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Media Access Protocol in Vehicular Ad-Hoc Networks: A Survey

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Abstract

There is the need of fast advancement and pervasive deployment in wireless communication technologies. Vehicular ad hoc networks (VANETs) are expected to develop in the above advancement with the pervasive development. A key challenge to the successful deployment of vehicular communication is the implementation and efficiency of the medium access control (MAC) layer. Broadcasting and relaying the communication safely and alert the surrounding nodes about critical driving situations are considered to be timely reaction. To achieve the message dissemination timely and lossless medium access in vehicular ad hoc network is needed. In this paper we survey several aspects and role of Media Access Protocol in Vehicular Ad-Hoc Networks.

Keywords

VANET, MAC, Safety Data, Channel Access

1. Introduction

The increase of cheaper, smaller and more powerful mobile devices have made wireless Ad-Hoc networks [1, 2] to become one of the fastest growing areas of research. This new type of self-deploying network may combine wireless communication with high degree node mobility. Unlike conventional wired networks they have no fixed infrastructure. This flexibility makes them attractive for many applications for a situation where either supporting structure is unavailable or deployment is unfeasible such as military networks and disaster recovery operations [3,4].The Ad-hoc self-organization also makes them suitable for virtual conferences, where setting up a traditional network infrastructure is a time consuming high-cost task.

Wireless radio networks nowadays are dominated by widely spread IEEE 802.11 [5] radio equipment and with IEEE's 802.16 [6], [7] standard, a high-data-rate back-haul mesh networking technology is available as well. Albeit 802.11 specifies an infrastructure-less mode of operation, the vast majority of radio networks use an infrastructure mode, connecting each mobile station with an access point (802.11) or base station (802.16). But in the case of mobile ad-hoc networks (MANETs) it is not possible to set up a fixed infrastructure. So (MANETs have been the subject of considerable research in the recent years [8], [9] with the main focus on efficient routing.

In [10] author suggest field of vehicular communications vehicles act as mobile nodes in wireless networks. In an ad hoc network nodes communicate directly with each other, without an access point. If you analyze the communication protocol then there are different layers where we need some communication protocol. We also discuss about the time stamp in different communication protocol. In this paper we survey several aspects in this direction with their advantages and drawback.

The remaining of this paper is organized as follows. We discuss Media Access Protocol in Vehicular Ad-Hoc Networks in Section 2. In Section 3 we discuss about literature review. In section 4 we discuss about problem domain. In section 5 we discuss about the proposed framework. Conclusions are given in Section 6. Finally references are given.

2. Media Access Protocol in Vehicular Ad-Hoc Networks

The most important challenges of a MAC layer for VANET according to[11] are as follows [11]: First the the dynamic nature of VANETs, second the scalability in various traffic densities, and supporting different applications with different requirements.

The nodes access through the MAC protocols is controlled can be categorized into contention-free and contention-based approaches. Contention-based approaches need little coordination or no coordination so that this assumption makes them more suitable for VANETs. However, unbounded delay and their low performance in high dense networks is problematic for safety messages as well as some infotainment applications with minimum requirements. Contention-free approaches can satisfy better (guarantee) Qos requirements for timely-critical applications but they suffer from high coordination especially in high variable conditions such as VANETs. Two different MAC protocols are

studied: carrier sense multiple access (CSMA) of 802.11p and self-organizing time division multiple access (STDMA). These two MAC methods are examined with respect to the communication requirements and protocol settings arising from C-ITS standardization. Based on these constraints, suitable performance measures are derived such as MAC-to-MAC delay and detection distance, where the former catches both the delay and reliability.

In STDMA, the channel access delay is upper-bounded and therefore known before transmission, since regardless of the number of stations within radio range, all stations are always guaranteed timely channel access. In CSMA, the channel access delay is not upper-bounded and it is unknown until transmission commences, as it is based on the instantaneous channel load and stations can experience a random delay when in backoff. The evaluation of CSMA and STDMA is performed through extensive computer simulations, modelling a 10 km highway with six lanes in each direction. Vehicles travel along the highway and broadcast position messages periodically with different update rates. Two different channel models have been used during the evaluations, one distinguishing between a receiver being in line-of-sight (LOS) or obstructed LOS (OLOS) from the transceiver, while the other does not consider this.

Node mobility, bad quality of channel, scarcity of resources and many other problems are attracting the attention of the researchers over the last decade [12]. These challenges are responsible for many problems that are still open issues, such as effective routing, effective medium access control (MAC) mechanisms, power management, mobility management etc. Data deployment is also a crucial aspect [13] and can be used for performance measurement [14][15].

3. Literature Review

In 2011, Abhijit Das et al. [16] propose to use shared cryptography to secure message communication in adhoc network. In this approach we divide any information into multiple shares and transmit the different shares via multiple disjoint paths between any pair of communicating nodes and if possible at different point of time. At the receiving end the original information is reconstructed by combining the shares received via different paths at different point of time. We have also proposed to keep redundancy in the number of shares to withstand loss of some shares due to loss in transmission or security attacks.

In 2011, Irshad Ahmed Sumra et al. [17] present the Vehicular ad hoc network (VANET) Security R&D Ecosystem is discussed. The R&D Ecosystem can be divided into four major aspects i.e. academic research, car manufacturers, government authorities, and end users.

In 2012, G.Gowtham et al. [18] suggest that aVANET is a adhoc network that uses moving cars as nodes in a network to create a mobile network.VANET allows cars approximately 100 to 300 metres of each other to connect and in turn create a network with a wide range.As cars falls out of the signal range and goes out of the network and other cars follows the same network and now mobile network is created. Here the communication between the nodes takes place in a secured way by using security algorithms like TESLA and ECDSA.VANET uses a hardware called TPM(Trusted platform module) to provide a secured communication between the nodes. For a secured communication between the nodes, a node must trust the communicating node before communication with it and if it is found legal then communicate with it. While trusting, if that node is found to be malicious one, avoid communication with it. In their proposed work, instead of maintaining long records of node details in central trusted authority, using password generator generate a password and parent node will distribute them to the child nodes.

In 2012, Ganesh S. Khekare et al. [19] suggest that the vast development in the wireless technologies emerged a new type of networks, such as Vehicular Ad Hoc Networks (VANETs), which provides communication between vehicles themselves and between vehicles and infrastructure. Various new concepts such as smart cities and living labs are introduced in the recent years where Vehicular Ad Hoc Networks (VANETs) plays an important role. A review of various Intelligent Traffic Systems (ITS) available and various routing protocols with respect to our proposed scheme is done in this paper. They introduces a new scheme consist of a smart city framework that transmit information about traffic conditions that will help the driver to take proper decisions. Their proposed scheme consist of a warning message module composed of Intelligent Traffic Lights (ITLs) which provides information to the driver about current traffic conditions.

In 2010, Sebastian Hanigk [20] develop and analyses a medium access protocol for vehicular and tactical ad-hoc networks which is based on a self-organising hybrid TDMA/OFDMA-approach and achieves hard real-time QoS levels. Author shows the implementation study on a software-defined radio platform providing real-world experience.

In 2011, Chrysostomos Chrysostomou [21] proposes a novel, adaptive medium access control mechanism for vehicular ad hoc networks. A simple, effective, and efficient nonlinear control law is built,based on fuzzy logic control principles, which can be easilyadopted in different network environments (V2V) communication and vehicle-to-infrastructure (V2I) c. They demonstrate, via simulative evaluation, that the proposed fuzzy control methodology offers inherent robustness with effective control of the system under dense and dynamic conditions, without the need to tune any parameters. Their proposed approach offers distinct differentiation among differently prioritized traffic types, thus providing adequate Quality of Service (QoS) in terms of throughput performance, in contrast with the IEEE 802.11p MAC protocol they compared against.

In 2012, Chong Han et al. [22] proposes a novel distributed asynchronous multichannel medium access control (MAC) scheme for large-scale vehicular ad hoc networks (VANETs), asynchronous multichannel medium access control with a distributed time-division multiple-access mechanism (AMCMAC-D). The proposed scheme supports simultaneous transmissions on different service channels while allowing rendezvous and broadcast of emergency messages on the control channel. The scheme is distributed, because it handles access to the shared control channel for different access categories without relying on the beacon frames from roadside units. This condition eliminates the overhead that is associated with channel allocation, making the proposed scheme suitable for large-scale networks in terms of the number of active nodes. Service differentiation in the author proposed scheme is enhanced by allocating different numbers of time slots for different access categories. They compare the performance of the proposed scheme with the IEEE 1609.4 standard and the asynchronous multichannel Coordination Protocol (AMCP) in terms of throughput, packet delivery rate, collision rate, utilization of service channels, service differentiation, and the penetration rate of no collided emergency messages.

In 2012, Steffen Moser et al. [23] suggest that by giving vehicles the ability to propagate warning messages to the other ones, the number and the severity of accidents on our streets could likely be reduced. Safety-related applications based on vehicular ad-hoc networks (VANET) are usually dependent on transmitting a message from source to sink within a given time limit. IEEE proposes the standard 802.11p which is an adaption of the well-known Wireless LAN 802.11a for inter-vehicle communication. While many properties have been improved, 802.11p still comes with a contention-based medium access control, only. This leads to an indeterminism and data dependencies. One deterministic and fairer alternative compared to contention based medium access mechanism would be Time- Divison Multiple Access (TDMA).

In 2013, Mehdi Khabazian et al. [24] present an analytical model for the performance evaluation of safety message dissemination in vehicular ad hoc networks with two priority classes. In particular, considering the IEEE 802.11 broadcast protocol and using 2-D Markov modeling, they derive the joint distribution of the numbers of low-priority periodic messages, which are in transmission mode and in a backoff process in a highway. Then, the result is used to derive the average dissemination delay of high-priority event-driven messages in the presence of the low-priority traffic in the network. The results are helpful in determining a good tradeoff between network parameters such as vehicles' transmission range, safety traffic generation rate, and medium access control (MAC) parameters to satisfy the required delay bounds for the critical high-priority traffic.

4. Problem Domain

After studying several research papers we observe the need of multi node communication. So that congestion can be control. Means if there is the possibility of communication , when one node is busy with other in communication other node can communicate it saves much more time. But this can be done securily so thaat only authorize communication is possible. So there is the nned of framwork for loading data with a secure trusted computing. This provides a way to hide the data and normal node and can protect their data from the others and also the communication time reduces without any congestion. In [23] author suggest that while CSMA/CA, which is part of the standard proposed by the IEEE, does not offer any real-time

guarantees, we have encountered that it performs better than the more deterministic S-TDMA. The latter is able to outperform CSMA/CA only for a very high density of vehicles.But there is the possibility of slot congestion also which can increase the waiting time.

5. Analysis

We provide the analysis of the paper in table 1.

Table 1: Analysis

Authors	Technique	Achieve
Abhijit Das et al. [9]	Shared Cryptography	keep redundancy in the number of shares
G.Gowtham et al. [11]	Random Password Generator	Instead of maintaining long records of node details in central trusted authority, using password generator generate a password and parent node will distribute them to the child nodes.
Ganesh S. Khekare et al.	ITL	Warning message module composed of Intelligent Traffic Lights (ITLs) which provides information to the driver about current traffic conditions.
Steffen Moser et al. [23]	Real-Time Media Access in Vehicular Ad-Hoc Networks	For the scenario with 100 vehicles CSMA/CA performs much better than S-TDMA. Even for the scenario with much higher load (1000 vehicles), CSMA/CA needs less time to wait for channel access than S-TDMA.
Nirav kumar Shah [25]	Multichannel Cognitive Medium Access Control Protocol for VANET	Simulation results confirm that the proposed cognitive MAC protocol increases the CU up to 70% compared to the IEEE 1609.4 standard, and improves reliability for the safety related data transmission.

6. Conclusion

Nevertheless, despite the surge in VANET research, security and privacy issues have been the root cause of impeded momentum in VANET deployment. There is the need of proper communication in the needed time which provides less congestion. There are some future suggestions which can be useful for the further extension:

1) Provide multiple communications with the needed time frame and with less communication.
2) Secure data transmission.
3) Apply on inner city scenario [23].
4) Proper attack detection mechanism is also a crucial concern in the AD-Hoc communication.

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