

Chapter 12

MAC Protocols in Vehicular Ad Hoc Networks

Chih-Yung Chang

Tamkang University, Taiwan, R.O.C.

ABSTRACT

*With the rapid development of wireless technologies, the Vehicular Ad Hoc Networks (VANETs) have recently received much attention. VANETs technologies aim to ensure traffic safety for drivers, provide comfort for passengers and reduce transportation time and fuel consumption with many potential applications. The achievement of these aims highly relies on efficient MAC protocols which determine the performance of packet transmission in terms of success rate, delay, throughput and bandwidth utilization. This chapter reviews the existing MAC protocols developed for VANETs. Initially, the IEEE 802.11p and DSRC standard are reviewed. Three TDMA-based MAC protocols, called CVIA, VeSOMAC and D*S, are then introduced. In addition, three MAC protocols that cope with the emergency-message broadcasting problem are proposed. Finally, a reliable MAC protocol which is developed based on the cluster topology is reviewed.*

INTRODUCTION

This chapter reviews the existing MAC protocols developed for VANETs. Initially, the IEEE 802.11p and DSRC standard are reviewed in Section 2. Three TDMA-based MAC protocols, called CVIA, VeSOMAC and D*S, are then introduced in Section 3. The CVIA MAC protocol mainly concerns the fairness

and throughput issues on the demand of Internet access in a multi-hop manner. The VeSOMAC MAC protocol intends to reduce the transmission latency for broadcasting a message over the VANETs. The D*S introduces the data access MAC scheduling protocol which aims to develop a scheduler in Road Side Unit (RSU) so that those upload and download requests can be satisfied as more as possible. In Section 4, three MAC protocols proposed for broadcasting the emergency message are depicted.

DOI: 10.4018/978-1-60566-840-6.ch012

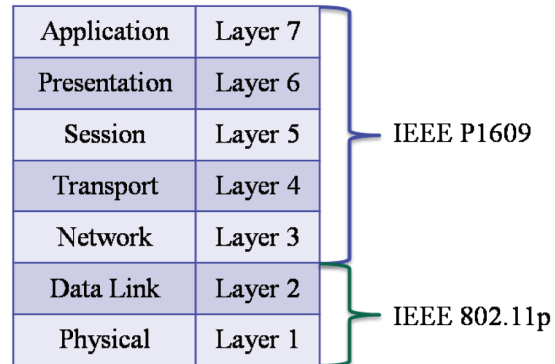
These MAC protocols aim at avoiding the packet collision and achieving high success rate. Finally, Section 5 reviews a reliable MAC protocol which is developed based on the cluster topology. The conclusions are finally given in Section 6.

IEEE 802.11P AND DSRC STANDARDS

DSRC (Dedicated Short Range Communications) (ASTM International E2213-03, 2003) is a well known standard supports both Public Safety and Private operations in roadside to vehicle and vehicle to vehicle communication environments. DSRC standard at 5.9 GHz band is projected to support low-latency wireless data communications between vehicles and from vehicles to roadside units. The DSRC specification is meant to be an extension of the IEEE 802.11 technology into the outdoor high-speed vehicle environment. In fact, the Physical Layer (PHY) of DSRC is adapted from IEEE 802.11a PHY based on Orthogonal Frequency Division Multiplex (OFDM) technology. Moreover, the Multiple Access Control (MAC) layer of DSRC is very similar to the IEEE 802.11 MAC based on the Carrier Sense Multiple Access with Collision Avoidance (CSMA/CA) protocol with some minor modifications.

DSRC is meant to be a complement to cellular communications by providing very high data transfer rates in circumstances where minimizing latency in the communication link and isolating relatively small communication zones are important. DSRC protocol layer is developed based on physical, data link and applications layers of traditional OSI model. In the Physical layer, DSRC defines physical parameters for uplink and downlink communication and is mainly working in the 5.9 GHz band (U.S.) or 5.8 GHz band (Japan, Europe). In the data link layer, DSRC defines frame format, frame wrapper and the procedures of MAC and Logical Link Control (LLC). Ap-

Figure 1. Protocol stack relating to OSI model



plication layer includes the fragmentation and defragmentation of data application service and service primitive for a variety of applications, including electronic toll collection, emergency warning system, vehicle safety service, commerce transactions via cars, electronic parking payments, probe data collection and so forth.

The standard of DSRC is comprised of IEEE 802.11p and IEEE 1609 family. Figure 1 shows the correspondence between DSRC and OSI models. **IEEE 802.11p** (Draft 7.0, 2009) is a draft amendment to the IEEE 802.11 standard to add Wireless Access in the Vehicular Environment (WAVE). As an extension of IEEE 802.11, IEEE 802.11p defines how data exchange between high-speed vehicles and between the vehicles and RSU in 5.9 GHz (5.85-5.925 GHz) band. IEEE 1609 is a higher layer standard based on IEEE 802.11p. The IEEE 1609 family is consisted of IEEE 1609.1 (2006), IEEE 1609.2 (2006), IEEE 1609.3 (2007) as well as IEEE 1609.4 (2006).

IEEE 1609.1 plays the role of WAVE Resource Manager which specifies a DSRC application overlying WAVE and allows remote site applications to communicate with OBUs or RSUs. As a standard of application layer, IEEE 1609.1 conducts application-level information interchanges.

IEEE 1609.2 supports WAVE security services for applications. It defines secure message

21 more pages are available in the full version of this document, which may be purchased using the "Add to Cart" button on the publisher's webpage:
www.igi-global.com/chapter/mac-protocols-vehicular-hoc-networks/39527

Related Content

Improvement of Simulative Analysis in Ad Hoc Networks

M. Fazio, M. Villari and A. Puliafito (2010). *Networking and Telecommunications: Concepts, Methodologies, Tools, and Applications* (pp. 1930-1944).

www.irma-international.org/chapter/improvement-simulative-analysis-hoc-networks/49847

Soft Decision Parallel Interference Cancellation for Multi-Carrier DS-CDMA

R. Radhakrishnan, K. R. Shankarkumar and A. Ebenezer Jeyakumar (2009). *Breakthrough Perspectives in Network and Data Communications Security, Design and Applications* (pp. 183-203).

www.irma-international.org/chapter/soft-decision-parallel-interference-cancellation/5941

A Brief Study on Smart Medicine Dispensers

Dayananda P., Amrutha G. Upadhyay, Nayana B. G., Priyam Poddar and Vandana Rao Emaneni (2022). *International Journal of Hyperconnectivity and the Internet of Things* (pp. 1-7).

www.irma-international.org/article/a-brief-study-on-smart-medicine-dispensers/294893

Security Aware Routing Protocols for Mobile Ad hoc Networks

M.S. Ali and P.M. Jawandhiya (2012). *Technological Advancements and Applications in Mobile Ad-Hoc Networks: Research Trends* (pp. 264-289).

www.irma-international.org/chapter/security-aware-routing-protocols-mobile/64707

Market of Resources for Virtual Enterprise Integration

Maria Manuela Cunha, Goran D. Putnik and Paulo Silva Ávila (2010). *Networking and Telecommunications: Concepts, Methodologies, Tools, and Applications* (pp. 220-226).

www.irma-international.org/chapter/market-resources-virtual-enterprise-integration/49742