Comparative Analysis of VANET Routing Protocols Using VANET RBC and IEEE 802.11p

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Abstract
The Vehicular Adhoc network is the emerging research area which makes a phrase 'Network on the wheel". VANET is a collection of communication vehicles to broadcast desired information. In this paper performance of three routing protocols namely Adhoc On Demand Distance Vector Routing (AODV), Destination Sequence Distance Vector (DSDV) and VANET Radio Broadcasting Protocol (VANETRBC) is compared for various parameters. Here, DSDV protocol is a table driven protocol while AODV is on demand protocol. VANETRBC is a general radio broadcasting protocol taken into consideration. To decide the protocols is a challenge as per author reference [1]. All these three protocols are compared with the help of IEEE 802.11p standard using NS-2.33(Network simulator – 2.33) as per author [12]. The main purpose of this paper is to focus on analysis and comparison of the routing protocols so that this will help researchers to add their contribution in the field of VANET.

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

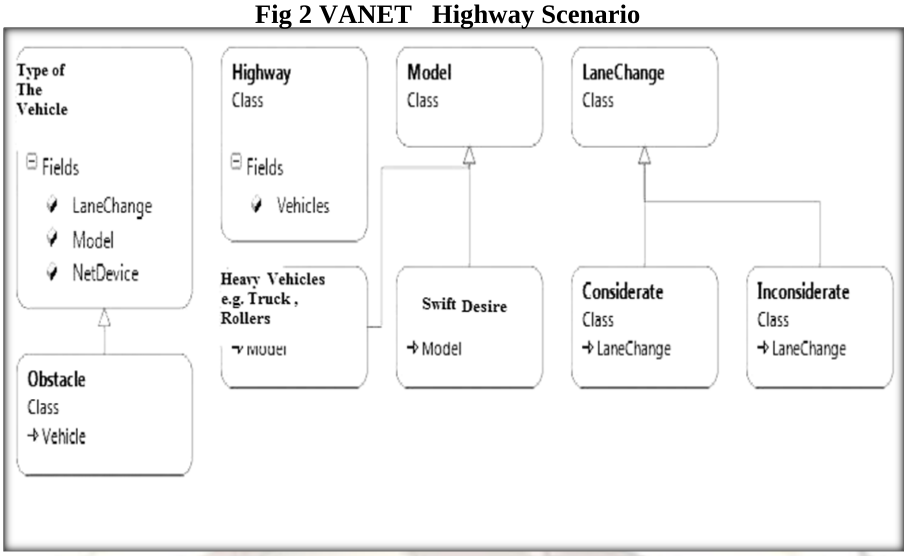
I. INTRODUCTION
Vehicular Adhoc Networks are special case of Mobile Adhoc Network (MANET). Both MANET and VANET networks are multi hop mobile networks with dynamic topology. VANET is an adhoc network which is formed between vehicles as per their need of communication. Every participating vehicle must be capable of transmission and reception of signals to develop VANET as discussed by author in reference [5]. Normally VANET communication range is restricted up to one thousand meters in various implementations. Beyond this range the communication of the vehicles is normally not feasible due to high packet loss rate. VANETs consists of two basic components: vehicle and infrastructures. Depending on this communication between two devices can be divided into Vehicle to Vehicle (V2V) and Vehicle to infrastructure (V21) communication as per author [3]. VANETs may be implemented with two kinds of routing methods, unicast and multicast routing. Unicast routing is used when two nodes are adjacent. For all other cases multicast routing is used as there is no clear direct link between source and destination.

The applications in VANET consists of safety oriented applications, traffic management applications, traffic coordination and traffic assistance, travel information support and few comfort applications [1]. The major concern in safety applications is to avoid the accidents of vehicles and save the lives. The safety applications are of two types: active safety, passive safety. Traffic management applications mainly include traffic monitoring, light scheduling etc. The focus is to anyhow improve the traffic flow so that the congestion in traffic and accidents occurring in the route may be reduced. Non – Safety applications provide the traffic information and enhance driving comfort as per author [9]. The major non – safety applications include:

a) Traffic Optimization
b) Infotainment
c) Payment Services
d) Roadside Service finder

Fig1 VANET (Vehicle to Vehicle Communication)

Fig 2 VANET Highway Scenario



II. VANET ROUTING PROTOCOLS

Wireless communication is established by nodes acting as routers and transferring packets from one to another in adhoc networks. Routing in this network 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.

Generally routing protocols are mainly classified into two categories: Table driven routing protocol and source initiated on demand driven routing protocol as per author [11]. The table driven routing protocols maintain consistent and up-to-date routing information from each node in the network in one or more routing tables regardless of the need of such routes. The source initiated on demand routing protocols are developed and employed in mobile ad –hoc networks and initiates routing activities only when required. The category is the set of proactive and reactive protocols. In proactive routing, each node has one or more tables which contains the updated information of the routes to any node in the network. Each row has the next hop for reaching a node/subnet and the cost of this route. 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).

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 usually happens with the help of flooding the route request packets throughout the network. Example is AODV.

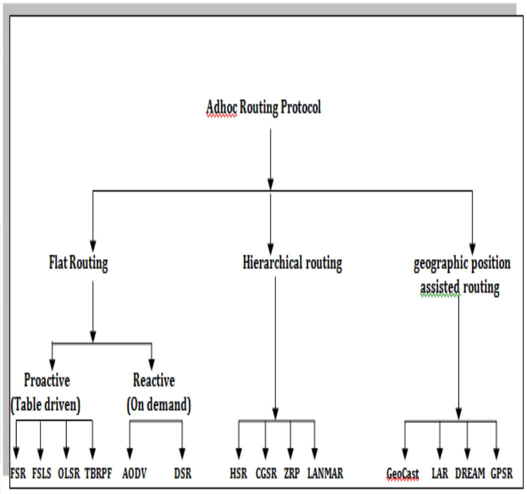


Fig 3 Classification of Adhoc Routing protocols

III. GENERAL ROUTING PROCESS

The data broadcast by each node contains a new sequence number and the following information for every new route:

- The destination address
- The number of hops required to reach the destination
- The new sequence number, originally stamped by the destination

The transmitted routing also contains the hardware and network address of the host transmitting them. The general routing table contains sequence number created by transmitter. This is why new sequence number is considered in making forwarding decisions [2].

After receiving the route information, the receiving node increments the metric and information by broadcasting. The time between broadcasting the routing information packets is also important factor.

i. 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 every vehicle broadcasts its own routing tables to its adjacent vehicles. The neighbor vehicles updates 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.

Advantages:

- DSDV guarantees loop free paths.
- It reduces infinity problem counts.
- It maintains best path not multiple paths to every destination so that routing table space is saved.
- With the use of incremental updates instead of full dump updates extra traffic can be avoided.

Limitations:

- It does not support multipath routing.
- Sometimes wastage of bandwidth happens due to unnecessary advertisement of routing information.
- Sometimes it is difficult to determine time delay of advertisement of routes.

ii. ADHOC –ON DEMAND DISTANCE VECTOR PROTOCOL (AODV) :

It is very simple, effective, source initiated and very efficient which do not uses fixed topology as per author [10]. This protocol uses on demand route discovery and route maintenance from DSR and hop by hop routing from DSDV. In this every node in the network maintains a routing table with the routing information entries to its neighboring nodes and two separate counters. A node sequence number and a broadcast id..

AODV provides unicast, Broadcast and Multicast communication. All the routes are loop free through use of sequence numbers. On demand route establishment with this protocol is achieved with small delay.

Advantages:

- AODV can handle highly dynamic behavior of VANETs due to its reactive nature.
- Link breakages in active routes can be easily repaired.
- It has minimal space complexity which allows maximum bandwidth utilization.
- It provides most effective routing info on demand.
- Use of sequence numbers is maintained properly to track information.

Limitations:

- Overhead on the bandwidth is observed when compared to DSR.
- It takes support of high throughput metrics.
- No reuse of routing info.
- Requirement of broadcast medium.

IV. BROADCASTING IN VANET

Broadcasting in VANET is very critical issue area of research. Actually broadcasting in VANET is different from broadcasting Manet due to several reasons such as network topology, mobility patterns, demographics, traffic patterns at different times. Possible applications relying on broadcast include sharing emergency traffic, weather and road data among vehicles and delivering advertisement and announcements [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 the entire node i.e. vehicles in the network.

i. Radio Broadcasting Protocol (VANETRBC)

One of the prominent radio broadcasting protocol is VANETRBC. VANETRBC is nothing but example protocol which can be used as a basis for your own protocol. This protocol does the work of creating channel load. It can also be used for getting started with the user's protocol. [4] We can take RBC protocol as a basis for the VANET protocol. There are lots of comments in the source files. When we want to rename the entire stuff, simply check for "RBC" and change them to your own protocol name. Care should be taken if a copy of VANETRBC protocol is to be made in different directory and want both the protocols to exist (Our protocol and VANETRBC) , the structures of packets headers is to be renamed in your new protocol, so that no packet headers of the two protocols share the same name.

V. STANDARDS USED : IEEE802.11P

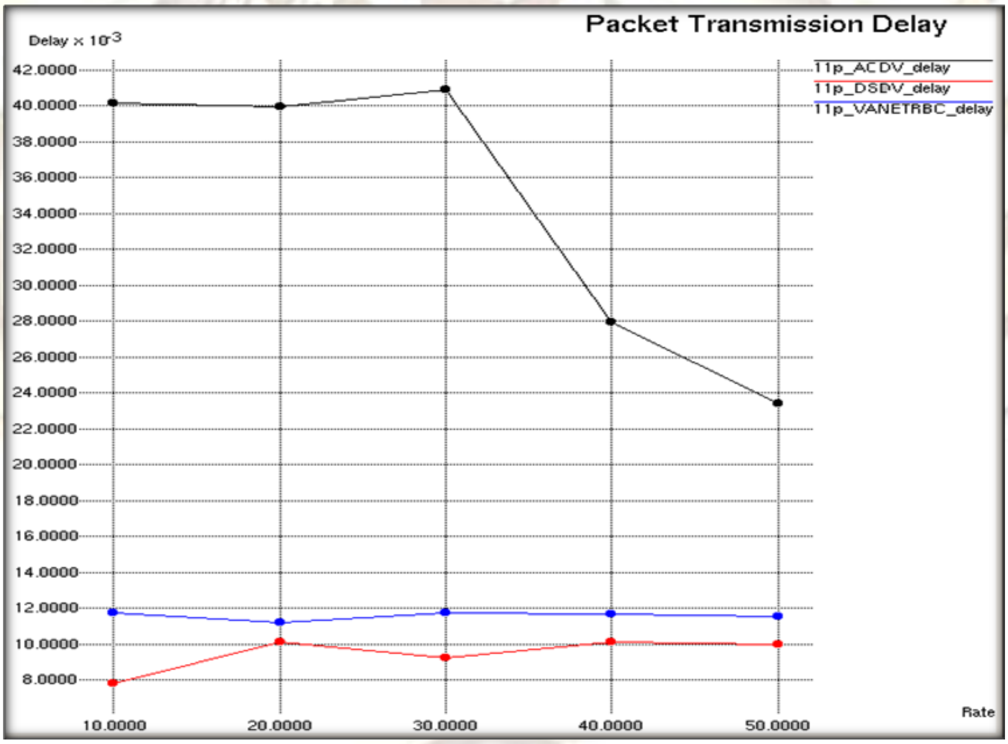
IEEE 802.11p is an approved amendment to the IEEE 802.11 to add wireless access in vehicular environments (WAVE). It defines enhancements to 802.11 required to support Intelligent Transportation Systems (ITS) applications. This includes data exchange between high-speed vehicles and between the vehicles 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.

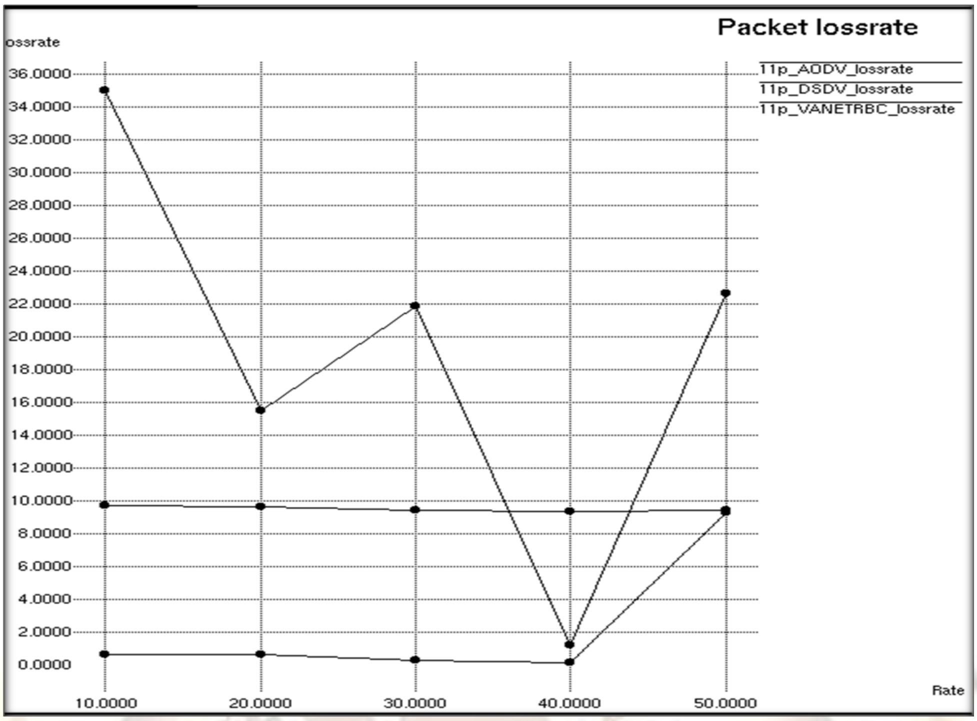
Red line shows AODV response
Green line shows DSDV response
Blue line shows VANETRBC response.

Table No 1: Data considered for simulation

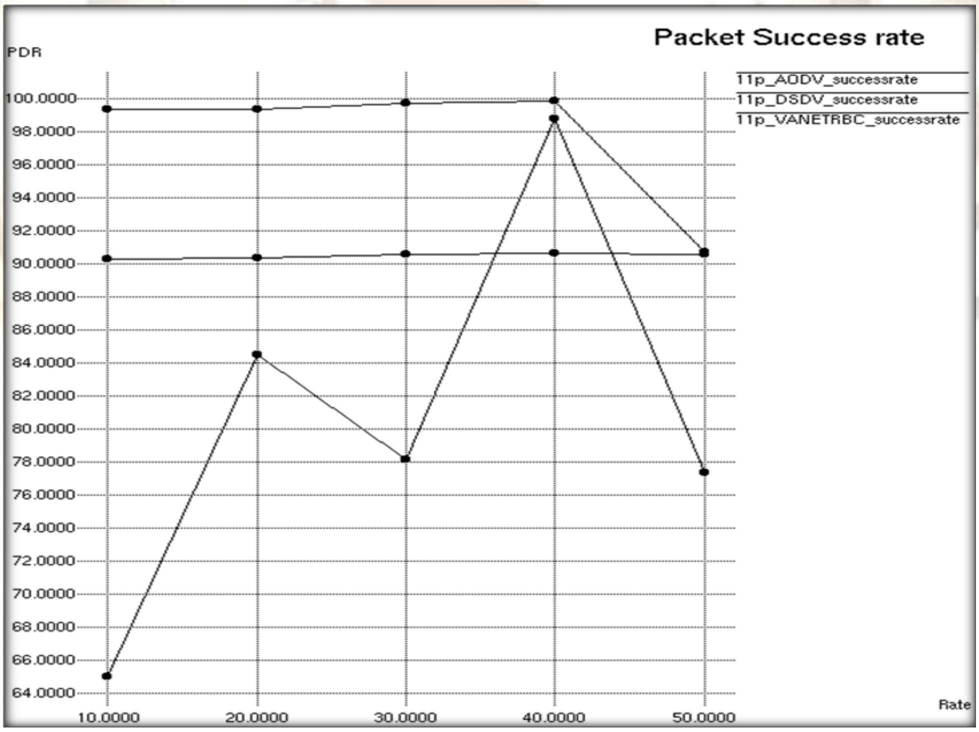
Network Area	**X = 5000 meters** **Y = 200 Meters**
Traffic type	**CBR**
Visualization Tool	**NAM,TRACE**
File Duration	**500 Secs**
MAC layer	**802.11p**
Protocols	**AODV,DSDV,VANETRBC**
Number Of Nodes	**30**



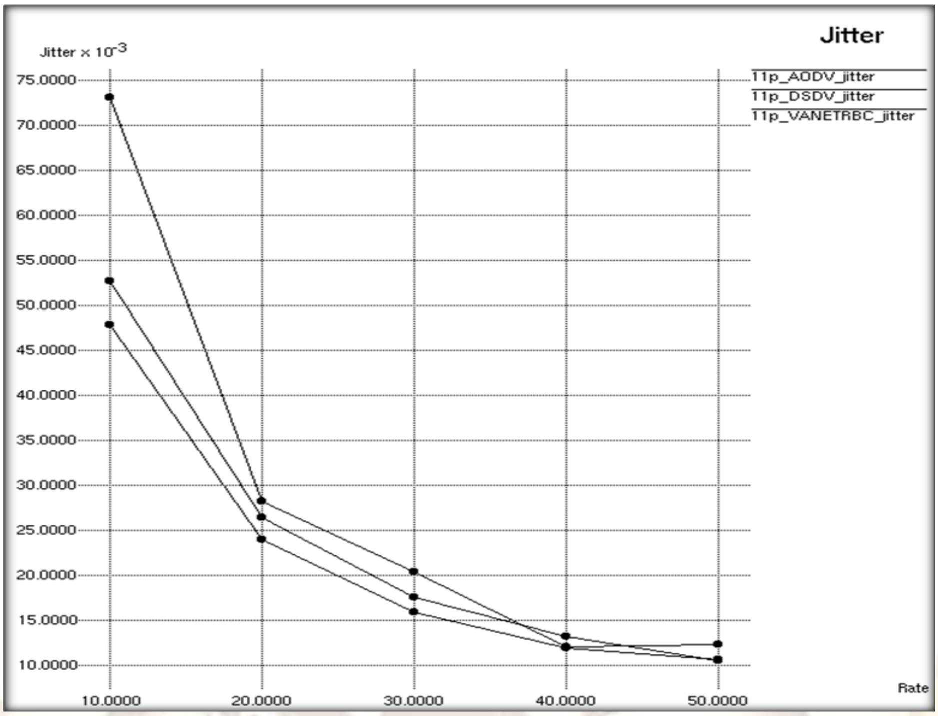
Packet Transmission Delay (IEEE802.11p)



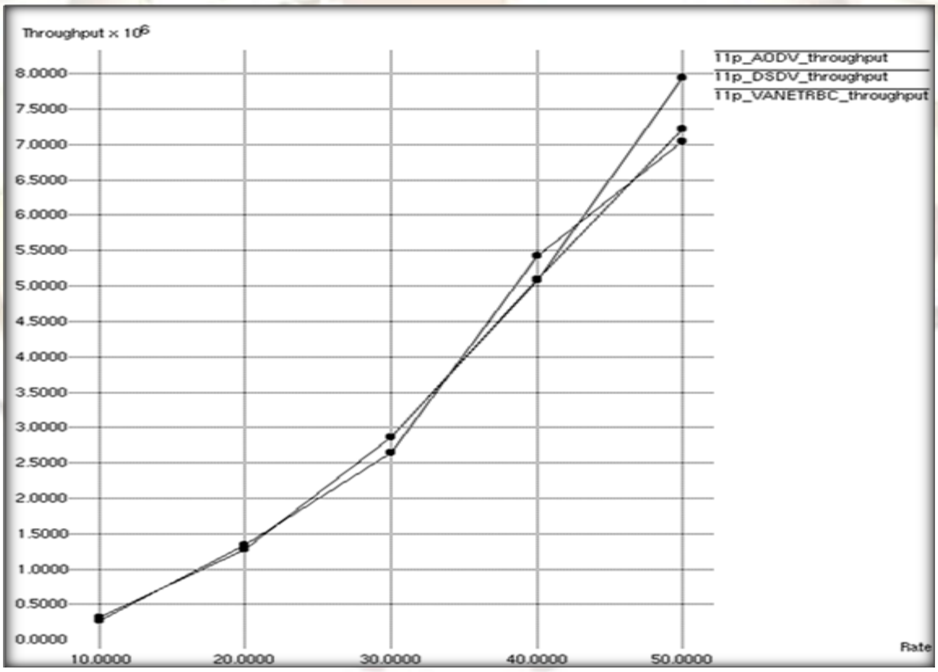
Packet Loss Rate (IEEE802.11p)



Packet Success Rate (IEEE802.11p)



Packet Success Rate (IEEE802.11p)



Throughput (IEEE802.11p)

VI. CONCLUSION

After simulation following points are observed.

1. AODV can perform better under high mobility conditions.
2. If number of nodes are increased AODV can perform well.
3. AODV has better Throughput and packet delivery ratio.
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.

VII. FUTURE WORK

In future, more complex simulation can be carried out in order to achieve more in – depth performance analysis and comparisonof Adhoc routing protocols. In addition to this other new protocols can also be studied.

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