

Comparison of Routing protocols in VANET scenarios

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Abstract—this paper presents a comparative test of two protocols namely-AODV and DSR in various mobility scenarios of Vehicular Ad-hoc NETWORKS (VANETs). In order to make comparison three performance criterions are selected which include number of packet drop, throughput and total time taken by Ns2 to simulate the given network. To carry out the simulation process an open source simulator tool is used for this study namely NS2. Based on the simulation results of both aforementioned protocols, the performance comparison is made and appropriate protocol is selected for individual scenario. The mobility scenarios selected on the basis of routing metrics

Keywords—DSR, proactiveAdhocg, styling, insert (*key words*)

I. Introduction

The world is progressing at a very fast pace in almost all spheres of life and so is the case with automobile industry. New techniques are being exploited to provide more and more facilities to customers, including safety applications. A lot of research work has been done in the field of road-safety and some works have already been incorporated in automobiles to enhance the safety of users. But alongside the safety applications a lot of time is being devoted to develop techniques which can integrate the safety and comfort applications to provide more satisfaction to consumers. After a lot of hard-work one such technique was found that provides amalgamation of both safety and non-safety applications for vehicle users. This technique was an extension of Mobile Ad-hoc NETWORKS (MANETs) which can provide ad-hoc networking capabilities between vehicles. The technique was named on the lines of MANETs as Vehicular Ad-hoc Networks (VANETs).

Besides providing inter-vehicle communication; VANETs also provides communication between vehicles and Road Side Units (RSU). Such networks comprise of sensors and On Board Units (OBU) installed in the car as well as Road Side Units (RSU). The data collected from the sensors on the vehicles can be displayed to the driver, sent to the RSU or even broadcasted to other vehicles depending on its nature and importance. The RSU distributes this data, along with data from road sensors, weather centres, traffic control centres, etc. to the vehicles and also provides commercial services such as parking space booking, Internet access and gas payment [1]. Thus, RSUs play a very important role in VANETs for message transmission between vehicles which in turn enables them to take intelligent decisions and avoid mishap.

In order to accomplish all these said tasks VANET make use of number of technologies like GPS (Global Positioning System) which is used by drivers to get their own, as well as, their neighbours location; GPRS (General Packet Radio Service) which a user can use to connect to the Internet for browsing web pages, checking email, downloading files etc. VANETs are characterized by highly mobile nodes that are abided by traffic rules and thus had to follow some set patterns of movement unlike MANETs in which nodes move randomly without any movement restrictions. Secondly, VANETs have very dynamic and complex topology due to different routes followed by drivers at different speeds and their behaviour of driving, whereas in MANETs topology changes are much less frequent. Due to these notable differences between MANETs and VANETs, the routing protocols used in MANETs have to be studied first and checked for their compatibility in VANET environments. The routing protocols that are selected for this study belongs to a special branch of MANET routing protocols namely-Topology Based Routing Protocols. The main reason for such selection is the dynamic topology aspect of VANETs which has a direct implication on routing protocol analysis. The performance of selected protocols is carried out using NCTUns-6.0 simulator tool which provides various advantages over other simulators like MOVE, TraNs, QualNet etc.

II. Related Work

Several researchers have done the qualitative and quantitative analysis of VANET routing protocols by means of different performance metrics and using different simulators for this purpose. Some of them are mentioned below as reference:-

- Khaleel Ur Rahman Khan et al. [3], in this paper AODV, DSR and DSDV protocols are compared on basis of packet delivery ratio, number of packets dropped, end-to-end delay and average routing overhead metrics using ns2 version.
- Pranav Kumar Singh et al. [4], in this paper AODV, OLSR and DSR are compared using MOVE and NS-2 simulators on basis of packet delivery ratio and end to end delay.
- S. S. Manvi et al. [5], in this paper comparison of AODV, DSR, and Swarm Intelligence based routing protocols is done using ns-2, 2.31 simulators interms of throughput, latency, data delivery ratio and data delivery cost.
- Rajendra V. Boppana et al. [6], in this paper AODV, ADV and DSR are compared using CBR (Constant Bit Rate) traffic on basis of average

data packet latency, network throughput and the percentage of data packets delivered.

- Samir R. Das et al. [7] evaluated the performance of SPF, DSDV, TORA, DSR, and AODV protocols with respect to fraction of packets delivered, end-to-end delay, and routing load by varying the number of conversation per node using Maryland Routing Simulator.”.

III. Routing Protocols

A routing protocol governs the way that two communication entities exchange information with each other, by establishing a route, making decision for forwarding the data packets and maintaining the route or recovering from routing failure [8].

In this paper topology-based routing protocols are studied. Some of these protocols are shown in figure 1. These routing protocols use links' information, which exists in the network, to perform packet forwarding. They can be divided into:-

- Proactive (table-driven) routing protocols
- Reactive (on-demand) routing protocols
- Hybrid routing protocols

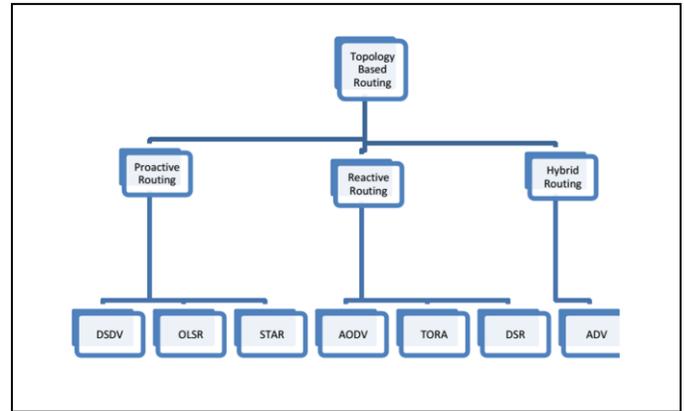
A. Proactive Routing

Proactive routing protocols are mostly based on shortest path algorithms and keep information of all connected nodes in form of tables which are also shared with their neighbours [9]. They maintain and update information on routing among all nodes of a given network at all times even if the paths are not currently being used. Thus, even if some paths are never used but updates regarding such paths are constantly broadcasted among nodes [8]. Route updates are periodically performed regardless of network load, bandwidth constraints, and network size which is one of the main drawbacks of using this approach in VANETs.

B. Reactive Routing

On demand or reactive routing protocols were designed to overcome the overhead problem, that was created by proactive routing protocols, by maintaining only those routes that are currently active [9]. These protocols implement route determination on a demand or need basis and maintain only the routes that are currently in use, thereby reducing the burden on the network when only a subset of available routes is in use at any time [8].

AODV maintains and uses an efficient method of routing that reduces network load by broadcasting route discovery mechanism and by dynamically updating routing information at each intermediate node. Route discovery in AODV can be done by sending RREQ (Route Request) from a node when it requires a route to send the data to a particular destination. After sending RREQ, node then waits for the RREP (Route Reply) and if it does not receive any RREP within a given time period, source node assumes that either route is not available or route expired [10]. When RREQ reaches the



particular destination and if source node receives RREP then by using unicasting, information is forwarded to the source

Figure 1. Topology-based Routing Protocols [8]

node in order to ensure that route is available for communication. DSR protocol [11] uses source routing, that is, the source indicates in a data

packet's the sequence of intermediate nodes on the routing path. In DSR, the query packet copies in its header the IDs of the intermediate nodes that it has traversed. The destination then retrieves the entire path from the query, and uses it to respond to the source. As a result, the source can establish a path to the destination. TORA routing [12] belongs to a family of link reversal routing algorithms where a directed acyclic graph (DAG) toward the destination is built based on the height of the tree rooted at the source. When a node has a packet to send, it broadcasts the packet. Its neighbour only broadcasts the packet if it is the sending node's downward link based on the DAG. Thus, among these three reactive protocol strategies AODV is preferred in VANETs because in AODV data packets carry the destination address, whereas in DSR, data packets carry the full routing information. This means that DSR has potentially more routing overheads than AODV. Furthermore, as the network diameter increases, the amount of overhead in the data packet will continue to increase. Also, TORA provides a route to all the nodes in the network, maintenance of these routes can be overwhelmingly heavy, especially in highly dynamic VANETs. The load carrying capacity of AODV is much better than proactive routing protocols like DSDV, OLSR etc. thus AODV is preferred for this study.

C. Hybrid Routing

Hybrid routing combines characteristics of both reactive and proactive routing protocols to make routing more scalable and efficient [9]. Mostly hybrid routing protocols are zone based; it means the number of nodes is divided into different zones to make route discovery and maintenance more reliable for MANETs or VANETs. The most recently developed ADV hybrid routing protocol starts with DSDV proactive routing approach by attaching sequence numbers to routing entries and then gradually shifts to on-demand approach in order to reduce the overhead related with proactive approach. This feature is achieved using the following dual strategy:-

- a) Varying the number of active routes maintained:- This is achieved by advertising and maintaining routes for active receivers only, which are receivers of any currently active connection.
- b) Varying the frequency of routing updates: - According to this approach a node should trigger an update under three conditions only:-
 - i) If it has some buffered data packets due to lack of route.
 - ii) If one or more of its neighbours make a request for fresh routes it is a forwarding node that intends to advertise any fresh valid/invalid route to the destination so as to keep the route fresh.

- 1400 bytes of UDP packets used for communication.
- 15dbm Transmission power used for node operation.

IV. Research Methodology Used

To carry out the experiment discussed in this paper Ns2 simulation tool is used. The scenarios used for analysis, simulation setup, performance metrics used for making various comparisons are discussed in this section.

A. Simulation Tool Used

In order to carry out a simulation work for vehicular networks two basic simulator types are required namely-network simulators and traffic simulator. But in this study a hybrid simulator is used which provides an integration of both network and traffic simulator. The hybrid simulator used is which is the latest version and whose core technology is based on the novel kernel re-entering methodology invented by Prof. S.Y. Wang [13]. The various features of VANET supported by ns2 makes it an obvious choice for this study. Figure 3: Strength of Traffic, VANET, and Ns-2 [3] 4.2. Performance Metrics For this study three performance metrics are selected namely:-

- Throughput: - Throughput describes as the total number of received packets at the destination out of total transmitted packets [14].Throughput is calculated in bytes/sec or data packets per second.

$$T = \frac{(\text{Total number of received packets at destination}) * (\text{packet size})}{\text{Total Simulation Time}}$$

- Packet Drop: It shows total number of data packets that could not reach destination successfully. The reason for packet drop may arise due to congestion, faulty hardware and queue overflow etc. 3. Time taken for simulation:- This criterion specifies the total time taken by NCTUns-6.0 simulator to simulate individual scenario cases with separate routing protocols.

B. Simulation Setup

In this simulation study following network parameters and tools are selected:

- IEEE 802.11 (ad-hoc mode) standard is used for each vehicular node.

TABLE I. COMMUNICATION MODEL

Propagation Model	Two Ray Ground	
Node Configuration	AdHoc Routing	
Communication System	MAC IEEE 802.11	
Total Number of Nodes	20	
Type of Traffic	UDP	
	DSR	AODV
Generated Packets	19298	19298
Received packets	19258	19278
Packet Delivery Ratio	99.5495	9.7927
End to End Delay	122.887ms	139.163ms

V. Conclusion

It can be concluded that AODV outperformed DSRat most of the instances in conformance with the work done by other researchers as mentioned earlier. It is noticed that for AODV, throughput peaks are almost 60-70% more in number as compared toDSR. Also, number of packet drop remains almost 80-90% below to that observed in DSRprotocol. Also the time taken by NCTUns-6.0 simulator for simulating each aforementioned scenarios give a clear indication that network with AODV protocol is simulated much faster as compared to DSR protocol. Since AODV exhibits the best characteristics of proactive algorithms and is simultaneously responsive to the network needs and conditions. Thus inference can be drawn from the simulation results that AODV protocol is a preferable choice for multi-hop, vehicular environment and is a preferable choice while making real-time tests of vehicular environments.

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