Chapter 8.3
Emerging Wireless Networks for Social Applications

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ABSTRACT

This chapter describes the implementation and performance evaluation of a novel routing protocol called Pandora, which is designed for social applications. This protocol can be implemented in a broad number of devices, such as commercial wireless routers and laptops. It also provides a robust backbone integrating and sharing data, voice and video between computers and mobile devices. Pandora offers great performance with both fixed and mobile devices and includes important features such as: geographic positioning, residual battery energy monitoring, and bandwidth utilization. In addition, Pandora also considers the number of devices attached to the network. Pandora is experimentally evaluated in a testbed with laptops for the first stage and commercial wireless routers for the second stage. The main goal of Pandora is to provide a reliable backbone for social applications requiring a quality of service (QoS) guarantee. With this in mind, the following evaluation of Pandora considers the following types of traffic sources: transport control protocol (TCP), voice, video and user datagram protocol (UDP) without marks. Pandora is also compared with different queuing disciplines, including: priority queuing discipline (PRIO), hierarchical token bucket (HTB) and DSMARK. Finally, an Internet radio transmission is employed to test the network re-configurability. Results show that queuing the PRIO and HTB disciplines, which prioritizes UDP traffic, performed the best.

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INTRODUCTION

Humans have always suffered from the effects of natural catastrophes, including earthquakes, hurricanes, floods, volcanic activity, tornados, droughts, tsunamis and famine. Presently, there are several proposals to better meet the special demands placed upon computer communications and information infrastructure in emergency and rural wireless networks for social applications. The need to provide immediate communications through an infrastructureless computer network that is connected to the Internet in emergency situations is critical in emergency response and disaster recovery (Portmann, 2008). Consequently, there are presently several interesting proposals to deal with the extremely important objective of better managing emergencies.

The use of emerging wireless networks for emergency and rural communities has received increased attention from both research and industry. When traditional communication and electrical infrastructure fails because of natural disasters or other unforeseen causes, a temporary and reliable back-up system must provide for the efficient capture and local transference of emergency information.

The opportune and accurate broadcast of information during disasters is a vital component of any disaster response program designed to save lives and coordinate relief agencies. In moments of disaster, when conventional systems are down, wireless broadband communications networks can provide access to databases that provide data, audio, video or geographical information essential to provide emergency assistance.

Emergency and rural wireless networks need to include fault tolerance (robustness), provide low cost voice/video communication, and possess different architectures that are easy to set up (e.g. ad hoc mode). Furthermore, they should also be flexible to provide interoperability among different wireless technologies, including existing operating systems, plug-and-play functionalities, and proactive and reactive algorithms.

Some reasons for the success behind hybrid wireless mesh network (HWMN) technology include: 1) they provide very inexpensive network infrastructure due to the proliferation of IEEE 802.11 based devices, 2) they offer easy network deployment and reconfiguration, 3) they give broadband data, audio, and video support, and 4) they use the unlicensed spectrum (Braunstein, et al, 2006). Because of these advantages, HWMNs find many applications in a variety of situations ranging from fixed residential broadband networking, based on rooftop wireless mesh networks, to emergency response networks for handling large- scale disasters.

This work analyzes the feasibility of voice over internet protocol (VoIP) in a HWMN for emergency and rural communications over the Pandora protocol. The proposed network architecture is composed of two distinct layers:

(1) An ad hoc network which is composed of wireless mesh clients (WMCs) and (2) wireless mesh routers (WMRs), with a backbone connection between the WMRs (Portmann, 2008). In this architecture, the two types of nodes that comprise the wireless mesh network (WMN) suffer different constraints. WMCs located at the end points have limited power resources and may be mobile, while WMRs possess minimum mobility but do not suffer from power constraints.

VoIP applications must take into account QoS parameters such as bandwidth, jitter, latency and packet loss. Consequently, Pandora should be compared with the PRIO, HTB, and DSMARK queuing disciplines using different kinds of traffic sources, including TCP, voice, video and UDP without marks.

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