



Advanced seamless vertical handoff architecture for WiMAX and WiFi heterogeneous networks with QoS guarantees

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ABSTRACT

The development of wireless networks brings people great convenience. More state-of-the-art communication protocols of wireless networks are getting mature. People attach more importance to the connections between heterogeneous wireless networks as well as the transparency of transmission quality guarantees. In this paper, WiFi wireless networks and WiMAX mobile communication system are selected as our research subjects. VHTC (Vertical Handoff Translation Center Architecture) is proposed to improve the transmission QoS guarantees. Thus, the quality of transmission cannot be reduced enormously even by the effect of vertical handoff between heterogeneous wireless networks. This paper includes new approaches and architecture among Packet Translation, QoS Mapping, Bandwidth Borrowing Management and Vertical Handoff Protocol with a view to achieve the goal, that is, an advanced seamless heterogeneous wireless networks. Also, through the modification of WiFi module of TKN and WiMAX module of NIST, these two heterogeneous wireless networks can be connected and embedded in NS2 (Network Simulator version 2) simulation system. Afterwards, the methods, proposed in this paper, can be implemented in such simulation system. Finally, lots of satisfactory simulation results about throughput, delay, jitter and packet loss rate were given to show the brilliant performance of vertical handoff implemented by VHTC.

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1. Introduction

Nowadays, the users of wireless networks cannot really enjoy the seamless service of heterogeneous wireless networks [1–5]. Users roam through different kinds of wireless networks, that is, so-called vertical handoff [6–10], as shown in Fig. 1. The users move between WiFi and WiMAX networks, so far, a breakdown of the service is unavoidable due to the absence of vertical handoff ability. Here, we make a simple definition and comparison between horizontal handoff [11–13] and vertical handoff as follows:

- (a) *Horizontal handoff*: It is the process of handoff that occurred by the movement of a mobile station [14,15] among the homogeneous base stations. Based on the homogeneous network protocols, generally speaking, there is no disconnection in the procedure of handoff, as shown in Fig. 1. There is a horizontal handoff process occurred between BS_A and BS_B.
- (b) *Vertical handoff*: It is the process of handoff that occurred by the movement of a mobile station among the heterogeneous base stations. Due to the packet formats of Layer 2 and Layer 3 and the differences between the communication protocols,

there must be a disconnection in the procedure of handoff, as shown in Fig. 1. There is a vertical handoff occurred between BS_C and AP_D.

To achieve advanced seamless vertical handoff, the following three requirements are essential: (1) effective packet translation methods; (2) smooth connection control mechanism between WiFi and WiMAX; (3) an advanced seamless vertical handoff protocol.

This paper is organized as follows to satisfy the demands. Section 2 introduces WiFi and WiMAX QoS Architecture, related to the condition of QoS flow classes of two kinds of networks. Section 3 presents a novel approach to establish a seamless heterogeneous wireless networks [16–23] architecture with QoS guarantees: VHTC Architecture. Aimed at Packets Translation, QoS Mapping, Bandwidth borrowing Management and Vertical Handoff Protocol, some efficient methods are proposed to keep the connections quality among heterogeneous wireless networks and QoS guarantees, such as: PTM (Packet Translation Module), QoSMM (QoS Mapping Module), EBBM (Efficient Bandwidth Borrowing Management) Module and HPHWN (Handoff Procedures over Heterogeneous Wireless Networks with QoS Transparency Guarantees). Section 4 illustrates the simulation modules in WiFi and WiMAX simulation architecture. The modified WiFi module of TKN is enabled to fit in with the architecture and approach of VHTC so as to connect WiMAX module provided by NIST.

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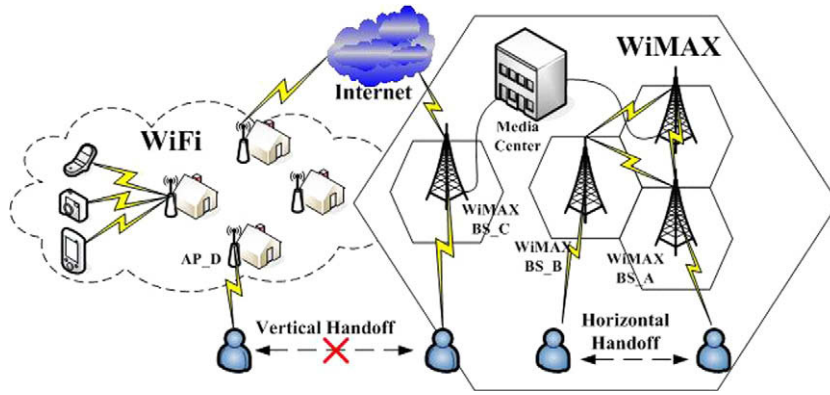


Fig. 1. Vertical handoff and horizontal handoff illustration.

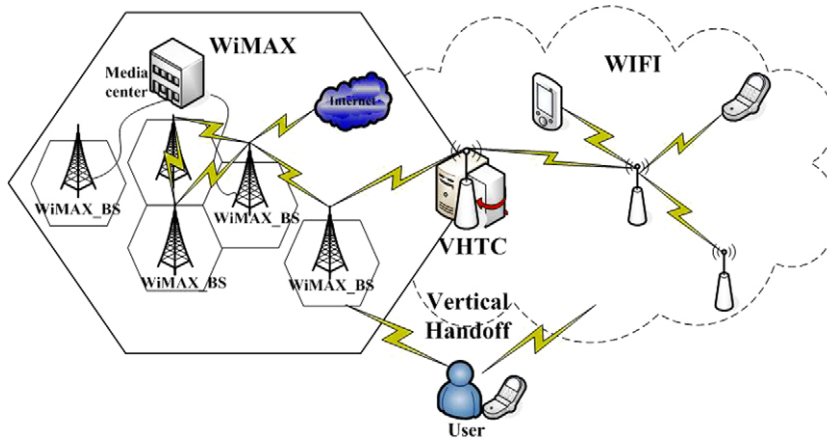


Fig. 2. Advanced seamless heterogeneous wireless networks archit.

Therefore, the approaches proposed could be simulated to show the results. Finally, Section 5 presents the simulation architecture of heterogeneous wireless networks and the simulation results to confirm the great efficiency of this study. Fig. 2 shows

the proposed advanced seamless heterogeneous wireless networks architecture. In the architecture, not only QoS guarantees but also roaming distance can be extended. This is the final target of our research.

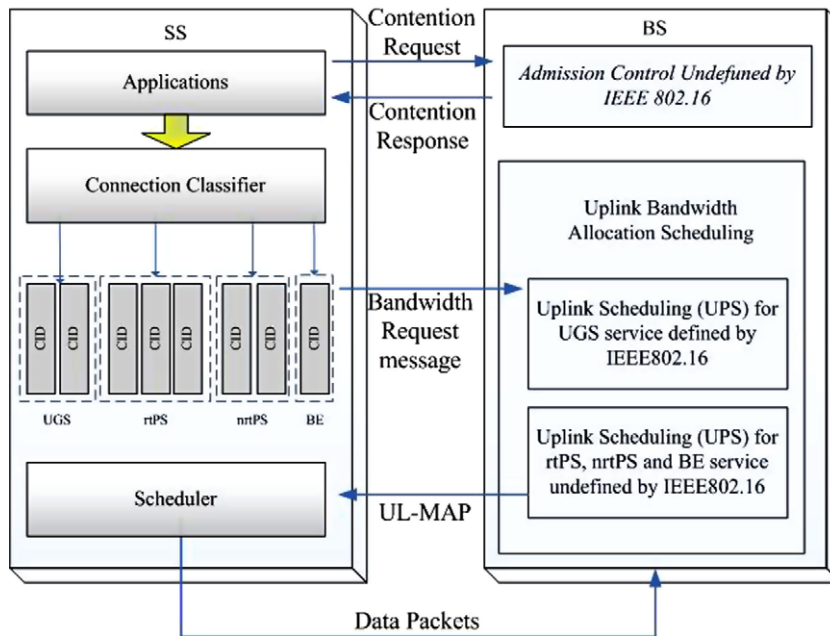


Fig. 3. The classification of WiMAX connections.

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