Chapter 79
A Novel Distributed QoS Control Scheme for Multi-Homed Vehicular Networks

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ABSTRACT

Resource availability in vehicular mobile networks fluctuates due to wireless channel fading and network mobility. Multi-homed mobile networks require a Quality-of-Service (QoS) control scheme that can select a routing path to guarantee high quality of communications with Correspondent Nodes (CNs) while using the maximum available bandwidth of wireless and radio communication technologies. In this chapter, the authors develop an intelligent distributed QoS control scheme which inter-operates between mobile routers, managing vehicular networks mobility, and Road Communication Gateways (RCGs). This proposed scheme manages Vehicle-to-Infrastructure (V2I) communications through enabling multi-homed vehicular networks to optimally distribute traffic among egress links of their mobile routers based on vehicular communication policies and available bandwidth and performance metrics of selected routing paths. This scheme considers the data control plane as a collaborative entity and specifies detailed operations to be performed in the mobile routers and RCGs. Simulation experiments show that the proposed scheme can improve the Congestion Window (CWND) of TCP and the e2e packet loss of video traffic, despite network mobility. It also guarantees the service parameter settings of uplink and downlink connections while achieving reasonable utilization efficiency of network resources and fairly sharing them.

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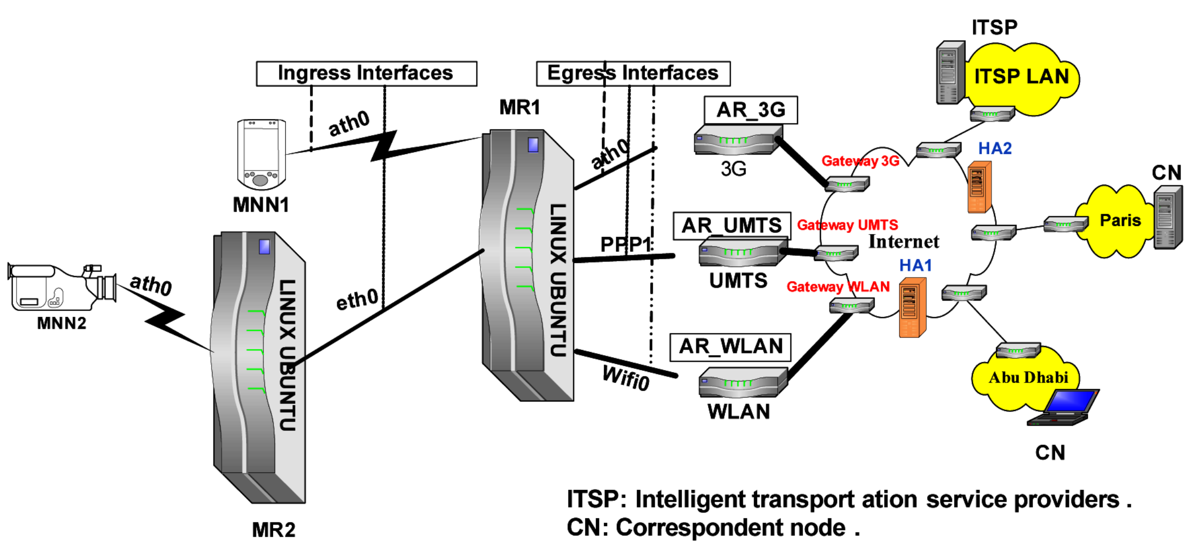
INTRODUCTION

Highway communication system gains momentum efforts to set up a transport communication network to let vehicles communicate with each other and with roadside communication stations. Some highway tests have already been completed for the Vehicle Infrastructure Integration (VII) systems (Costlow, 2008), which aim to reduce accidents and congestion. Because of wireless channel fading and network mobility, QoS provisioning in wireless and mobile networks is more challenging than in fixed networks (Xie & Narayanan, 2010; Gu, Jung, & Kim, 2010). Multi-homing in Intelligent Transportation Systems (ITSs) often refers to the connection of a vehicular mobile network (NEMO) to multiple Internet Service Providers (ISPs) through different wireless and radio communication technologies (Alshaer, Ernst, & Fortelle, 2012). Multi-homing is also used by large enterprises or stub ISPs to connect to the Internet in order to get more service benefits in terms of cost, reliability or performance (Bates & Rekhter, 1998). Multi-homing enables vehicular NEMOs to be reached anywhere anytime under varying network topologies and communication circumstances.

Different wireless interfaces are available on the market, which can enable NEMOs to access Internet. This includes WLAN IEEE 802.11a/b/g, WiMax 802.16, wireless access vehicular environment (WAVE) IEEE 802.11p, Dedicated Short-Range Communication (DSRC), satellite, GPRS (Generalized Packet Radio Switching) and UMTS (Universal Mobile Telecommunication System) (Johnson, Perkins, & Arkko, 2004; Chen & Guizani, 2006). Ng, Ernst, Paik, and Bagnulo (2007) investigated different multi-homing configurations for vehicular NEMOs. However, throughout this Chapter, we will focus on the multi-homing configuration depicted in Figure 1, where the root Mobile Router (MR) of NEMO is equipped with wireless, radio and satellite cards to reach Internet through multiple routing paths. NEtwork MObility Basic Support Protocol (NEMO-BSP) (Devarapalli, Wakikawa, Petrescu, & Thubert, 2005) is employed to manage communications between NEMOs through egress interfaces of their mobile routers and Home Agents (HAs), as shown in Figure 1. NEMOs can send and receive traffic through multiple routing paths established with HAs. The upstream traffic can be managed by MR of NEMO, meanwhile the downstream traffic can be managed by HA and Road Com-

Figure 1. A multi-homed nested NEMO connected to a number of ISPs



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