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A bidding model and cooperative game-based vertical handoff decision algorithm

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ABSTRACT

The next-generation wireless network is envisioned as a convergence of different wireless access technologies, and can offer mobile users the best service anywhere anytime. While mobile users roam between heterogeneous access networks, vertical handoff may take place and vertical handoff decision (network selection) would be a clear challenge. Because game theory is an effective mathematical theory to deal with models for studying interaction among decision makers, in this paper, the competition between mobile users and heterogeneous access networks can be formulated as a multi-tenderee bidding model; at the same time, the competition among heterogeneous access networks can be formulated as a cooperative game process to seek for larger total payoff. Then, the proposed algorithm is evaluated by network utility and standard deviation through simulation, and the experimental results show that it is effective to achieve the load balancing and meet the quality of service (QoS) requirements of various applications.

1. Introduction

The next-generation wireless network is envisioned as a convergence of different wireless networks such as Wi-Fi, WiMAX and Universal Mobile Telecommunications Systems (UMTS), which can offer mobile users the best service anywhere anytime. Therefore, supporting terminal seamless handoff across heterogeneous access networks is a clear challenge and becomes one of the most critical mechanisms for next-generation wireless network. Currently, numerous mobility management protocols have been proposed by IETF for IP-based wireless networks (McNair and Zhu, 2004). IEEE 802.21 working group has been working on standard development to enable handoff between heterogeneous access networks including both 802 and non-802 networks. Unlicensed Mobile Access (UMA), along with Generic Access Network (GAN), has been providing fixed-mobile convergence between cellular and unlicensed spectrum technologies such as Wi-Fi and Bluetooth.

Handoff is often defined as a process by which a mobile node (MN) moves from one network to another. Handoff can be primarily classified into homogeneous and heterogeneous handoff. Homogeneous handoff (horizontal or traditional handoff) process occurs to provide an uninterrupted service when a mobile node moves between two homogeneous access networks or cells (Chen et al., 2004). Heterogeneous handoff (vertical handoff) process is generally described in three phases (Kassar et al., 2008): handoff initiation, handoff decision and handoff execution. The handoff initiation (network discovery) phase is used to collect all the information required from candidate networks. The handoff decision phase is used to determine whether and how to perform the handoff by evaluating and selecting the most appropriate access network. It is also called network selection phase. The handoff execution phase is used to change channels and associate with the target network. Therefore, handoff decision is an important and intelligent part of vertical handoff process, and in this paper our study will mainly focus on the network selection algorithm (which network it should connect to and which criteria this choice is based on?).

Generally, horizontal handoff decision takes into account some link quality condition parameters such as received signal strength indicator (RSSI), signal-to-noise ratio (SNR) and so on drop below a specified handoff threshold. In a heterogeneous wireless environment, mobile users can move between different wireless access networks, and they will benefit from different network characteristics (coverage, bandwidth, power consumption, cost, etc.) that cannot be compared directly. Therefore, the handoff decision making (network selection) becomes more difficult in such an environment than the homogeneous one. It usually needs to take into account not only the aforementioned network characteristics but also the user preferences and the traffic classes. In this paper,

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