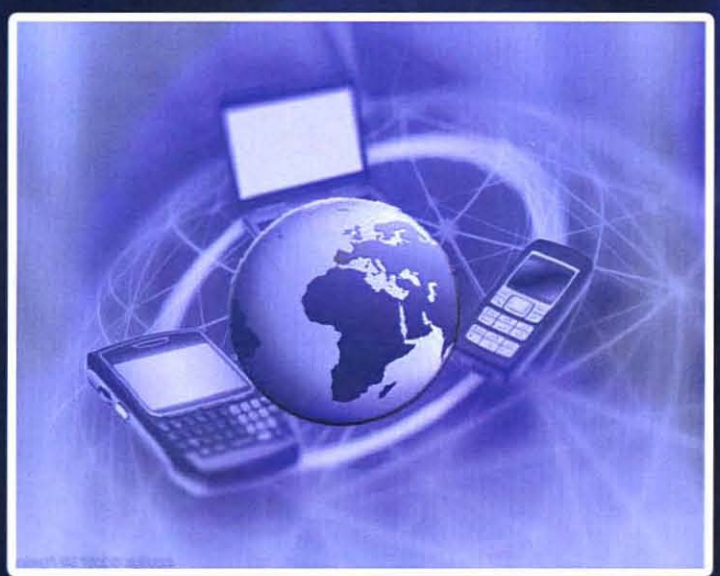
Research Issues in Wireless

Communications and Networking

Farhat Anwar
Wajdi Al-Khateeb



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CHAPTER 16

ROAD SIDE -TO-VEHICLE COMMUNICATIONS

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16.1 INTRODUCTION

Wireless vehicular communication (WVC) has been identified as a key technology for intelligent transportation systems (ITS) for the past few years. IEEE 802.11p is the proposed standard for the physical and MAC layer of the WVC devices. The main objective of the standard is to change the frame format in order to increase the delay spread tolerance introduced by the vehicle mobility, in which the channel bandwidth is scaled from 20 MHz, i.e., 802.11a to 10 MHz, i.e., 802.11p. This chapter proposes the TDMA technique with fixed time slots and a guard band between the slots to ensure interoperability between the wireless devices to communicate in rapidly changing environment where transactions must be completed in small timeframes. The new TDMA sub-layer is proposed to be on top of the conventional 802.11p CSMA/CA MAC. We have found that 802.11p-based TDMA can achieve much higher throughput compared with the conventional 802.11p-based CSMA/CA, as the distance, vehicle speed and numbers increase. Ns-2 simulation results present the performance analysis and validate the efficiency of the proposed scheme.

The wireless LAN technology 802.11 offers a high data rate wireless access for local area environments. WLANs provide much higher data rates than the mobile WiMAX and 3G networks and are relatively cheap and easy to install and maintain, where the fast advancements and sophistication of the chipset and the semiconductor industry enables the IEEE 802.11 devices price curve to continue to sliding. All these features favor the WLAN as a good networking choice to be adopted for vehicular communication standard. Many organizations and standard bodies have agreed with the 802.11 WLAN standards which will be adopted in dedicated short-range communications (DSRC) projects. This allows vehicles on the road to communicate with one another (also called the Inter-vehicle communication (IVC)) and to communicate with road side equipments for safety and ITS applications.

The Federal Communications Commission (FCC) has allocated 75 MHz of spectrum at 5.9 GHz that will be used by the IEEE 802.11p wireless access in vehicular environments (WAVE) and dedicated short-range communications (DSRC) chipsets.

The objective of using TDMA with the contention-free topology rather than with the contention-based IEEE802.11 is to increase the coverage distance of the AP in the RSU. This is mainly due to the sensitivity of the acknowledgement (ACK) messages to propagation delay in the IEEE 802.11 CSMA/CA (Carrier Sense Multiple Access/ Collision Avoidance) protocol with binary exponential back-off where a positive acknowledgement is used to notify the sender that the transmitted frame has been successfully received.

An acknowledgement is sent after the Short Inter Frame Space (SIFS) has received the frame. The SIFS is smaller than the Distributed Inter-Frame Space (DIFS), hence, the receiving station does not need to send and apply the back-off procedure to transmit an acknowledgement. If the acknowledgement is not received due to some reasons, the sender then assumes that the frame has been lost and enters the back-off process again to retransmit