Chapter 1
Message-Based Routing in Mobile Networks

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ABSTRACT

Mobile phones and PDAs can be utilized as ad-hoc mobile messaging communication devices for near field communication by using Bluetooth technology and mobile ad-hoc networks (MANET). Until now known MANET concepts rely on stationary networks. Liability and stability of the connection in near field communication-based networks are pivotal and require sophisticated and complex mechanisms. However, these mechanisms often do not reflect the application’s particularities such as memory or interface restrictions.

This contribution provides an approach for an ad-hoc messaging network (AMNET), which uses simple store-and-forward message passing to spread data asynchronously. This approach focuses primarily on application-specific needs that can be covered by simple message passing mechanisms. In this paper, we will describe a network based on the AMNET approach. Results are derived by scenario analysis to provide insights into speeding up the network setup process and enable the use of AMNETs - even with a limited number of participants - by introducing a hybrid infrastructure and by adding mobile nodes.

INTRODUCTION

Nowadays, simple mobile phones as well as smart phones, provide multiple communication interfaces which enable users a wide spectrum of interconnectedness for various applications. However in most cases, the underlying networks depend on infrastructures that are bound to stationary devices, such as access points, cellular mobile radios, or providers who regulate access to the
Internet and to the traffic control. In our research, we concentrate on a new “message-based” approach. This allows data exchange between mobile devices without the need for a centralized service unit. Data exchange mechanisms are based on the Bluetooth standards and follow store-and-forward principles. By categorizing the transferred data into personalized or anonymous messages, it is possible to analyze the different requirements in ad-hoc messaging networks (AMNETs) regarding security, stability, and flexibility (Fuchß et al., 2006). This contribution is embedded in research on routing problems (Zhen et al., 2003) between nodes on mobile ad-hoc networks, e.g. common MANETs or mesh-networks (Macker et al., 1998). On this basis, we will present the AMNET concept and provide empirical research in this field of ad-hoc networking based on Bluetooth connectivity.

Furthermore, we will test the concept in a simulation and investigate the message transfer behavior in AMNETs. For this reason, we set up an environment that allows numeric simulations of message transfers. Therefore, we are able to track the influence of additional stationary nodes that are statically connected. This structure represents a hybrid network of mobile and stationary nodes which speed up message transfer compared to scenarios containing only mobile nodes. This is the most important factor concerning a potential use of AMNET technology in reality. This contribution ends with the description of the simulation results and final conclusions.

**ROUTING IN MOBILE NETWORKS**

In recent years, a growing number of research has been conducted on routing in MANETs (Artail et al. 2008, Chin et al., 2002; Royer et al., 1999; Xu et al., 2003), particularly with regard to the limitations of routing protocols (Ni et al., 1999). Some reactive and proactive routing algorithms are provided with respect to different situations. Common protocols show specific vulnerabilities according to scalability, mobility, and network utilization. In growing networks, both methods run out of control because scalability is not suitable and depends on the network’s structure. According to Broch et al. (Broch et al., 1998), the main factors that delay the effectiveness of the algorithms in scaling networks are unpredictable mobility, network load, and complex topology. Networks with fast moving nodes often change their topology. These “vivid” networks rely on mechanisms to find routes that are too complex to grant enduring topologies (Chlamtac et al., 2003).

These highly dynamic MANETs, which contain a large number of network nodes, are based on ad-hoc routing protocols (Ni et al., 1999; Woo et al., 2001). In practice, a trade-off between stability and the maintenance of bandwidth overhead limits the effectiveness of those settings in growing scenarios. Especially reactive algorithms tend to be unusable within huge networks, and reactive routing algorithms do not tend to scale well in large settings (Xiaoyan et al., 2002; Yu-Chee et al., 2002).

Promising improvements have been suggested by Hass et al., combining proactive and reactive paradigms to a hybrid routing algorithm, such as the “Zone Routing Protocol (ZRP)” (Haas et al., 2002), which proves efficient in various environments. With respect to a remarkable increasing complexity of the cutting-edge MANET routing algorithms (which are the main obstacle for implementing and using them in practice), we follow an approach of a different direction: To keep routing as simple as possible, one should consider messages as the point of interest and deny the ambition to bring all internet features to mobile networks.
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