On Selection of Efficient MAC Protocol for VANET

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***Abstract*: The rapidly increasing vehicles on the road causes various problems like road blockage due to traffic jams, accidents etc. in recent times the Inter Vehicle Communication provides efficient solution to these problems. For its proper functioning the vehicles should be intelligent enough to communicate with neighbouring nodes independent of any central unit. This approach is feasible only if networks are formed casually between moving vehicles and among moving vehicles and some road side fixed equipments. This type of networks is known as Vehicular adhoc Networks (VANETs). As Vehicles move in high speed, there is a rapid change in physical layer topology and very short ranged communication required is very short ranged is used. This makes 802.11a/b/g less suitable for these types of networks. IEEE 802.11p protocol is a member of 802.11 protocol which enables data exchange between vehicle and vehicles and vehicles to infrastructure. The purpose of this work is to analyze and compare 802.11p with 802.11a/b (used for VANETs before 802.11p) on Ns2.**

***Keywords:* VANET,IEEEStandards,AODV,NS2.**

I. INTRODUCTION

In past few years Vehicular Adhoc Networks (VANETs) came into existence because of its capability to provide vehicle road safety, traffic control & management, efficiency and also it is convenient to use. VANETs is a configuration of wireless networks in which vehicles acts as a node which connects with themselves (V to V) and with Road Side units (RSUs). VANETs has its own specified features like high mobility, inbuilt GPS, sufficient battery power, high processing mode. There are large number of services developed in VANET like-

- Vehicular safety applications
- Safety Warnings
- Non safety applications like traffic congestion
- Routing information

The demand to create high performance, high reliability, and high scalability and secure communication in VANET technology presents a challenge to wireless research community. VANET are based on ITS (Intelligent Transport System) which aids to road safety, traffic density avoidance, and gives efficient services. To support vehicular communication devices. VANET provides services which improve vehicular communication. To meet out these services each vehicle requires to access channels in efficient manner without collisions. MAC protocol describes the way to access channel, to vehicles in VANETs. There are some issues which are considered while designing MAC layer for VANET. Such collaborating multiple channels, uncertain acknowledgements, priority based access of channels. The main challenge is the periodic changes in network topology due to the quick navigation of vehicles. MAC protocols are classified into following three categories:

***Contention based Protocols*:-**

In this protocol, whenever node wants to access a channel they compete with the neigbouring nodes to get access. The node which aquire the channel gets access for an agreed time. Since these protocols are not delay bound, it does not guarantees safety messages to deliver on actual time. An exploded traffic is a well suited scenario for these protocols because in this manner there is an effective use of the bandwidth. The effectiveness of these protocols get troubled when there is a wide range of users. A familiar example of Contention-based protocols is Carrier Sense Multiple Access (CSMA). In CSMA, the device used for transmission first observes the network in order to avoid collisions. However collision may take place, as a result of this packets may undergo unlimited delays. So Mac protocols should lessen the Medium Access delays in order to improve safety applications in VANET. CSMA/CA approach is applied in IEEE Standards 802.11a/b/g.

Contention-free Mac protocols:

Contention free protocols are also known as controlled access protocol. In these protocol nodes does not required to compete to get channel access. Channels are allocated to the medium beforehand.

Hybrid Mac protocols:

Hybrid protocol is generally formed by combining both contention-free and contention-based mechanisms. To improve the network performance in VANET this combination is proposed. Hybrid MAC protocol allocates an amount of time for contention-based operation and remaining time is allotted for contention-free processes (hybrid mac).

This paper focuses on the comparison of performance of IEEE 802.11p, 802.11a and 802.11b for Vanet. This study is aimed to show the implementation of above mentioned WLAN standards and compare the performances with others. For simulation ns2 is used to show the performance on increasing number of CBR i.e 5,10,15,25 and 40.

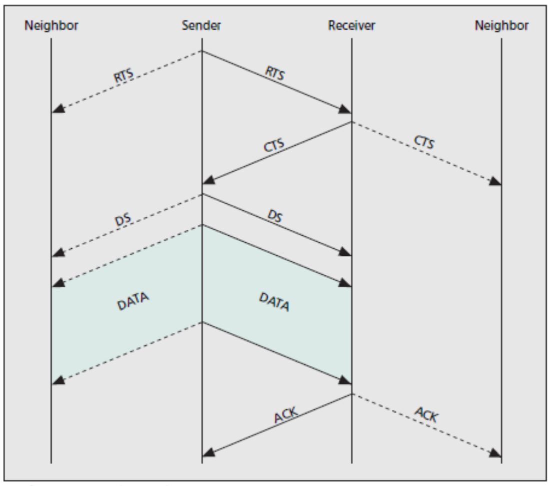
The paper is organized as follows. Section 1 describes the introduction of the study. Section 2 gives the description about the IEEE standards and Mac layers for Vanet. Section 3 describes about the background of this study.

IEEE 802.11

This is well known wireless communication standard, its operation is defined in two modes that is centralized mode and ad hoc mode. For the centralized mode operation there is a communication between the terminals of one or more access points whereas for ad hoc mode mobile nodes communicate directly without any provision of basic infrastructure. For the operation of VANETs prototyping the IEEE 802.11 standard are often used. It is widely available in the market for the wireless devices. Physical layer and MAC addressed by IEEE 802.11.

IEEE 802.11 MAC Layer

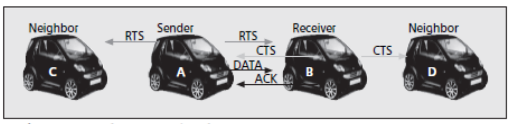
The Distributed coordination Function (DCF) in IEEE 802.11 is responsible for the median access based on CDMA. In this the device coordinates to the network before transmitting to avoid the collisions. To access the medium design for centralized network and real time services, point coordination function (PCF) method is also recommended.
In IEEE 802.11 two methods is used to determine the medium is idle or not are Physical carrier sensing network and virtual carrier sensing network. Physical carrier sensing network is depend on physical layer whereas virtual carrier sensing networks based on network Allocation vector (NAV). NAV is just like a timer that indicate the duration for which medium is busy.NAV has any value other than zero that mean medium is busy.
Interval spacing in wireless networks is called inter-Frames (IFSs) which are set between two successive transmission frames to manage process of medium access. While using IEEE 802.11 in ad hoc mode each vehicle has to first check the medium state before attempting to transmit. For a certain duration time (DIFS) if it sense to be idle the vehicle can transmit whereas it back off when attempts again after an amount of time chosen within a contention window (CW). IEEE 802.11 is mainly based on RTS/CTS/ACK packets exchange to access the medium (figure 1).
If medium is idle and vehicle wants to access the medium then sends and the duration time of the whole transmission and RTS packet including its ID. The receiver vehicle neighbours hear the RTS packet and set their NAV according to the transmission duration time indicated in the RTS packet.



■ **Figure 1.** *Packet exchange in MACAW.*

Figure 1

After receiving the RTS, if the receiver is ready to receive the transmission, it waits for a Short IFS (SIFS) time and then replies by sending a CTS packet including the transmission duration time. All neighbours receiving this CTS set their NAV according to the indicated transmission duration time. When receiving the CTS, the sender vehicle waits for SIFS before starting the data transmission.
The receiver vehicle, after successfully receiving the data frame, waits for another SIFS then it sends an ACK only to the sender. Each terminal set its NAV to zero after receiving the ACK packet.
To minimizes the risk of frame collisions in IEEE 802.11 RTS/CTS/ACK packets exchange and the different inter-frames spaces (Fig. 2).



■ **Figure 2.** *Packets control exchange in IEEE 802.11.*

Figure 2:Packet Exchange in 802.11

***IEEE 802.11 Physical Layer for VANETs* —**

Related to the physical layer there are several IEEE 802.11 versions which have been propose. In which 802.11a, 802.11b and 802.11g are the most prominent ones. Other versions are also proposed as the enhancement of previous versions such as 802.11i, this version adds to security. 802.11b is the most prominent one and broadly accepted IEEE standard. Like 802.11g, 802.11b operates on illicit 2.4 GHz band in which interference is attainable with wireless IP cameras, microwaves ovens, cordless phones and also on other devices. Theoretically, IEEE 802.11b can reach data rates of 11 Mb/s, but practically it can reach upto 7.5 Mb/s only due to CSMA/CA protocol overhead.
In comparison to 802.11b and 802.11g, 802.11a uses frequency band of 5GHz. Logically 54 Mb/s is considered as maximum throughput but effective ones goes up to 25 Mb/s utmost. 802.11a have advantage less interference due to 5GHz, but it does not acknowledge it to penetrate through walls and obstacles. 802.11g and 802.11b can work simultaneously. 802.11g is capable to meet the uppermost bit rate of 802.11a with maximum net throughput of 25 Mb/s.

II. BACKGROUND

In [7] the authors have made some empirical measurements for V2V communications. They have used prototype of IEEE 802.11p equipment. Two vehicles are equipped with CVIS OBU with a microwave communication module (MCM). Their experiment environments are highway, rural, and urban areas. They consider different speeds and distances in their measurements.
In [8] authors have presented a literature survey on congestion control of VANETs. The research contributions that we have reviewed in this paper exhibit the potential and limitations of congestion control implemented in service control channel (SCH) for vehicular ad hoc networks. We first compared each of IEEE standards. Then we investigated technologies and methods realized by various researchers and proposed a framework for congestion control for SCH applications mainly for non-safety applications. The congestion control approach is one of the solid solutions to minimize the congestion in wireless communications channel. We have highlighted the algorithm for the non-safety messages queues and mechanism to monitor the channel communications based on defined threshold.
In [9] authors have exploit three routing protocols of VANET which are GPSR, DSDV and BMFR by comparing their three parameters throughput, end to end delay and number of packets dropped during communication. As we study out of this three protocols BMFR and GPSR are position based routing protocol and DSDV is topology based routing. In this paper we also simulate these protocols using NS2 simulator and using the standard protocol i.e. IEEE 802.11 p in Vehicular Adhoc Network.

III. SIMULATION AND RESULTS

A. Table-: Configuration Parameters in NS-2 Simulator

Parameters	Values
NS-2 Version	NS-2.35
Mac Layers	802.11p,802.11a,802.11b
No. of Active Nodes	5,10,15,25,40
Speed of Nodes	20 m/s
Traffic Type	CBR
Simulation Type	100 s
Antenna Type	Omni-Antenna
Transmission Range	500*500
Routing Protocol	AODV

B. Simulation Results:

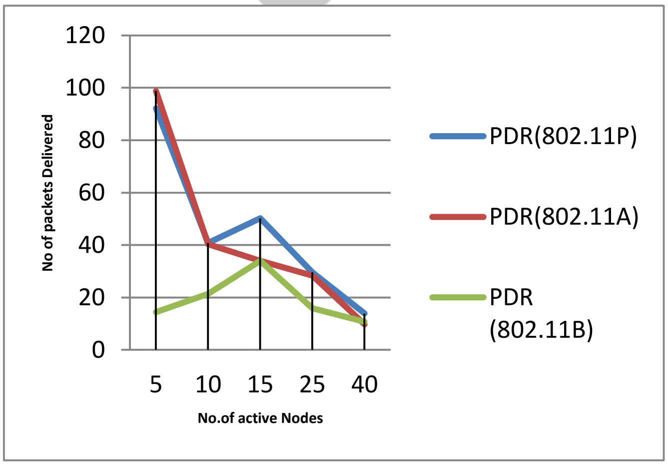


Figure 3: Packet Delivery Ratio

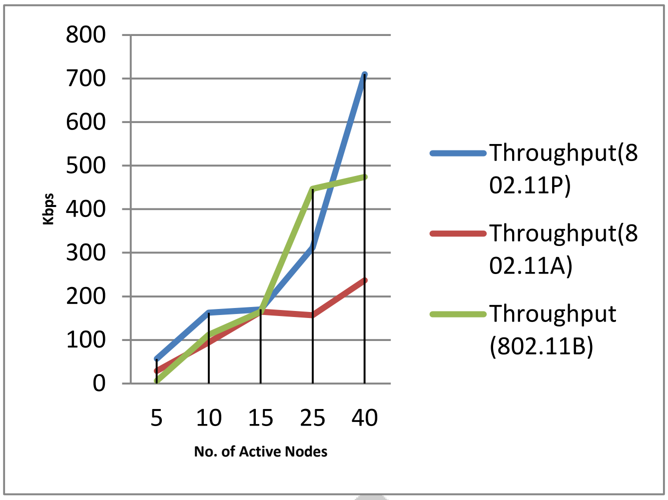


Figure 4: Graph represents Throughput

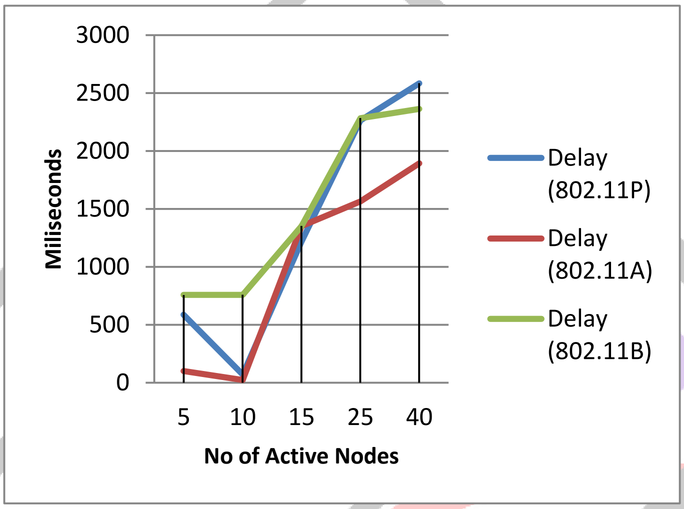


Figure 5: Graph represents Delay

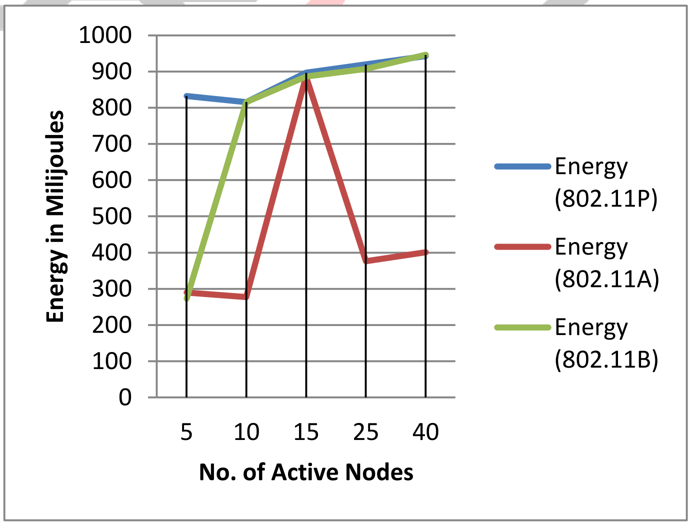


Figure 6: Graph represents Energy Consumed

IV. CONCLUSION AND FUTURE SCOPE

This research work has presented congestion window and Transmitting and receiving threshold Value and energy model. For the improvement of VANET range in the proposed work, IEEE 802.11p networks are demanded to outline a multi-hop network. The area where the position of nodes are not changed but the routing can be executed in an ad hoc manner by using routing protocols named as AODV. It is precisely a necessity to remove the burden of illegal packets due to unwanted nodes in a network. It has been concluded that the packet delivered rate and throughput rate when measured are better in 802.11p .But energy is higher in IEEE 802.11p. The work of minimizing energy consumption work can be carried out in future work.

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