CCIT Report #627
July 2007

Scalable Real-time Gateway Assignment in Mobile Mesh Networks

Edward Bortnikov Israel Cidon Idit Keidar
Department of Electrical Engineering
The Technion, Israel Institute of Technology
ebortnik@techunix.technion.ac.il {cidon,idish}@ee.technion.ac.il

Abstract

The perception of future wireless mesh network (WMN) deployment and usage is rapidly evolving. WMNs are now being envisaged to provide citywide "last-mile" access for numerous mobile devices running media-rich applications with stringent quality of service (QoS) requirements. Consequently, some current-day conceptions underlying application support in WMNs need to be revisited. In particular, in a large WMN, the dynamic assignment of users to Internet gateways will become a complex traffic engineering problem that will need to consider load peaks, user mobility, and handoff penalties. We propose QMesh, a framework for user-gateway assignment that runs inside the WMN, and is oblivious to underlying routing protocols. It solves the handoff management problem in a scalable distributed manner. We evaluate QMesh through an extensive simulation (mostly of VoIP), in two settings: (1) a real campus network, with user mobility traces from the public CRAWDAD dataset, and (2) a large-scale urban WMN. Simulation results demonstrate that QMesh achieves significant QoS improvements and network capacity increases compared to traditional handoff policies, and illustrate the need for intelligent gateway assignment within the mesh.

1 Introduction

Wireless mesh networks, or WMNs, are a rapidly maturing technology for providing inexpensive Internet access to areas with limited wired connectivity [8]. While initially designed for small-scale installations (e.g., isolated neighborhoods), WMNs are now envisioned to provide citywide access and beyond through deploying thousands of access points and supporting thousands of simultaneous users [6, 14].

WMN users access the Internet through a multihop backbone of fixed wireless routers. Some of these routers, called gateways, are connected to the wired infrastructure. The WMN assigns each user to a gateway upon initial connection, and can migrate it between gateways over time. In traditional implementations, the gateways provide only Internet access. However, QoS-sensitive applications will probably be supported by high-level services at the network edge, similarly to the recent trend in wireline networks [5]. We envision a future WMN gateway that also provides application-level support, e.g., acts as a SIP proxy, a media server cache, or a full-fledged game server [15]. This trend extends the scope of the gateway assignment problem to a large variety of applications and services.

This paper considers gateway assignment – a traffic engineering (TE) problem that seeks optimizing the QoS or fully exploiting the network's capacity for a specific application. The solution