COMPARATIVE PERFORMANCE EXPLORATION OF AODV, DSDV & DSR ROUTING PROTOCOL IN CLUSTER BASED VANET ENVIRONMENT

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ABSTRACT

Vehicular ad-hoc network (VANET) is self-organizing wheeled networks that enable communication in between high speed moving road vehicles like cars, trucks, busses etc. in VANET network each vehicle behave as a mobile node and can be move in any direction with varying speeds that makes highly dynamic environment. The existing mobile ad-hoc network (MANET) routing protocol are unsuitable for VANET because of frequently change in mobility pattern and topology of this network. In last few years many ideas has come and implemented in this area but still there is scope of modernization. The reconstruction of existing protocol or introducing new idea of routing in VANET environment will be a milestone and the performance evaluation will be a nice approach towards that. In this paper we evaluate performance of AODV, DSDV and DSR routing protocol on the basis performance metric packet delivery ratio, end to end delay, and throughput of the network, in the cluster based VANET environment with increasing the number of mobile nodes. The Simulation studies are conducted using NS2.

KEYWORDS: *Routing Protocols, VANET, Clustering, Mobility.*

I. INTRODUCTION

Vehicular Ad hoc Network (VANET) are a subclass of Mobile Ad-hoc Network (MANET) where vehicles moving at high speed are the nodes which are used to exchange data in the network. In this environment vehicle can move anywhere, any direction with varying speed that make the frequent changes in the topology and mobility pattern of VANET network that present the key difference from the MANET [1,2,3]. Today all major vehicle manufacture companies and industries focus in this area for reducing communication issues in between vehicles [4]. Many researchers has given their contribution in in this area of research like CarNet, CarTALK 2000, DRIVE, FleetNet and COMCAR projects [5-10]. The performance of the routing protocol degrades with speed and size of the network, so designing of efficient routing protocols are always challenging in high mobility environment that is main characteristic of VANET.

In VANET network for exchanging data the entire mobile nodes behave as a router as well source and destination node. The DSDV (Destination-Sequenced Distance Vector) routing protocol is based on the Distributed Bellman-Ford algorithm. Each node in DSDV maintains a next-hop table, which it exchanges with its neighbors. The Dynamic Source Routing (DSR) protocol is based on secure routing method. In this algorithm the mobile node whose want to send data in network knows the complete path of destination and store that in route cache. The data packet carries the source path in

the packet header. Instead depending on the intermediate mobile node routing table information this protocol use the source routing path. So the path length in between source to destination node affects the routing overheads. The broken link in this protocol does not repair locally by route maintenance process that shows shortcoming of this protocol. It has two important phases, route discovery and route maintenance [11, 12]. AODV protocol combines the mechanisms of DSR and DSDV for routing. For each destination, AODV creates a routing table like DSDV and using mechanism of routing route maintenance and discovery as DSR.

In this paper we have evaluate routing performance of AODV, DSDV and DSR routing protocol in cluster based VANET environment where number of mobile node increases the size of cluster. The performance evaluation is based on the metric of packet delivery ratio, end to end delay and throughput of the network. The rest of the paper is organized as: section 2 discuss about the overview of AODV, DSDV and DSR routing protocols. Related work is present in section 3. The simulation setup and performance metric is discussed in section 4. The results are shows in section 5 and finally paper is concluded in the section 6.

II. OVERVIEW OF AODV, DSDV AND DSR ROUTING PROTOCOLS IN VANET

The routing protocols basically perform the three main functionality route discovery, maintenance and selection of the efficient path from the various available paths. The routing protocols in the VANET environment are characterized on the basis of area / application where they are most suitable and are classified into five categories can be seen in figure 1.

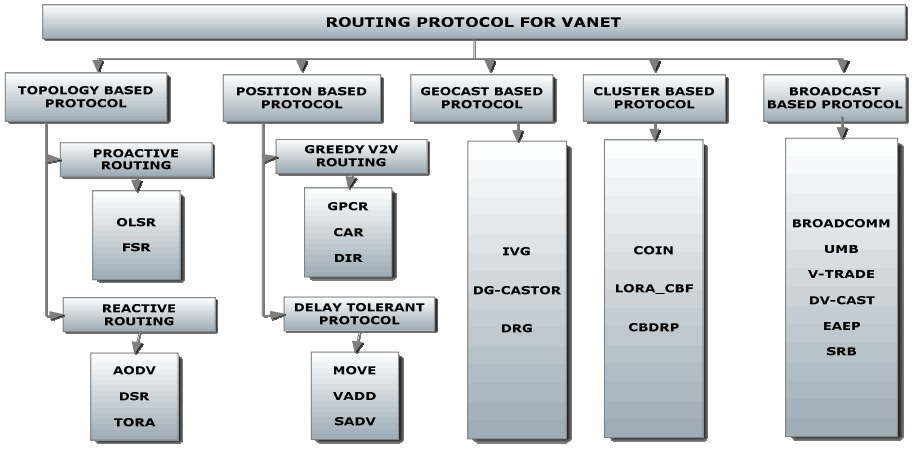

Fig. 1: Routing Protocol in VANET

There are several papers [13, 14, 15] presents information about various VANET routing protocols. We have also described the categories of VANET routing protocol in our previous work [16]. In this paper we have selected AODV, DSDV and DSR routing protocol for our simulation purpose.

2.1 Destination-Sequenced Distance-Vector Routing (DSDV)

The C. Perkins and P. Bhagwat developed this routing protocol in 1994 [17]. It is table driven routing scheme for ad-hoc mobile network based on classical Bellman Ford routing algorithm with some improvements. Solving routing looping problem, increases convergence speed and reducing control overhead message was the main contribution of this algorithm. In DSDV nodes transmit update periodically to its neighbor node with the information of its routing table. DSDV routing protocol maintain a routing table that store cost metric for routing path, address of next hop up to the destination and the destination sequence number assigned by the destination node. Whenever the topology of the network changes, a new sequence number is necessary before the network re-converges and the node changed routing table information into event triggered style and send updates to its neighbor nodes. The “full dump” and “incremental update” is two ways in DSDV for sending

information of routing table updates. As like name "full dump" the complete routing table is send in update message while incremental update contains only the entries with metric that have been changed since last update was sent.
This algorithm is suitable for small ad-hoc networks but the regularly updating routing table, less bandwidth and essentially requirement of new sequence number at the time of network topology change shows the shortcoming of this protocol and make it unsuitable for long and highly dynamic network environment like VANET.

2.2 Dynamic Source Routing (DSR)

The Dynamic Source routing protocol (DSR) is a on demand routing protocol based on a method known as source routing that are designed specifically for use in multi-hop wireless ad-hoc network to reduce the amount of bandwidth consumed by control packets by eliminate the requirement of periodic table update message. This algorithm provides the route on-demand and the sender node knows the complete hop by hop route to the destination. The routes are store in route cache. Route discovery and maintenance are two major phases of this protocol. At the time when node wants to send message, it check its route cache for searching the availability of unexpired route up to the destination from that node. If route is found than node start transmission of packet else start the route discovery process for searching new route in between source and destination node. Each route request packet carries the source node address, a new sequence number and the destination node id. The entire node that receiving route request packet checks the sequence number and rebroadcast that packet to it neighbors if it has not forwarded it already or that node is not the destination node after adding its address information in packet.
The advantage of this protocol is that it provide on-demand routing path and does not require periodic packet that are used by a node to inform its presence to its neighbors. The control overhead is reduced by using the information efficiently from route cache by node to access the route for packet transmission that are already discovered but In this protocol path length effect the routing overhead and broken links in network does not repair locally at route maintenance process. This is the main limitation of this protocol that makes it unsuitable for large high mobility network [18,19].

2.3 Ad-hoc On-Demand Distance Vector (AODV)

This protocol combines some property of both DSR and DSDV routing protocols with significant differences. In AODV when a node sends a packet to the destination then data packets only contains destination address. On the other hand in DSR when a node sends a packet to the destination the full routing information is carried by data packets which causes more routing overhead than AODV. The AODV establishes a route when a node requires sending data packets i.e. on-demand. For finding path from source to destination node in AODV algorithm the source node sends a route request packet to its neighbors and this process is repeat till the destination node path is not found. The sequence number of packet is check at every intermediate node to produce a loop free path. If a node finds that number in its routing table than node discard the route request packet otherwise store record in its table. It has the ability of unicast & multicast routing and uses routing tables for maintaining route information. It doesn't need to maintain routes to nodes that are not communicating. AODV use only symmetric links between neighboring nodes because the route reply packet follow the reverse path of the route request packet. If one of the intermediate node realize path broken than it send information to its upstream neighbor and this process is execute until source node not get this message and after it again source node transmit the route request packet to neighbors node for finding new path.
The AODV has the advantage of establishing on-demand route in between source and destination node with the lower delay in connection setup and does not require much memory for communication but there are several disadvantage with this protocol like if the source node sequence number is very old than the intermediate nodes can lead to route inconsistency. Heavy control overhead if there has multiple route reply packets for a single route request packet. It consumes extra bandwidth because of periodic beaconing.

III. RELATED WORK

Many of the researchers evaluate the performance of routing protocol like AODV, DSDV and DSR in the VANET environment using different evaluation methods means on the basis of different performance metric or using different simulators for this purpose. In [20, 21] routing protocol AODV,DSDV and DSR performance analyze in highway scenario on the basis of vehicle speed and the density of traffic. Novel multipath routing approaches for urban area present [22] that perform better in path discovery with low overhead. In the same fashion protocol AODV, FSR, DSR and TORA performance analyzed in VANET environment [23]. The existing protocol that are non-multipath performance compare with the multipath proposed protocol performance [24] at the basic of PDR, throughput and E2E delay performance metric. Result shows that proposed method produce satisfactory results in comparison of other. By using CBR traffic three routing protocol AODV, DSR and ADV analyze at the basis of performance metric of throughput, average packet latency [25]. The AODV protocol performs better in comparison of DSDV and TORA routing protocol shows in the simulation work results [26]. The performance of AODV, DSDV, DSR, and TORA evaluated at the basis of E2E delay and PDR performance metric. For this work they used Maryland Routing Simulator [27]. The different simulators are also used to perform the analysis of routing protocols. [28] The NCTUns 4.0 simulator use to compared the performance of AODV, DSDV and DSR routing protocol and in the same fashion of work MOVE ans NS-2 simulator used to analyzed performance of AODV, OLSR and DSR routing protocol on basis of PDR and end to end delay [29].

IV. SIMULATION SETUP AND PERFORMANCE METRICS

4.1 Simulation Tool & Parameters

There are many network simulators available in the market but the most frequently used are OPNET, Qualnet, and NS2. OPNET and Qualnet both also best network simulators, but these are not opens source tools and having the more cost for purchasing for such kinds of education studies. Hence the best choice is to use the NS2 simulator which is completely free and open source tool for all kinds of network simulations and researches. There are many versions of NS2 available ranging from ns-2.26 to ns-2.34.

In our simulation work to evaluate the performance of original AODV, DSDV and DSR routing protocol we use the open network simulator NS-2 in its version 2.29.3. Nodes follow a random waypoint mobility model, traveling at a variety of speeds over a 1000 x 1000 meters area for 600 seconds of simulated time. We used same scenario for all protocols because of unique behavior of each protocol to produce the output. The simulation parameters are summarized in Table 1

Table 1 Simulation Parameters

Network Simulator	NS-2, 2.29.3 version
Number of Nodes	5, 10, 20, 40, 75
Network Size	1000 x 1000
Mobility Model	Random Way point (RWP)
Channel Type	Wireless Channel
Antenna Type	Omnidirectional
Pause Time	2.0s
Transmission Packet Rate	10 m/s
Max Speed	10 m/s
Simulation Time	600s
Routing Protocol	AODV,DSDV and DSR

4.2 Performance Metric

There are several performances metric at which routing protocols can be evaluated for network simulation [30]. We use the performance metrics in our simulation purpose are: Packet delivery ratio, Throughput and End to End delay.

Packet Delivery Ratio: It is calculated by dividing the number of packets received at the destination node by the total packets sends by the source node. It specifies the packet loss rate, which limits the maximum throughput of the network and the delivery ratio performance. The high packet delivery ratio presents better performance of a protocol.
Throughput: The throughput of the protocols can be defined as percentage of the packets received by the destination among the packets sent by the source. It is the amount of data per time unit that is delivered from one node to another via a communication link. The throughput is measured in bits per second. This metric show the total number of packets that have been successfully delivered to the destination nodes and throughput improves with increasing nodes density.
End to End delay: The total time for transmitting a packet from source to the destination node is known as end to end delay. The delay performance metric include the delays due to route discovery, packet propagation and sending time and the time of packet in queue [31].

V. SIMULATION RESULTS

Following graphs show the performance in cluster based VANET environment with varying the number of mobile nodes in terms of throughput, end to end delay and packet delivery ratio.
Figure 2 shows throughput of all three AODV, DSDV and DSR routing protocol in the cluster based VANET environment in which mobile node increases. It is observed that DSDV protocol is suitable in low mobility environment and the DSR protocol also shows better result in comparison of AODV protocol in this environments but as the size increases AODV protocol change drastically and show its suitability for routing in that large environments in comparison of other two routing protocol.

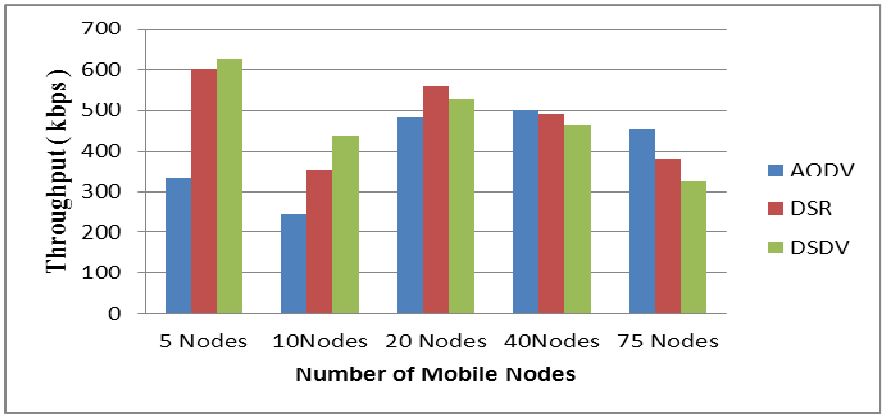

Fig. 2 Throughput Analysis

Figure 3 shows end to end delay results of our simulated routing protocol. It is observed that AODV produce higher delay in the small network in comparison of other two DSDV and DSR routing protocol. DSR protocol show the consistency in the low delay performance comparatively while DSDV is produce higher delay as the size of cluster is increased.

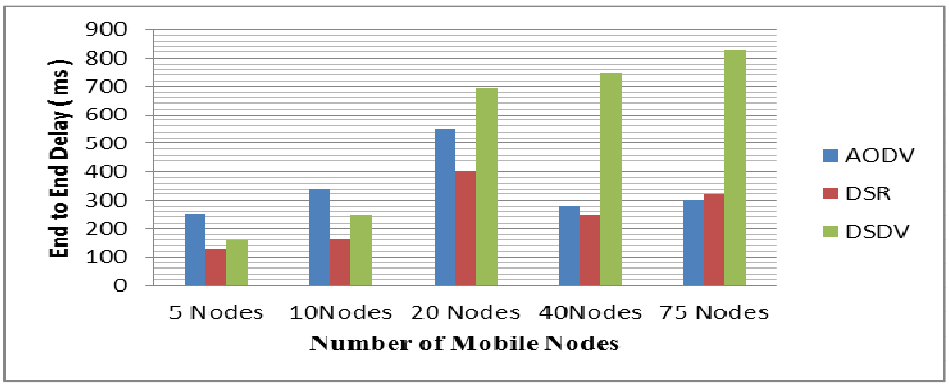

Fig. 3 End to End Delay Analysis

Figure 4 shows the analysis of packet delivery fraction ratio of AODV, DSDV and DSR protocol. It is observed that AODV protocol perform well in the large network as DSR which shows better performance in comparison of these two protocols in the small network while DSDV is not suitable in both environments comparatively.

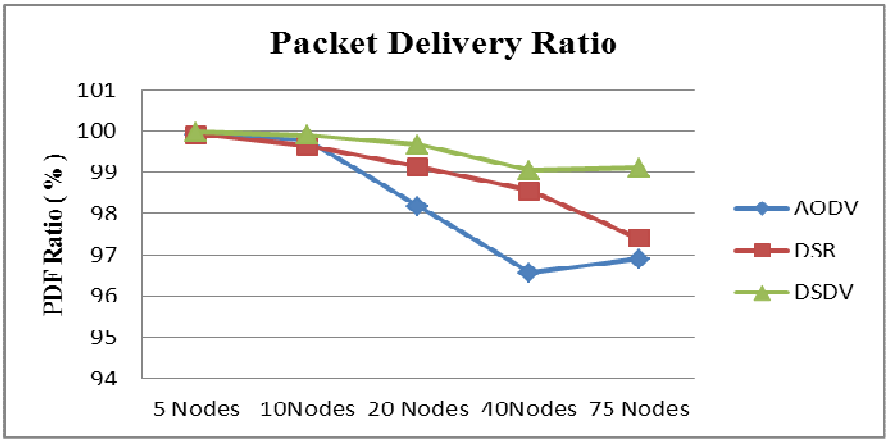

Fig. 4 Packet Delivery Fraction Ratio

VI. CONCLUSIONS

The performance evaluation is necessary for analyzing the shortcoming of existing approaches and making the requirement with more applicable design for VANET. This paper compares the routing protocols AODV, DSDV and DSR performance in the cluster base VANET environment with increases the mobile node in the cluster for making high traffic scenario. Finding indicates that from these any single protocol is not suitable for efficient routing in different environment. DSR protocol is more applicable in small size of cluster but as size of the cluster increased AODV protocol shows drastic changes in its performance and more applicable while DSDV evaluation results are not desirable in comparison with other two reactive routing protocols.

In the area of VANET research, there is always scope for further works; here for future work we can suggest energy aware approach for routing. For wireless networks, energy is always vital resource, so we have to add mechanism to minimize the energy consumption as well to present study.

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