



## Analysis AODV, DSR&DSDV Protocols with Uniform Pause & Speed type Over CBR&TCP Connections in VANET

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**Abstract**— Over the past few years Vehicular Networks are receiving a lot of attention due to the wide variety of services they can provide. VANETs is a form of mobile ad hoc network providing communications among nearby vehicles as well as between vehicles and nearby fixed equipment, usually described as roadside equipment. Vehicles are becoming “computer networks on wheels” and acts as mobile nodes of the network. In last few years many ideas of ad hoc routing protocols have been proposed and implemented in this area to improve three main functionalities, route discovery, maintenance and selection of the efficient path from the various available paths but the highly dynamic mobility patterns of vehicles may influence the protocols performance and applicability that shows the unsuitability of the existing mobile ad-hoc network (MANET) routing protocol for VANET. 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 compare and evaluate the performance of following routing protocols: AODV, DSDV, and DSR with Uniform Pause & Speed type Over CBR&TCP Connections. The Simulation studies are conducted using NS2.

**Keywords**— Routing Protocols, VANET, Mobility, Performance, NS2

### I. INTRODUCTION

Over the last decades, current advancement into wireless network has led to the introduction of a new type of network called vehicular network. the vehicular ad hoc network (VANET) is a special and challenging class of mobile ad hoc network (manet) that enable the wireless communication in moving vehicles like cars, buses, trucks, motorcycles etc. and in between the vehicle to road side unit. in VANET each vehicle behaves as a mobile node and each node acts both as the host as well as the router. The nodes which are within the communication range of each other can directly communicate between them. But, if a source node wants to send data to a destination node, which is outside of its communication range, in that case it has to forward the data packet through intermediate nodes. However, VANET is a subclass of MANET but the network nodes in VANET moves in predefined road path and speed affect the network topology. This high dynamicity of network with high speed and mobility make routing even more challenging in VANET and shows the difference from MANET. Schematic representation of a Vehicular Adhoc Network present in figure.1

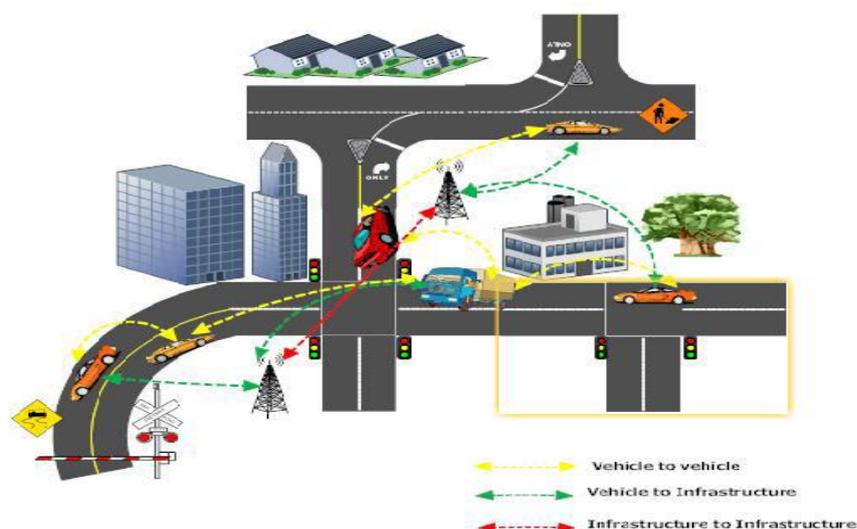


Figure 1: Vehicular Ad Hoc Network overview

Most of the researchers in previous comparative studies on routing protocol applied to VANET focused more on performing simulation with the constant pause type and normal speed of mobile nodes in the network. Some of researchers apply simulation with single routing protocol with different parameters but the selection of routing method heavily depends on the nature of the network. Thus single ad hoc routing method is not sufficient enough in meeting all the different types of ad hoc networks. In this paper we analysis the performance of AODV, DSDV and DSR routing protocol in different scenario with Uniform Pause & Speed type Over CBR&TCP Connections in VANET. The rest of paper is organized as follows.

## II. OVERVIEW OF ROUTING & AD-HOC ROUTING PROTOCOLS FOR VANET

In Simple definition, a routing protocol is a set of rules used by routers to dynamically advertise and learn routes, determine which routes are available and which are the most efficient routes to a destination. In VANET each node acts both as the host as well as the router. The nodes which are within the communication range of each other can directly communicate between them. But, if a source node wants to send data to a destination node, which is outside of its communication range, in that case it has to forward the data packet through intermediate nodes. Routing data between the source and destination vehicle depends on the routing protocols being used in vehicular ad-hoc network. Today all major vehicle manufacture companies and industries focus in this area for reducing communication issues in between vehicles [1]. Many researchers has given their contribution in this area of research like CarNet, CarTALK 2000, DRIVE, FleetNet and COMCAR projects [2]-[7]. However, Routing in vehicular ad hoc network is considered a challenging task due to the drastic and unpredictable changes in the network topology resulting from the random and frequent movement of the nodes and due to the absence of any centralized control. The performance of the routing protocol degrades with speed and size of the network. VANET deploys the concept of continuously varying vehicular motion. Nodes can move around with no boundaries on their direction and speed. This arbitrary motion of vehicles poses new challenges to researchers in terms of designing a protocol set more specifically for VANETS. In VANET environment the routing protocols are characterized on the basis of area / application where they are most suitable [8] and are classified into five categories can be seen in figure 2.

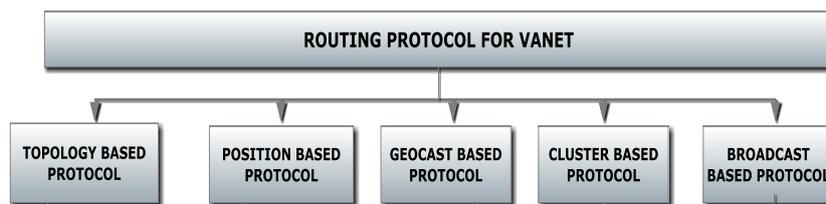


Figure 2 VANET Routing Protocols

The **topology based** routing protocols use link's information and stores that information in table before sending data from source to destination node.

The **position based** routing protocols use nodes location information rather than link information to determine the optimal path for communication. In this type of network each node having whole information about source, destination and the intermediates nodes. With the low overhead and the dynamic connectivity of node the position based routing protocols usually perform better than topology based protocols.

**Geo cast** based routing protocol is basically a location based multicast routing protocol and use to send a message to all vehicles in a pre-defined geographical region. The philosophy is that the sender node need not deliver the packet to nodes beyond the Zone of Relevance (ZOR). The scheme followed a directed flooding strategy within a defined ZOR so that it can limit the message overhead.

In **cluster based** protocol, the geographic area is divided into some foursquare grids. Only if there is a vehicle in a grid will a vehicle be elected to the cluster header, and the data packet is routed by cluster header across some grids one by one. In VANET due to high mobility dynamic cluster formation is a towering process.

**Broadcast based** protocols most frequently used in VANET especially to sharing, traffic, weather and emergency, road conditions among vehicles and delivering advertisements and announcements. Broadcasting is used when message needs to be dispersed to the vehicle beyond the transmission range i.e. multi hops are used. Simplest of broadcast method is carried by flooding in which each node rebroadcast the message to other nodes. Broadcast sends a packet to all nodes in the network, usually using flooding techniques, ensuring the delivery of the packet but bandwidth is wasted and nodes receive duplicates. This routing technique performs better for a less number of nodes but has a higher overhead cost. There are several papers [9]-[11] presents information about various VANET routing protocols in details. In this paper we have selected topology based routing protocol AODV, DSR and DSDV for our simulation purpose.

### A. Ad-Hoc On-Demand Distance Vector (AODV) Protocol

AODV combines some property of both DSR and DSDV routing protocols with significant differences. The route discovery mechanism of AODV is similar to DSR and routing table of AODV with destination sequence numbers is similar to DSDV [12]. It is reactive routing protocol that establishes route on-demand in source to destination node and does not require maintaining routes to node that are not communicating. It has the ability of unicast & multicast routing and use routing tables for maintaining route information. In this algorithm the sender node send a Route Request (RREQ) message to its neighbors for route discovery and after establishing route if any link failure occur than node send

information to its upstream neighbor in form of Route Error (RRER) message. This process execute till sender node not receive the information of failure link, after receiving message sender node resend another RREQ message to find new route [13]. 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.

#### **B. 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 [14],[15].

#### **C. Destination-Sequenced Distance-Vector Routing (DSDV)**

The C. Perkins and P. Bhagwat developed this routing protocol in 1994. 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 recon verges 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.

### **III. CONNECTION PATTERNS**

There are several types of connection patterns are presents in VANET. These patterns describe how the data is transmitted from source to destinations node. We have use Constant Bit Rate (CBR) and Transmission Control Protocol (TCP) for our simulation purpose.

#### **A. Constant Bit Rate (CBR)**

CBR generates constant traffic during the simulation, where there is an inherent reliance on time synchronisation between the traffic source and destination. CBR is tailored for any type of data for which the end-systems require predictable response time and a static amount of bandwidth continuously available for the life-time of the connection. There is no assurance that data successfully reached at destination node because of CBR connection is establish in one way direction like from source to destination so there no acknowledgment from destination for confirming the data transmission.

#### **B. Transmission Control Protocol (TCP)**

TCP establish connection in between the source and destination nodes before sending the data packets and use acknowledgement for confirmation of successful delivery of data packet to destination in the network. If source node not receive acknowledgement within a specific time than the source node resend the packet to destination.

### **IV. SIMULATION PARAMETERS AND PERFORMANCE METRICS**

In evaluation of the performance of original AODV, DSDV and DSR routing protocol we use the open network simulator NS-2 in its version 2.34. Nodes follow a random waypoint mobility model, traveling at a variety of speeds over a 600 x 600 meters area for 500 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 TO EVALUATE PERFORMANCE OF SELECTED ROUTING PROTOCOLS

Parameters	Value
Number of nodes	5, 15, 30, 50, 75
Simulation Time	500 Sec.
Channel Type	Wireless Chanel
Pause Time	2.0 Sec.
Pause Type	Uniform
Environment Size	600 X 600
Transmission Range	250 m
Traffic Size	CBR & TCP
Packet Size	512 bytes / packet
Packet Rate	4 packet per second
Maximum Speed	10.0 ms
Minimum Speed	5.0 ms
Queue Length	20
Simulator	NS-2.34
Mobility Model	Ramdom Way Point Mobility
Antenna Type	Omni
Interface Queue Type	DropTail/Priqueue & CMUPriqueue
Routing Protocol	AODV, DSR, DSDV

#### A. Performance Metrics

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

#### Packet Delivery Ratio (PDR)

It is the fraction of generated packets by received packets. That is, the ratios of packets received at the destination to those of the packets generated by the source. As of relative amount, the usual calculation of this system of measurement is in percentage (%) form. Higher the percentage, more privileged is the routing 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.

#### End-to-End Delay (E2E Delay)

It is the calculation of typical time taken by packet (in average packets) to cover its journey from the source end to the destination end. In other words, it covers all of the potential delays such as route discovery, buffering processes, various in-between queuing stays, etc, during the entire trip of transmission of the packet. The classical unit of this metric is millisecond (ms). For this metric, lower the time taken, more privileged the routing protocol is considered.

#### Normalized Routing Load

Normalized routing load is the number of routing packets transmitted per data packet sent to the destination. Also each forwarded packet is counted as one transmission. This metric is also highly correlated with the number of route changes occurred in the simulation.

### V. SIMULATION RESULTS AND DISCUSSION

The performance of selected routing protocols AODV, DSR and DSDV has been analysed with uniform pause and speed type in term of CBR and TCP traffic under five different scenarios of 5, 15, 30, 50 and 75 nodes. We measure the result in metrics of packet delivery ratio (PDR), throughput, average end to end delay (E2E Delay) and normalized routing overhead. The simulation results have shown by graph as follows:

#### A. Packet Delivery Ratio (PDR)

TABLE 2 PACKET DELIVERY RATIO (%)

Protocols	AODV		DSR		DSDV	
	CBR Traffic	TCP Traffic	CBR Traffic	TCP Traffic	CBR Traffic	TCP Traffic
5	68.1094	98.1253	0.673237	86.9234	47.2285	97.9004
15	99.143	97.8901	40.1718	84.9569	60.2781	97.2708

30	98.8074	98.0861	84.404	95.3732	56.1775	94.7306
50	98.95	97.2526	83.2172	96.6469	50.3447	91.518
75	98.2798	97.0429	66.2504	89.8289	44.0262	79.3775

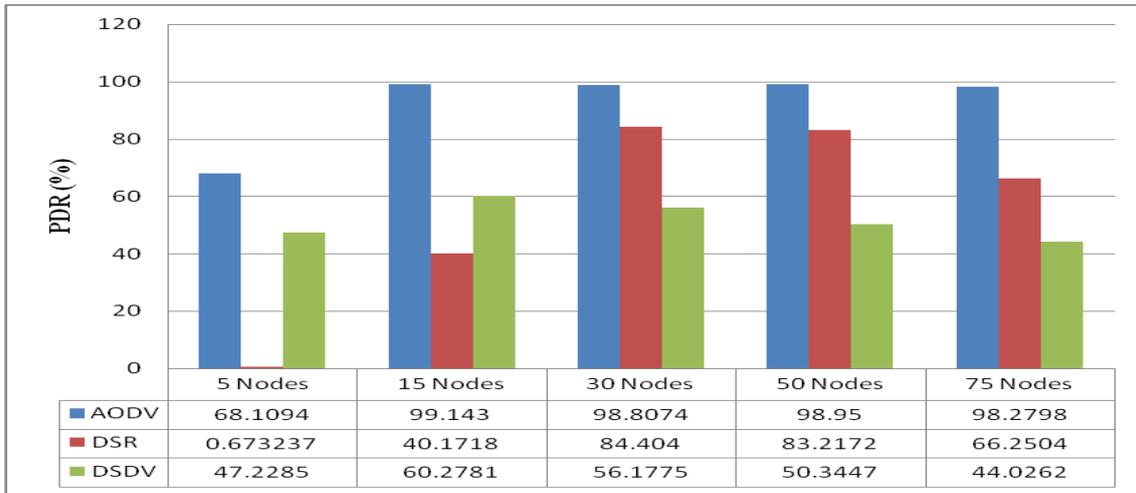


Figure 3 Analysis AODV, DSR and DSDV on base of PDR with CBR Traffic

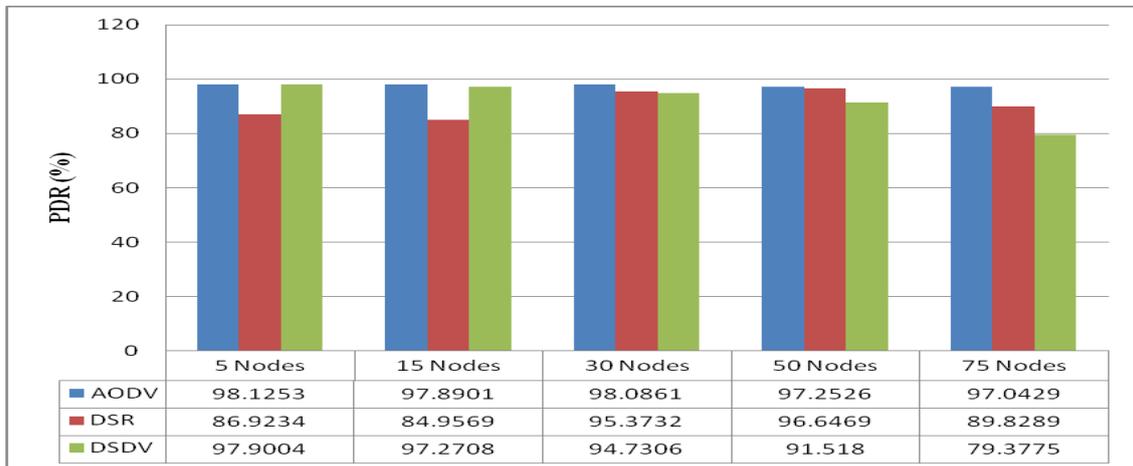


Figure 4 Analysis AODV, DSR and DSDV on base of PDR with TCP Traffic

The figure 3 and figure 4 clearly indicates that the AODV routing protocol outcomes is better with the CBR traffic. However in the low node scenario i.e. 5 node scenario it perform better with the TCP traffic but with all other network scenarios the protocol outcomes better with the CBR traffic. AODV protocol performs better in comparison of other two selected routing protocols in such network environment. However DSR produce poor result with low traffic scenarios such as 5 and 15 nodes scenarios but with medium and high traffic network scenario with both CBR and TCP traffic the DSR protocol perform well in comparison of DSDV routing protocol. The performance of DSDV is better from DSR in low traffic but not significant or can say lesser from the outcome of AODV routing protocol performance with both CBR and TCP traffic.

### B. Throughput

TABLE 3 THROUGHPUTS (IN KBPS)

Protocols	AODV		DSR		DSDV	
	CBR Traffic	TCP Traffic	CBR Traffic	TCP Traffic	CBR Traffic	TCP Traffic
5	21.70	281.93	24.47	319.50	15.90	268.68
15	42.46	277.31	42.91	400.81	29.90	388.07
30	42.41	401.90	42.78	412.60	34.51	396.00
50	68.42	342.15	68.95	407.83	56.20	370.38
75	94.50	345.69	95.19	374.01	75.73	318.03

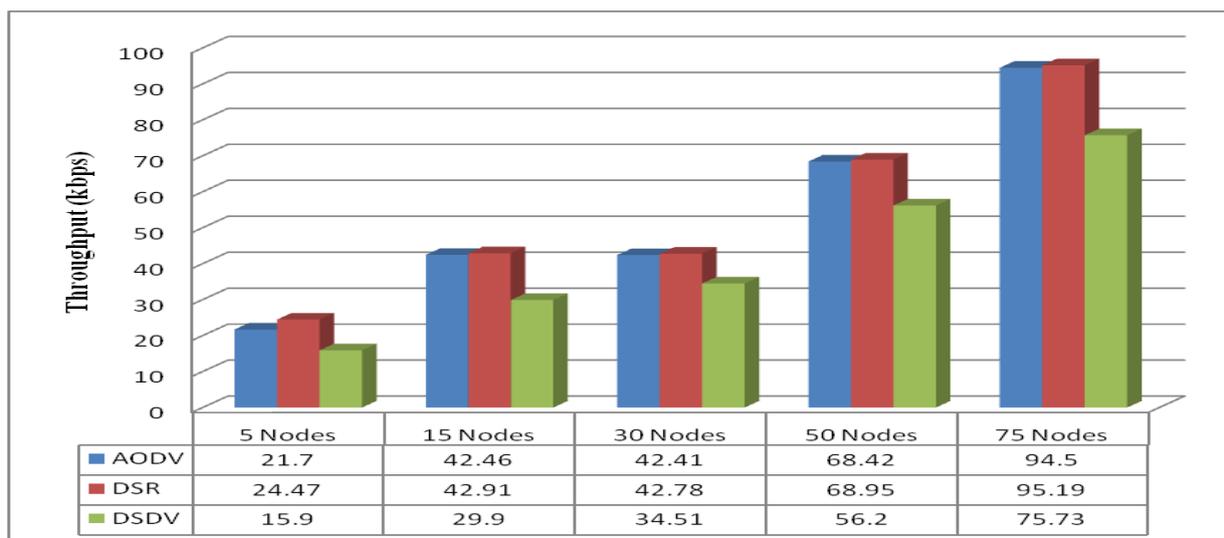


Figure 5 Analysis AODV, DSR and DSDV on base of Throughput with CBR Traffic

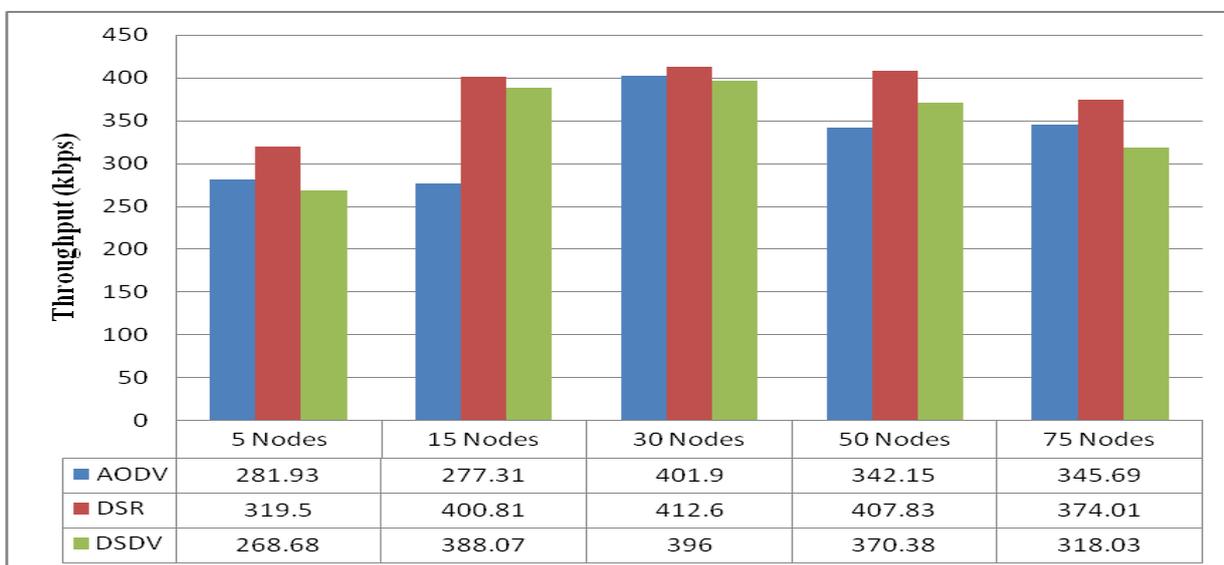


Figure 6 Analysis AODV, DSR and DSDV on base of throughput with TCP Traffic

The table 3 shows the throughput of selected routing protocols on the base of CBR and TCP traffic. The result clearly indicates that the network throughput is more significant in TCP traffic. When we compare the results at the base of protocols than DSR present the significant results in comparison of another two most popular routing protocols.

### C. End to End Delay

TABLE 4 END TO END DELAY (MS)

Protocols	AODV		DSR		DSDV	
	CBR Traffic	TCP Traffic	CBR Traffic	TCP Traffic	CBR Traffic	TCP Traffic
5	0.6784	0.9811	0.7652	0.9965	0.5020	0.9829
15	0.9895	0.9788	0.9942	0.9931	0.6979	0.9823
30	0.9861	0.9808	0.9930	0.9920	0.7997	0.9686
50	0.9882	0.9724	0.9929	0.9906	0.8141	0.9741
75	0.9819	0.9703	0.9890	0.9931	0.7876	0.9723

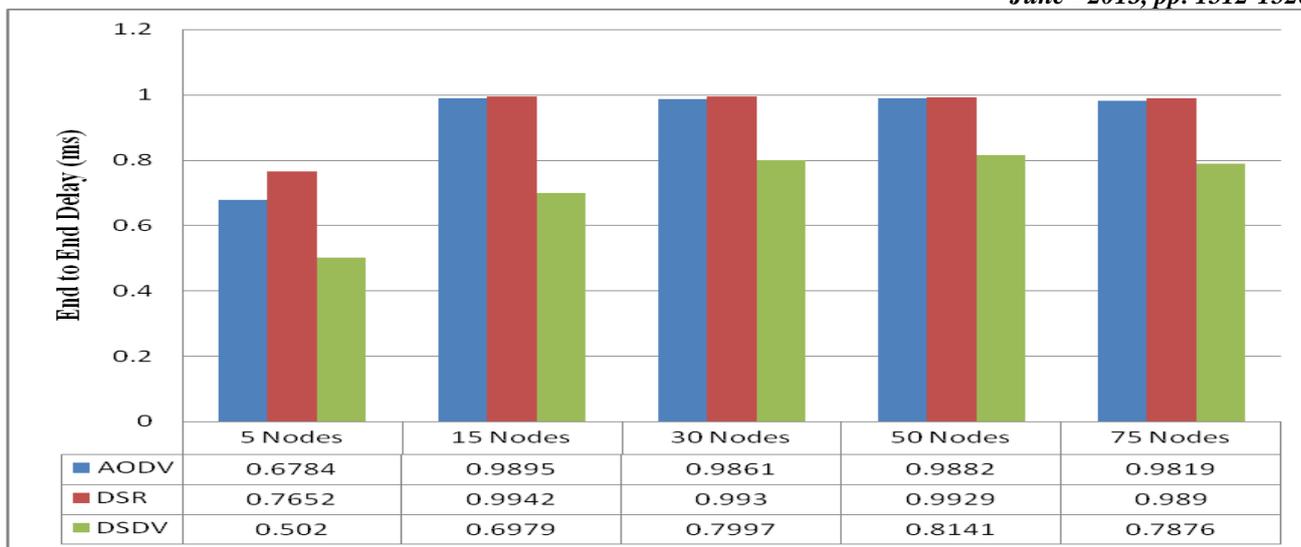


Figure 7 Analysis AODV, DSR and DSDV on base of E2E Delay with CBR Traffic

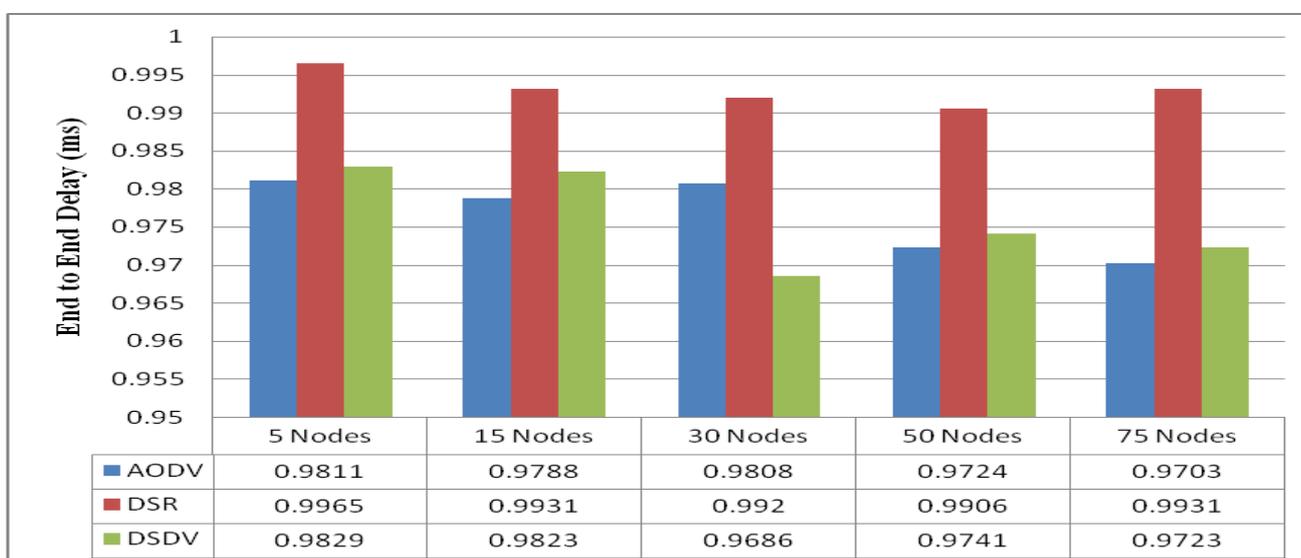


Figure 8 Analysis AODV, DSR and DSDV on base of E2E Delay with TCP Traffic

The table 4 and above figure clearly shows that delay rate is highest with DSR routing protocol in comparison of other two AODV and DSDV routing protocol in such network environment. The protocol produce significant results with TCP traffic in comparison of CBR. AODV produce lowest end to end delay results that have advantages over DSR and DSDV routing protocol with both CBR and TCP traffic. DSDV protocol in comparison of DSR perform well with CBR traffic whereas with TCP agent protocol performance decrease by taking more delay time in comparison of both other two AODV and DSR routing protocols.

#### D. Normalized Routing Overhead

TABLE 5 NORMALIZED ROUTING OVERHEAD

Protocols	AODV		DSR		DSDV	
	CBR Traffic	TCP Traffic	CBR Traffic	TCP Traffic	CBR Traffic	TCP Traffic
5	0.201	0.014	0.134	0.011	0.135	0.008
15	0.265	0.035	0.150	0.009	0.226	0.020
30	0.481	0.052	0.142	0.017	0.530	0.045
50	0.852	0.155	0.218	0.033	0.759	0.129
75	1.383	0.432	0.525	0.139	1.003	0.455

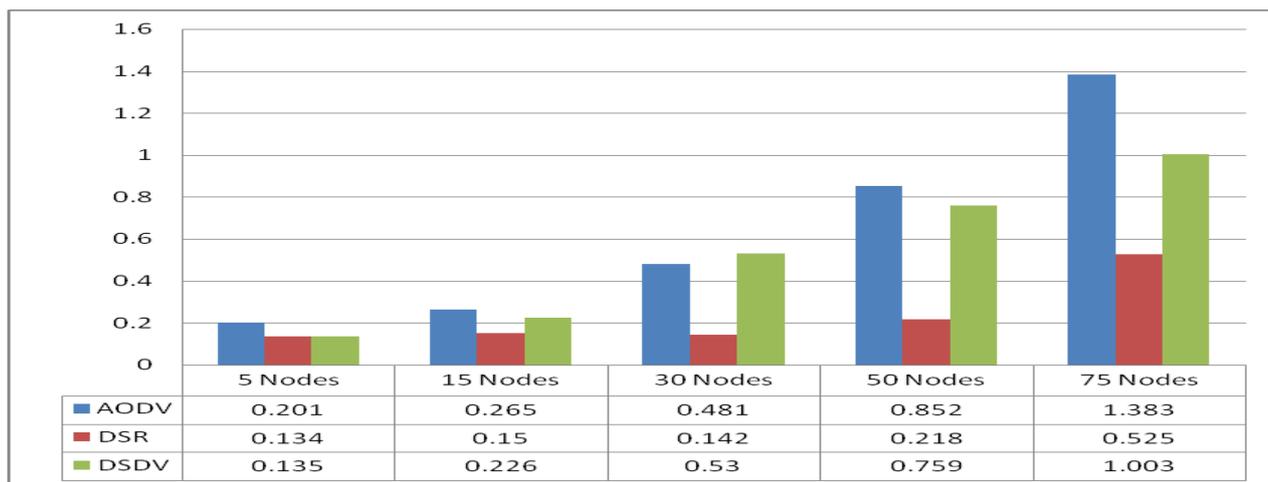


Figure 9 Analysis AODV, DSR and DSDV on base of Normalized Routing Overhead with CBR Traffic

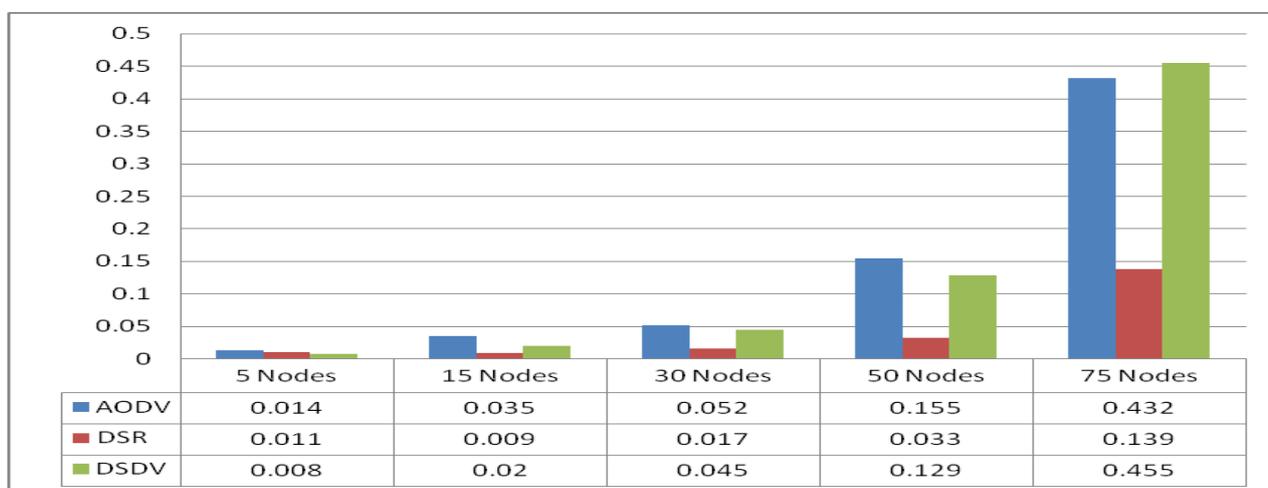


Figure 10 Analysis AODV, DSR and DSDV on base of Normalized Routing Overhead with TCP Traffic

The table 5.5 shows the simulation results of normalized routing overhead ratio of selected routing protocols on the base of CBR and TCP traffic. As the previous simulation result work with TCP agent routing protocols perform significant results in comparison of the performance of such selected protocols with the CBR traffic. AODV protocol performs better in comparison of other two selected routing protocols in such network environment. However DSR produce poor result with low traffic scenarios such as 5 and 15 nodes scenarios but with medium and high traffic network scenario with both CBR and TCP traffic the DSR protocol perform well in comparison of DSDV routing protocol. The performance of DSDV is better from DSR and AODV in low traffic but as the network size grow the DSR perform better and in the high complex network scenario the AODV routing protocol outcomes produce efficient results in comparison of other two selected routing protocols for the simulation purposes.

#### VI. CONCLUSION

This paper presents the comparative simulation of AODV, DSR and DSDV routing protocol with uniform pause & speed type over CBR and TCP connection. The simulation performs with the five different network scenarios. The various tables in simulation result & discussion section definitely help for researchers to understand the performance of these routing protocols. However no one single protocol perform well in all scenarios of VANET network with the CBR and TCP traffic but as the network size increases the AODV produce significant result with the TCP traffic that shows its suitability for such type of network in comparison of DSR and DSDV routing protocols. From the experimental analysis we can conclude that in low density network the DSR and DSDV perform better in comparison of AODV routing protocol with CBR traffic but as the size of the network increases the AODV performance increases drastically. It produce high PDR and low End to End delay with the TCP traffic in comparison of other two DSR and DSDV routing protocol.

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