A Study on Different MAC Protocols for VANET

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Abstract— Vehicle Network is most dynamic and composite network form. To optimize the communication in this network, the work can be applied to different network layers. One of such layer is physical layer controlled by MAC protocol. This MAC protocol is responsible for communication initiation and data encoding. In this paper, a study on different MAC protocols for vehicular adhoc network is presented. The paper has identified the significance of MAC protocol and provided its integration with MAC protocol.

Keywords: MAC, VANET, Protocol, Layered.

I. INTRODUCTION

Vehicle Adhoc network is a vast range communication network in which vehicle nodes performs cooperative communication to optimize the communication throughput. As the nodes in the network increases, the network suffers from the load and congestion problems. This congestion slows down the communication and degrades the network performances. To provide the effective communication in the network, intelligent communication analysis approach is required. These communication approaches are defined respective to different layers or the different communication or network phenomenon. The most consideration is provided either on the architecture level or the communication level. The architectural level optimization can be achieved by setting up the scenario and the road side units at optimal locations. The physical constraints to the network nodes can be defined to optimize the communication. The communication level analysis can be applied to provide the safe communication over the network. The communication in vehicle network can be performed either cooperatively by performing the vehicle to vehicle communication or by the help of infrastructure Devices in such case V2R (Vehicle to roadside) communication is performed.

Here the RSU devices are considered as the communication controller that works as the centralized authority that observe the communication event over the region and provide the relative communication response. This kind of periodic analysis is applied on different safety parameters such as positional constraints, speed, communication time, vehicle trajectory analysis.

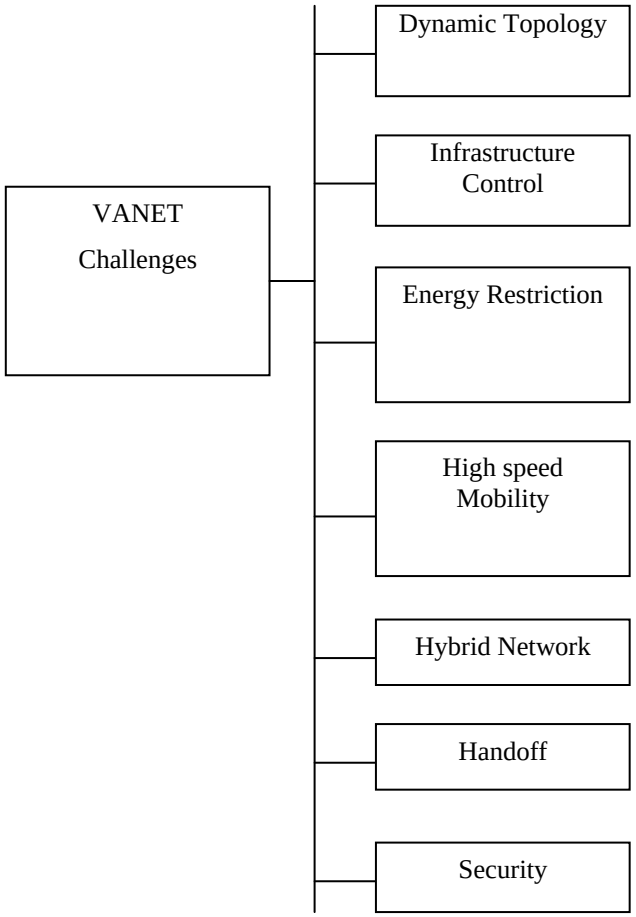

Figure 1: VANET Characteristics

Another property of vehicle nodes is the energy specification with each node. As the node participates in communication some amount of energy is consumed. The energy adaptive communication describes the network life and utilization of available battery. Another challenge in these networks is the variable and high speed mobility of vehicle nodes. The mobility is generally direction specific so that the predictive estimation and decisions can be taken to optimize the communication. Another challenge in mobile network is the hybridization of different network types and the associated technologies. Such as the same network can have WiFi and

WiMax adaptive base stations. A single node can be present in more than over network coverages at the same time. As the vehicle node moves outside its current coverage, the handoff situation occurs. The selection of effective base station is also a challenge to the network. The final associated aspect to the network is security. As of public network, the network suffers from various internal and external attacks. These attacks can degrade the network performance or can reveal the network information.

A) MAC Challenges in VANET

MAC protocols such as TDMA, FDMA or CDMA are not easy to define and implement in VANET because of lot of hybridization, dynamism and complexities. These protocols requires optimization in terms of time slot adaptation, channel allocation and communication synchronization. In vehicular network, the major challenge is the vehicle type and its prioritization. Another challenge about MAC to analyze the situation or existence of RSU. The configuration relative to the infrastructure device will be different as well as it is required to define different MAC configuration for infrastructure devices. Another challenge for MAC protocol is to analyze the vehicle collision. The vehicle and message college adaptive safe communication is complex communication activity applied in vehicle area network.

In this paper, a study or the review to the physical characteristics of vehicle area network along with MAC protocol. The paper also discussed different type of MAC protocols available for vehicle adhoc network. In this section, the vehicle adhoc network is discussed along with associated challenges. The section also discussed the challenges associated with MAC protocol. In section II, the work defined by earlier researchers is discussed. In section III, the VANET associated MAC protocols are discussed along with architectural specification. In section IV, the conclusion of the work is presented.

II. RELATED WORK

Different researchers provided lot of work on VANET optimization in different aspects. The most challenge phenomenon associated with vehicle adhoc network is MAC configuration and management. A significant research is provided by earlier researchers to utilize the MAC protocol in different ways for vehicle network. In this paper, some of the contribution of earlier researchers is discussed.

Cristina Rico Garcia[1] has provided a work on design of an improved reliable MAC protocol. Author define the cell based analysis driven MAC protocol to provide localized communiation during broad cast. This improved protocol is able to reduce the collision over the network. The high speed communication support is provided by the protocol along with cross layer communication. Author provided the intra cell communication scheme to provide the direction and speed aware communication.

Hamid Menouar[2] has provided a study based work to identify the role MAC protocol in VANET optimization. Author analyze the network collision and provided the efficient communication under characteristics specification with high mobility. Author provided the safe communication under summarized and qualitative communication in vehicle network.

Marthinus J. Booysen[3] has provided a study based work on MAC protocols in VANET. Author discussed different configuration of MAC for different scenarios and for different communication types. Author discussed the associated deployment along to optimize the communiation in VANET.

Khalid Abdel Hafeez[4] has provided a work on efficient and reliable MAC protocol configuration for VANET. Author provided the accident analysis adaptive communication. Author provided the MAC optimization under safety vector and provided the conditional traffic driven communication. Author provided the situation adaptive communication to provide the safe communication under constraints specification. The knowledge adaptive safe communication is provided to improve the analytical behaviour of network.

V. Baskar[5] has provided a work on broadcast services under TDMA adaptive communication in VANET. Author provided the safety adaptive improvement in protocol to provide the activity control adaptive communication.

Jagruti Sahoo[6] has provided a partition adaptive message dissemination for MAC optimization. Author provided the service range based road safe communication to identify the emergency messages. Author control the density, accident adaptive communication in network.

M.Hari Prasad[7] has provided a performance adaptive communication in clustered routing model. Author defined the hierarchical communication model for route generation under multi metric analysis.

Boangoat Jarupan[8] has provided the cross layer communication design to provide shared channel

communication under dynamic constraints. A validation adaptive cross layer design is defined to optimize the transportation system.

III. MAC FOR VANET

MAC protocol is integrated in MAC layer and provided the packet formation, communication behavior analysis and the channel estimation. Because of the dynamic nature of vehicle ad hoc network and the hybrid communication technology, a robust MAC protocol design is required. MAC protocol must adapt the environmental and communication feature along with contention control mechanism in congested network. Some of the MAC protocol design challenges are described in section I. According to those issues, MAC protocol design is described under traffic condition, mobility constraints and multipath environment specification. The delay spread adaptive reflective communication, diffraction and refraction is required to handle by the MAC protocol. This protocol analyzes the communication demand dynamically and provides the spectrum resource generation under frequent connection and disconnections. Author obtained the latency analysis to attain the QoS optimization with service and application specification.

The MAC protocol is responsible to provide the communication synchronization under time slot allocation and bandwidth allocation so that the specialized characteristic formation is done. In VANET, this protocol is divided in two main categories called centralized and decentralized MAC. As the name suggest the centralized MAC is defined for the infrastructure inclusive networks. In these networks, the RSU adaptive communication is controlled by the centralized MAC. The random access protocol comes in this category. If the V2V communication adaptive network is formed the decentralized MAC can be implied. Other types of MAC protocols include TDMA, FDMA, and CDMA. In the prioritization adaptive communication, MAC also provides the scheduling such MAC is defined by ADHOC-MAC or the dynamic TDMA. In this section some of common MAC protocol for VANET are discussed in detail.

A) IEEE 802.11

This protocol standard provides the communication through access point called Basic service set. The node level communication is provided under gain access and service adaptive communication. The association adaptive handshaking is provided to provide the neighbor based communication. The infrastructure based communication is here performed using independent BSS. The protocol provides two access methods to the medium called distributed coordination function (DCF) and Point Coordination Function (PCF). DCF is based on CSMA/CA and provide the coordinate driven access over the medium whereas the PCF works for RSU adaptive centralized communication. The protocol also uses the back off time to generate the contention window along with size estimation. The priority message specification adaptive traffic category estimation is provided by the protocol.

B) IEEE 802.11p

It is improved protocol defined specifically for short term communication such as VANET. This protocol work on reduced resource requirement including the limited bandwidth, guard period analysis and the long range adaptive communication, collision free polled communication is also provided by the protocol.

C) Directional MAC

This kind of MAC is defined with the specification of directional antenna such as Omni directional or directional. As the RTS message is generated during the communication, the omni directional antenna based node check is performed. To control the communication, certain transmission area can be blocked which received CTS message. This protocol is defined under the following concerns.

- To perform Directional Discovery. In such case, the communication direction is identified
- To perform Directional Handover. In such as, the control switching is performed
- To perform Directional Forwarding : In such case, the handshaking is performed with Data/ACK message

The characteristics adaptive communication process is defined by the protocol. The basic direction discovery process of this protocol is shown in figure 2.

To provide the communication, the antenna management mechanism is defined along with resource controlling system. The protocol is defined along with limitation analysis and the constraints analysis. These constraints include the directional observation and the time synchronization.

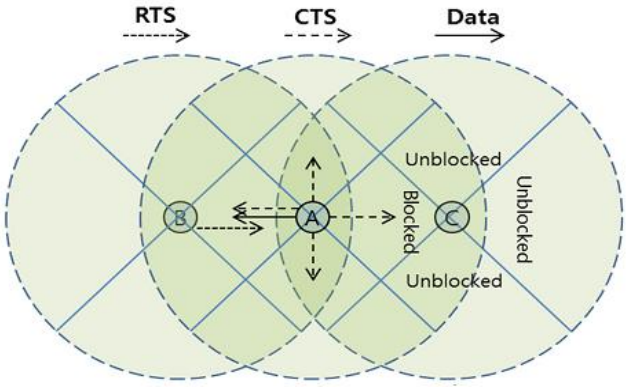

Figure 2 : Directional Discovery

D) Cluster Based MAC

In small range communication, the nearby nodes forms a virtual network or cluster. The clustering scheme is here presented under mobility and the resource utilization in the network. This network model is able to generate the cluster by observing the surrounding nodes. This cluster formation is dynamic and able to perform the group communication. This communication is also defined with the specification of cluster head. The protocol performs the analysis based on the speed, distance, acceleration and direction so that the time synchronized communication will be formed. This communication model is defined under weighted stabilization factor so that the communication synchronization is achieved. The vehicle synchronization is achieved here with time and specific for the location derivation. The RSU based communication is also formed in this network form.

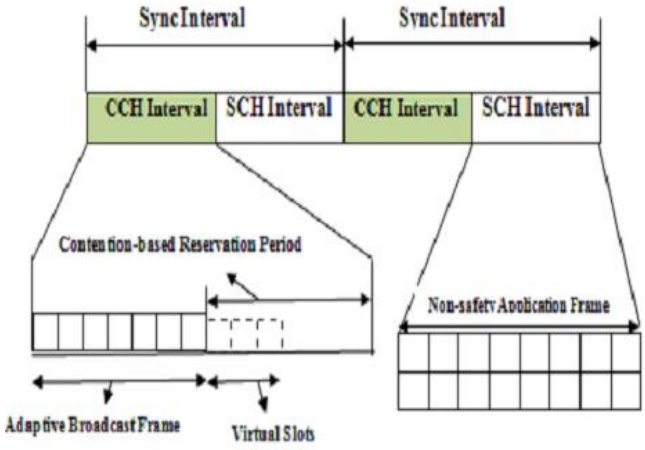

Figure 3 : Multichannel MAC

E) Multichannel MAC

The multi channel MAC protocol is defined respective to adaptive broadcasting mechanism. The protocol provides the collision free and delay transmission adaptive communication for safety application in traffic environment. The architecture of the protocol is shown in figure 3

This architecture is similar to WAVE mac protocol. The channel time based partitioned division communication is performed in synchronized intervals. The slot adaptive communication control is performed under channel and service optimization. This model include the control interval based adaptive broadcast frame generation and contention based reservation period generation is provided by the protocol. This network form provides the transmission control adaptive safe message communication under collision analysis and uniform communication analysis.

IV. CONCLUSION

In this paper, a study to the MAC protocols is presented for vehicle area network. The paper has identified the different changes performed by different researchers to optimize the MAC and vehicle network. The paper also presented the different type of MAC protocols for vehicle adhoc network.

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