ANALYSIS AND COMPARISON OF VANET ROUTING PROTOCOLS USING IEEE 802.11p AND WAVE

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Abstract

The Vehicular Adhoc network is the emerging research area which makes a phrase 'Network on the wheel". VANET is ad hoc network technology where cars or vehicles are used as mobile nodes to form a communication network. Routing protocols play a big vital role in terms of performance. MANETs and VANETs are infrastructure less networks, where they are similar in characteristics. The similarity in both cases is the nodes are in motion with their self organizing characteristics where there is no requirement of any fixed or existing infrastructure. [1]. The main purpose of VANET is to provide[2] ubiquitous connectivity while on the road to the mobile users, those are otherwise connected to the outside world.

Due to the distinct features of VANETS, various problems can be tackled by the researchers. Applications developed for VANETS have very specific and clear goals such as providing intelligent and safe transport system.

Keywords— Routing protocols, simulation, VANET, Network Simulator, AODV, DSDV, OLSR

I. INTRODUCTION

Fig 1 VANET Scenario

Vehicular Adhoc Networks are special case of Mobile Adhoc Network (MANET). Both MANET and VANET networks are multi hop mobile networks with dynamic topology. Due to dynamic nature of the mobile nodes in the network, finding and maintaining the routes is very challenging in VANETS. Routing in the VANETS is main concern for maintaining mobility and safety issues.

As MANET and VANET share similar protocols and principles e.g. self organization, self management, low bandwidth, and short radio transmission range, most of the ad hoc routing protocols are applicable such as AODV, DSR, and DSDV etc. VANET differs from MANET by its highly dynamic topology. Wireless communication is established by nodes acting as routers and transferring packets from one to another in ad hoc networks. Routing in these networks is complex due to node movements and so there is a need of effective routing protocols. A routing protocol is needed whenever a packet is transmitted to a destination via number of nodes and various routing protocols are proposed for the same. These protocols find a route for a packet delivery and deliver the pack to correct destination.

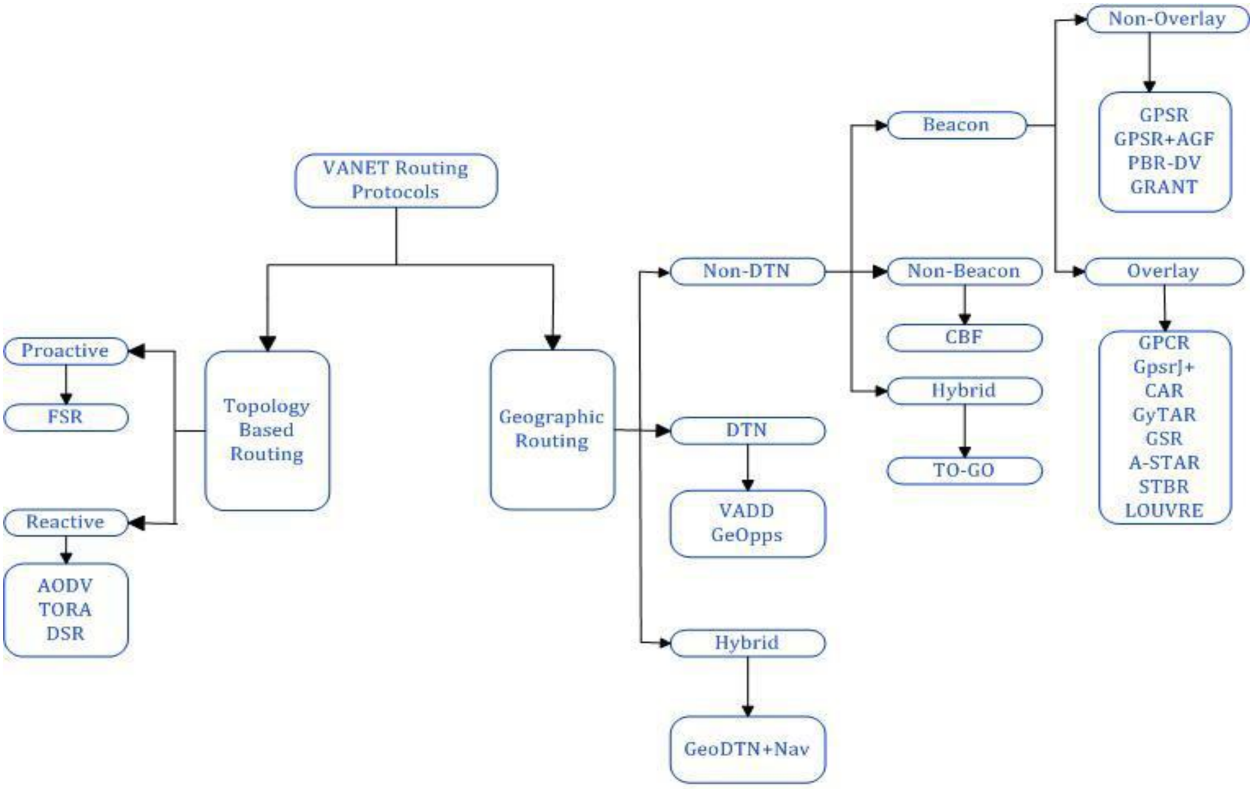


Table 1 – Classification of VANET Routing Protocols

II. CLASSIFICATION OF ROUTING PROTOCOLS

Generally routing protocols are classified into two categories.

1 Topology Based Routing
2 Geographic Routing

The topology based routing protocols are of two types proactive i.e. table driven routing protocols and reactive i.e. on demand routing protocols. The Geographic routing protocols are further divided into various categories as shown in above diagram (Table 1).

Here the protocols are major concern are proactive and reactive.

Proactive (Table Driven) Protocols

In this type of routing protocol, each node in a network maintains one or more routing tables which are updated regularly. Each node sends a broadcast message to the entire network if there is a change in the network topology. However, it incurs additional overhead cost due to maintaining up-to-date information and as a result; throughput of the network may be affected but it provides the actual information to the availability of the network. Distance vector (DV) protocol, Destination Sequenced Distance Vector (DSDV) protocol, Wireless Routing protocol Fisheye State Routing (FSR) protocol are the examples of Proactive protocols.

The proactive protocols are not suitable for larger networks as more node entries are to be maintained for each and every node. The resultant is cost of overheads increases with more bandwidth consumption. Examples of proactive protocols are destination Sequence Distance Vector (DSDV), Optimized Link State Routing (OLSR). Proactive routing protocols are mostly based on shortest path algorithms. They trace information of all connected nodes in form of tables because these are table based protocols.

Reactive Protocols

In this type of routing protocol, each node in a network discovers or maintains a route based on-demand. It floods a control message by global broadcast during discovering a route and when route is discovered then bandwidth is used for data transmission. The main advantage is that this protocol needs less touting information but the disadvantages are that it produces huge control packets due to route discovery during topology changes which occurs frequently in MANETs and it incurs higher latency. The examples of this type of protocol are Dynamic Source Routing (DSR), Ad-hoc On Demand Routing (AODV) and Associatively Based Routing (ABR) protocols. Reactive routing is also known as on – demand routing protocol as they do not maintain routing information at the network nodes when there is no communication. If the node wants to send a packet to another node then only this protocol searches for the route on demand and thus establishes the communication to transmit and receive the packet. Normally the route discovery happens with the help of flooding the route request packets throughout the network. Example is AODV.

Ad hoc On Demand Distance Vector Routing (AODV)

The AODV Routing protocol uses an on-demand approach for finding routes, that is, a route is established only when it is required by a source node for transmitting data packets. At that point the network node that needs a connection broadcasts a request for connection [4]. Other AODV nodes forward this message, creating an explosion of temporary routes back to the needy node. When a node receives such a message and already has a route to the desired node, it sends a message backwards through a temporary route to the requesting node. The needy node then begins using the route that has the least number of hops through other nodes. Unused entries in the routing tables are recycled after a time. The advantage of AODV is that no extra traffic is created for communication along existing links. Also, distance vector routing is simple, and doesn't require much memory or calculation. However AODV requires more time to establish a connection, and the initial communication to establish a route is heavier than some other approaches.

Destination Sequenced Distance – Vectors Routing (DSDV)

DSDV is proactive i.e. table driven routing protocol scheme. The contribution of this is to solve routing loop problem as per author [4]. DSDV solves major problems associated with Distance Vector routing of wired networks as per author [8]. Each entry in the routing table contains sequence numbers. Initially routing tables are broadcasted by every vehicle to its adjacent vehicles. The neighbor vehicles update the routing table with the help of two types of packets namely Full Dump packets and Incremental Normally Full Dump packets which contain information about every participating vehicle in the VANET [10]. The major advantage of DSDV is that it guarantees loop free paths. It also reduces infinity problem counts. Further it maintains best path not multiple paths to every destination so that routing table space is saved. The drawbacks of DSDV are that it does not support multipath routing and sometimes wastage of bandwidth happens due to unnecessary advertisement of routing information.

III. Broadcasting in VANET

Broadcasting in VANET is very critical issue area of research. The difference in broadcasting in VANET is different from broadcasting Manet due to several reasons such as network topology, mobility patterns, demographics, traffic patterns at different times. Sharing emergency traffic, weather, road data among vehicles and delivering advertisement and announcements may be the applications relying on broadcast include [3]. Because of the vehicles moving at high speeds in VANET, dynamic changes in topology happens frequently, which results in changes in routing information. Broadcasting in VANETs can disseminate assistant traffic condition messages to all vehicles within a certain geographical area[4]. The simplest way to implement a broadcast service is flooding, in which each vehicle rebroadcast messages to all its neighbors except the one it received from. Flooding guarantees that the message will eventually reach all the nodes i.e. vehicles in the network.

IV. Standards Used : IEEE802.11p And WAVE

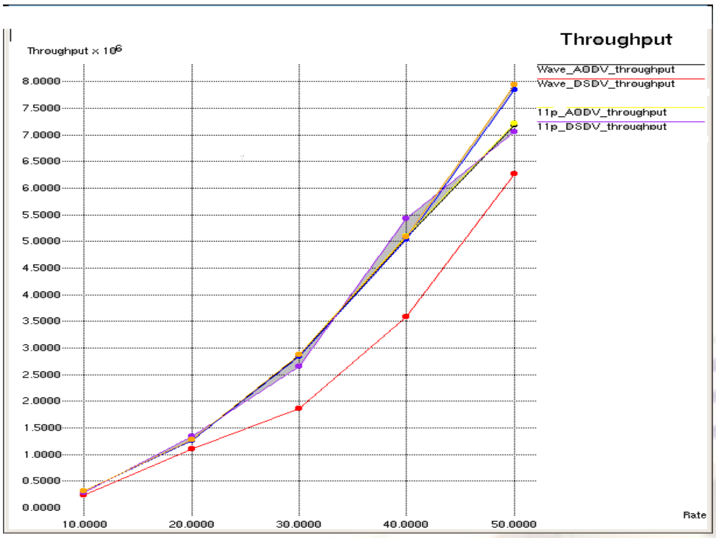
IEEE 802.11p is an approved amendment to the IEEE 802.11 to add wireless access in vehicular environments (WAVE). It defines enhancements to 802.11 required to support Intelligent Transportation Systems (ITS) applications. This includes data exchange between high-speed vehicles and between the vehicles and the roadside infrastructure in the licensed ITS band of 5.9 GHz (5.85-5.925 GHz). IEEE 1609 is a higher layer standard on which IEEE 802.11p is based. IEEE 802.11p is more suitable for high speed vehicle data communication as per author [6]. Wireless Access in a Vehicular Environment (WAVE) refers to a set of emerging standards for mobile wireless radio communications. WAVE is highlighted in IEEE 1609.1/.2/.3/.4. IEEE 802.11p protocol contains approved modifications to the IEEE 802.11 standard which enhances wireless access functionality that will permit applications for rapidly changing vehicular environments. The enhancements allow the exchange of data in both V2V and V21 scenarios involving high speed vehicles. In IEEE 802.11p both MAC and PHY layers belonging to DSRC/WAVE protocols are enhanced.

Graphs showing the performances of the parameters.

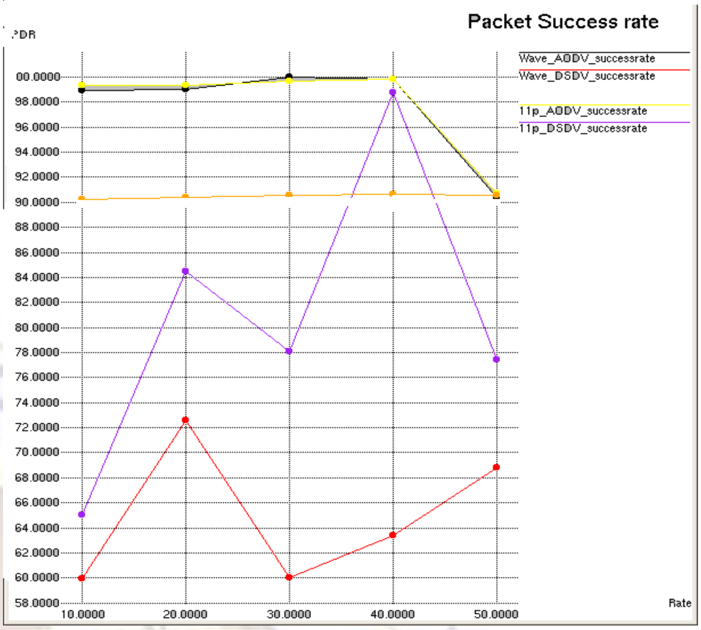
Red line shows AODV response
Green line shows DSDV response

Network Area	**X = 5000 metersY = 200 Meters**
Traffic type	**CBR**
Visualization Tool	**NAM,TRACE**
File Duration	**500 Secs**
MAC layer	**802.11p**
Protocols	**AODV,DSDV**
Number Of Nodes	**30**

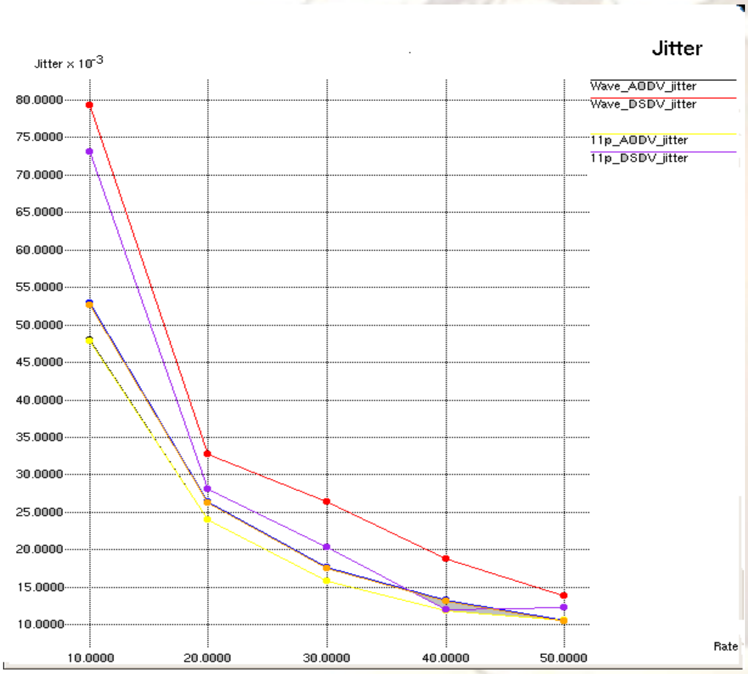
Table No 2



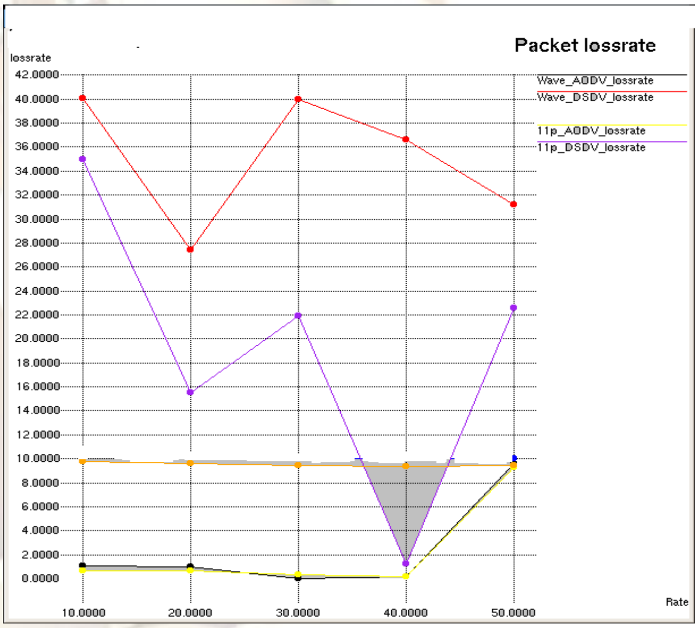
Packet Transmission Delay (IEEE802.11p) and WAVE



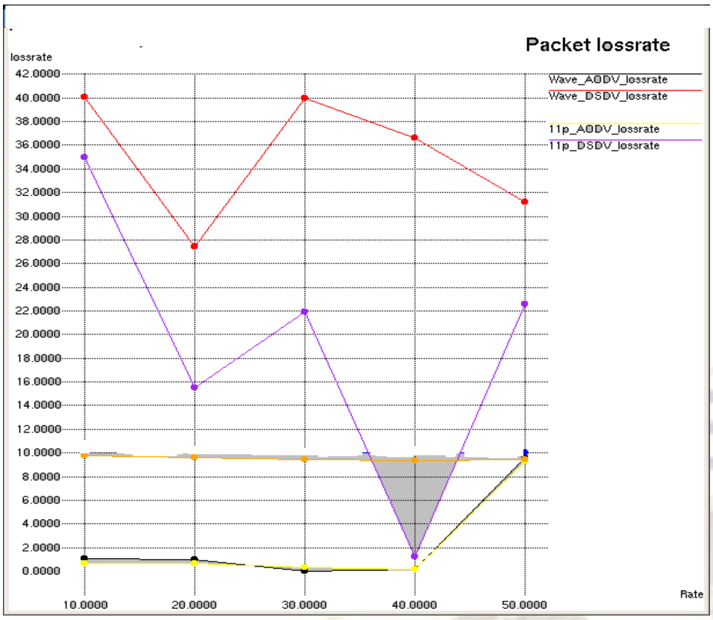
Packet Success Rate (IEEE802.11pand WAVE)



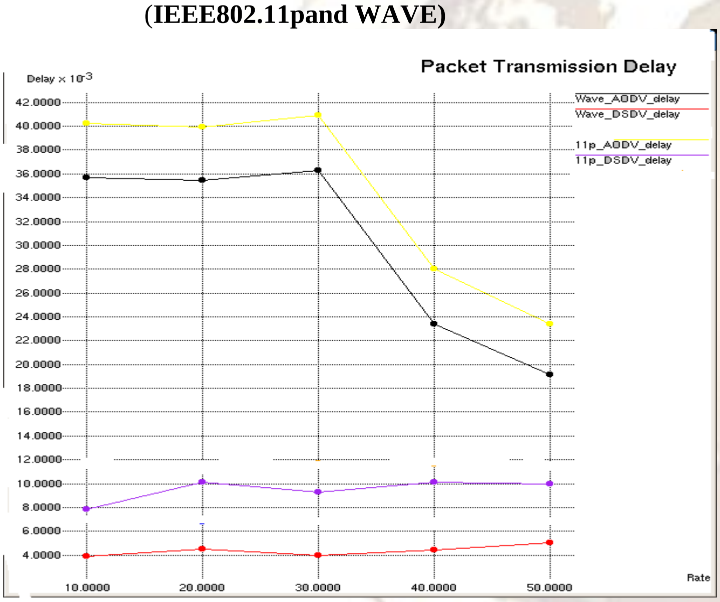
Jitter (IEEE802.11p and WAVE)



Packet Success Rate (IEEE802.11pand WAVE)



Packet Loss Rate (IEEE802.11pand WAVE)



Packet Transmission delay (IEEE802.11pand WAVE)

V. CONCLUSION

After simulation following points are observed.

1. AODV can perform better for IEEE 802.11 P than WAVE under high mobility conditions
2. If number of nodes is increased AODV can perform well.
3. AODV has better Throughput and packet delivery ratio for IEEE 802.11p than WAVE
4. Link failure requires new route discoveries in AODV as it has almost one route per destination vehicle in its routing table.
5. DSDV is better choice if delay is main concern.
6. DSDV is worst for dropped packets. The performance degrades with increase in number of nodes.

It is concluded that overall performance of AODV with EEE 802.11p is superior than DSDV .

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