networks is referred to as 'vertical handovers'. The IEEE 802.21 standard provides a framework in order to support the protocols for enabling of seamless vertical handovers (Fig. 2) however, actual algorithms to be implemented are left to the designers (Mohr and Konhauser, 2000).

A number of previous studies have surveyed the VHD algorithms. Zhu and McNair (2004) originally presented a tutorial on the design and performance issues

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Corresponding Author: Mahmood Adnan, Faculty of Engineering, Universiti Malaysia Sarawak, Kota Samarahan, 94300 Sarawak, Malaysia