Chapter 6
Overview of Mobile Ad Hoc Networks and their Modeling

Nadia N. Qadri
COMSATS Institute of Information Technology, Pakistan

Martin Fleury
University of Essex, UK

ABSTRACT
Infrastructureless or ad hoc wireless networks have long been a target of research, because of their flexibility, which is matched by the difficulty of managing them. As this research approaches maturity, it behoves researchers to be more responsible in modeling such networks. In particular, as this chapter discusses, the range of ad hoc networks has been extended to vehicular networks, for which it is no longer possible to loosely define their topology. The chapter then discusses how to improve the modeling of such networks in terms of more representative wireless channel models and more realistic mobility models for vehicular networks. The chapter also contains a review of a topic that has been the subject of intensive research: selection of suitable multi-hop routing. The chapter serves as a prelude to the study of applications on such networks, including multimedia streaming.

INTRODUCTION
This chapter gives an overview of Mobile Ad Hoc Networks (MANETs) and Vehicular Ad Hoc Networks (VANETs). In particular, the technologies used at each layer of the standard protocol stack are discussed. There follows an overview of key studies carried out so far on the performance of mobile ad hoc routing protocols. This leads to taxonomy of a wide variety of different protocols, based on mechanisms including route construction, maintenance, and update, topology formation, network configuration, and exploitation of specific resources. Then well-known ad-hoc routing protocols with their advantages and disadvantages are discussed. Furthermore VANET’s and IEEE 802.11p standard for vehicular networks is explained. In addition to this, an overview of ad hoc and vehicular mobility models are given. Finally the GloMoSim network simulator, which is specialized for the study of ad hoc networks is introduced.

DOI: 10.4018/978-1-4666-1613-4.ch006
MOBILE AD HOC NETWORKS

Mobile Ad hoc Networks (MANETs) are a type of pervasive network that truly support pervasive computing, pervasive networks allow users to communicate anywhere, anytime, and on-the-fly. Future advances in pervasive computing rely on advancements in mobile communication, which includes both infrastructure-based wireless networks and non infrastructure-based MANETs. The traditional infrastructure-based communication model is not adequate for today’s user requirements. In many situations, communication between mobile hosts cannot rely on any fixed infrastructure. The cost and delay associated with installation of infrastructure-based communication model may not be acceptable in dynamic environments such as disaster scenes, battlefield, and inter-vehicular communications. MANET would be an effective solution in these scenarios.

MANET technology draws great attention of worldwide researchers and scientists. Since the first appearance of wireless ad-hoc networks in the DARPA packet radio networks in the 1970 (Jubin and Tornow, 1987), it became an interesting research object in the computer industry. In the 1990s, the concept of commercial ad-hoc networks arrived with notebook computers and other viable wireless communications equipment. At the same time, the idea of a collection of mobile nodes was proposed at several research conferences. The IEEE 802.11 subcommittee had adopted the term “ad-hoc networks” and the research community had started to look into the possibility of deploying ad-hoc networks in other areas of application. During the last couple of years tremendous improvements have been made in the research of ad hoc networks. Due to their ability to create and organize a network without any central management, MANETs are characterized as the art of networking without a network (Jiang et al, 1984).

A MANET can be defined as a self-organizing and autonomous system of mobile nodes that communicate over wireless links. Since the nodes are mobile, the network topology may change rapidly and unpredictably over time. The network is decentralized, where all network activity including discovering the topology, routing functionality and message delivering is executed by the nodes themselves. MANETs introduce a new communication paradigm, which does not require a fixed infrastructure - they rely on wireless terminals for routing and transport services. Therefore MANET can be flexibly and rapidly deployed. The special features of a MANET bring about great opportunities together with severe challenges. Due to their highly dynamic topology, the absence of an established infrastructure for centralized administration, bandwidth constrained wireless links, and limited resources, MANETs are hard to design in terms of efficient and reliable networks (Goldsmith & Wicker, 2002). Figure 1 shows a typical MANET.

MANET Protocol Layers

In most MANET studies simulation models are used for evaluation of higher-layer protocols and applications, as it is otherwise difficult to formulate solutions, due to the complex computation required by the many variables involved. Similarly testing on a real testbed is not easily implementable as it requires movement of peoples or vehicles with handheld devices in different patterns. Typically for such testing the focus is only on higher layers ignoring the details of models at other layers. There are many factors (Takai et al., 2001; Xu et al., 2002; Kekmat & Mieghem, 2004; Yang & Vaidya, 2005; Gupta & Kumar, 2000; Weber et al., 2007) such as physical layer modelling, signal reception method, path-loss model, fading models, mobility models, MAC models, interference and noise calculations which have a huge effect on performance of higher layer protocols and applications.

In this Section, brief explanations of models for the lower layers are presented. Network layer routing protocols are discussed in detail in the Section after that.
Related Content

A Simulation Framework for the Evaluation of Frequency Reuse in LTE-A Systems
Dimitrios Bilios, Christos Bouras, Georgios Diles, Vasilios Kokkinos, Andreas Papazois and Georgia Tseliou (2014). *International Journal of Wireless Networks and Broadband Technologies* (pp. 56-83).
[www.igi-global.com/article/a-simulation-framework-for-the-evaluation-of-frequency-reuse-in-lte-a-systems/115590?camid=4v1a](www.igi-global.com/article/a-simulation-framework-for-the-evaluation-of-frequency-reuse-in-lte-a-systems/115590?camid=4v1a)

Multi-System Integration Scheme for Intelligence Transportation System Applications
[www.igi-global.com/article/multi-system-integration-scheme-for-intelligence-transportation-system-applications/125874?camid=4v1a](www.igi-global.com/article/multi-system-integration-scheme-for-intelligence-transportation-system-applications/125874?camid=4v1a)

Wireless Sensor Network to Support Intelligent Transport Systems
[www.igi-global.com/chapter/wireless-sensor-network-support-intelligent/62753?camid=4v1a](www.igi-global.com/chapter/wireless-sensor-network-support-intelligent/62753?camid=4v1a)

Website Usability: A Re-Examination through the Lenses of ISO Standards
[www.igi-global.com/article/website-usability/115587?camid=4v1a](www.igi-global.com/article/website-usability/115587?camid=4v1a)