Chapter 15

IP Mobility Support in Hybrid Wired–Mobile Ad Hoc Networks

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ABSTRACT

Mobile ad hoc networks (MANETs) make use of a distributed routing mechanism to support connectivity between nodes within the ad hoc network. A wireless ad hoc network can be deployed for multiple applications, such as extending the coverage of wire based networks, where interworking is achieved via wireless access routers. However, the implementation of a hybrid (i.e. wired and wireless) network is not straightforward and several issues must be solved for these types of deployments to become a reality. One concern is related to terminal mobility while preserving ongoing communication sessions over IP networks; as a mobile node moves from one subnetwork to a new subnetwork, a mobility protocol (e.g. Mobile IP) is required for the mobile node to preserve a communication session without having to reestablish the session with a correspondent node. This issue is more complex in a hybrid network where the wireless domain is composed of a mobile ad hoc network (MANET). For instance, MANET routing protocols usually do not account for the connectivity toward a wired network, such as the Internet, via a single or multiple access routers. As a result, there are multiple routing issues that must be taken into consideration to support interconnectivity between nodes located in a hybrid network topology. The main contribution of this work is to present a review on the state of the art of IP mobility support for hybrid wired–MANETs and discuss some of the relevant issues in this area. In addition, two case studies are presented where macromobility (e.g. Mobile IP) and micromobility (Mobile-IP – HAWAII) protocols are implemented to support IP mobility on hybrid networks.

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INTRODUCTION

During the last decade there has been a tremendous growth in the implementation and deployment of wireless local area networks (WLANs), in particular those based on the IEEE 802.11 standard. A wireless network can be classified either as a wireless infrastructure network, or as a wireless ad hoc network. A wireless infrastructure network is characterized by the use of a central coordination device (e.g. an access point or a base station), whereas in a wireless ad hoc network there is no central coordination device and the wireless nodes must implement a distributed coordination mechanism (i.e. routing protocol) to enable communication between them. Experts believe that wireless networks will not replace the wired infrastructure, but instead they will provide additional capabilities, such as extending the coverage of service provided by a wired network like the Internet. An additional benefit of wireless networks is the support of mobility as the user is no longer constrained to a physical connection within a building.

A mobile ad hoc network (MANET) is defined as an autonomous network where there is no single point of coordination and it is formed by a collection of mobile nodes which communicate using the wireless medium. These types of networks are characterized by dynamic topologies and limited bandwidth. Usually, mobile nodes have limited resources, such as batteries. In a MANET, each mobile node (MN) can transmit information using a direct link or a multi-hop link to propagate packets to a destination node; as a result, all the mobile nodes in a MANET must implement the routing functionality (Benzaid, Minet, & Agha, 2004). Furthermore, the design of fast and efficient routing protocols is essential in the performance of mobile ad hoc networks.

The mobile nodes in a MANET do not require implementing a specific hierarchical subnetwork addressing scheme, as opposed to wired networks, where a node is usually assigned a single IP address which belongs to a specific subnetwork. As a result, there are different routing issues related to the support of connectivity between mobile nodes in a MANET and a wired network, such as the Internet, which is based on a hierarchical addressing scheme. On the other hand, routing protocols for MANETs generally provide a node with routing information allowing the forwarding of packets to other nodes inside the MANET, and there is usually no implicit support for the routing of packets toward a wired network via a single or multiple access routers.

There is currently an intrinsic problem related to mobility in computer data networks which implement the IP network protocol stack; this issue is related to the fact that IP addresses are commonly used as both an identifier and a locator of a node within a subnetwork (Wisely, Eardley, & Burness, 2002). When a node changes its point of attachment to the network (e.g. the MN moves to a different subnetwork or access router) the assigned IP address can no longer be used as a locator for the node in the new subnetwork. To address this issue, there have been different proposals like Mobile IP, which is a well-known and accepted approach to support macromobility (i.e. mobility between different administrative domains). On the other hand, mobility inside a single administrative domain is called micromobility; micromobility protocols try to reduce the overhead, packet loss and path reestablishment latency which is commonly experienced by macromobility protocols during handoff. The most common micromobility protocols are HAWAII, Cellular IP and Hierarchical Mobile IP (Campbell, Gomez & Kim, 2002).

A hybrid network (i.e. wired and wireless) introduces additional challenges; one concern is related to terminal mobility while preserving ongoing communication sessions during a layer 3 handoff procedure. As a MN moves from one subnetwork to a new subnetwork, a mobility protocol is required to allow the MN to preserve a communication session without having to reestablish the session with a correspondent node; this issue
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