

Abstract

Next generation wireless Internet is envisioned to be heterogeneous in nature with an increase in demand towards ubiquitous services. The mobile wireless internet is not just an extension of the internet into the mobile environment, giving users access to the internet services while they are on the move; it is about integrating the internet and telecommunications technologies into a single system so as to satisfy all our communication needs. The wireless Internet is heterogeneous at the device level, network level and also at the application level. Even though various solutions have been proposed to address the related issues, user or application requirements still pose many challenging problems.

As various networks have widely different characteristics, it is difficult to guarantee a particular level of quality of service (QoS) to an application after executing handoff between different types of networks, known as vertical handoff. As the wireless Internet is a collection of heterogeneous networks, vertical handoff needs an intelligent handoff decision mechanism. This thesis, first of all, proposes a QoS-aware fuzzy rule-based (FRB) vertical handoff mechanism that makes a multi-criteria-based decision, found to be effective for meeting the requirements of different applications in a heterogeneous networking environment. The QoS parameters considered are available bandwidth, end-to-end delay, jitter, and bit error rate. A new evaluation model is proposed in this work based on a generalized Markov chain, in which the states correspond to the available networks. Simulation results show that compared to other vertical handoff algorithms, the proposed algorithm gives better performance for different traffic classes. The FRB algorithm is then integrated with the technique for Order of Preference by Similarity to Ideal Solution (TOPSIS) approach to develop an improved strategy to arrive at the handoff decision.

A related problem to vertical handoff is mobility management that is highly significant in the wireless Internet. While IETF work groups have standardized various mobility management protocols, such as Mobile IPv6 (MIPv6) and Proxy Mobile IPv6 (PMIPv6), developing a good analytical or evaluation model, in terms of various performance metrics like handover latency and the related signaling cost is needed for the comparison of various mobility management protocols. In this thesis, a novel analytical model that takes the signaling cost into account is developed for comparison of various mobility management protocols in terms of the handover latency, as well as the packet density, and packet arrival rate during the handover time. The model is derived by applying transport engineering principles in the field of telecommunications.

While proposing standards like Mobile IPv6 (MIPv6), and Proxy Mobile IPv6 (PMIPv6) for mobility management protocols, one important challenge being addressed by IETF work groups and the research community is flow mobility in multi-homed heterogeneous wireless networks. The final chapter of this thesis presents a block prefix mechanism for flow mobility in PMIPv6. The proposed mechanism is compared with existing prefix based mechanisms for flow mobility in PMIPv6 in terms of important performance metrics such as handover latency, average hop delay, packet density, signaling cost and packet loss, both analytically and through simulation studies. Results demonstrate that the proposed mechanism outperforms the existing flow mobility management procedures that use either shared or unique prefixes.

Keywords: Heterogeneous wireless networks, Vertical handover, Fuzzy logic, QoS parameters, Generalized Markov chain, Mobility management, Flow mobility, MIPv6 protocol.