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Comparison and Analysis of QoS (Quality of service) of Peer-to-Peer, UDP Traffic over an Ad-Hoc Network

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Abstract- In recent years, the usage of mobile computing has increased, especially when needing to access different types of information anytime and anywhere. Over these new networks, the impact on quality of service (QoS) factors such as packet loss, delay, throughput, completion time, packet dropped, packet delivery ratio, routing overhead and path length etc. are important considerations for users. For communication between mobile devices, using a peer-to-peer network model to establish direct ad-hoc connections often provides higher efficiency for exchanging data.
In this paper i analyse Peer-to-Peer, UDP Traffic over a Mobile Ad-Hoc Network utilizing the AODV, DSDV and DSR routing protocols under different mobility by varying pause times for a medium traffic and find out which protocol will perform better in these situations and also attempt to find out points for improvement. I also perform comparison of all these three routing protocol under different traffic load and high mobility environment to find out which routing protocol is better for which situation.

Keywords: Ad hoc networks; MAC layer; Pause time; Routing overhead; Path length; Packet delivery ratio, NS2; Random Waypoint mobility; AODV; DSDV; DSR

I. INTRODUCTION

A Mobile Ad-hoc Network (MANET) is a collection of wireless nodes that can dynamically be set up anywhere and anytime without using any pre-existing network infrastructure. It is an autonomous system in which mobile hosts connected by wireless links are free to move randomly and often act as routers at the same time. The topology of such networks is likely highly dynamic because each network node can freely move and no pre-installed base stations exist. Due to the limited wireless transmission range of each node, data packets then may be forwarded along multi-hops. Route construction should be done with a minimum of overhead and bandwidth consumption. Since their emergence in the 1970s, wireless networks have become increasingly popular in the computing industry. This is particularly true within the past decade, which has seen wireless networks being adapted to enable mobility. AODV is perhaps the most well-known routing protocol for MANET [1], which is a hop-by-hop reactive (On demand) source routing protocol, combines DSR and DSDV mechanisms for routing, by using the on-demand mechanism of routing discovery and route maintenance from DSR and the hop-by-hop routing and sequence number from DSDV. For each destination, AODV creates a routing table like DSDV, while DSR uses node cache to maintain routing information [2]. It offers quick adaptation to dynamic link conditions, low processing and memory overhead, low network utilization, and determines unicast routes to destinations within the Ad-hoc network [1]. Destination-Sequenced Distance Vector (DSDV) routing protocol is a typical routing protocol for MANETs, which is based on the Distributed Bellman-Ford algorithm [3]. In DSDV, each route is tagged with a sequence number which is originated by destination, indicating how old the route is [2]. All nodes try to find all paths to possible destinations nodes in a network and the number of hops to each destination and save them in their routing tables. New route broadcasts contain the address of destination, the number of hops to reach the destination, the sequence number of the information receive regarding the destination, as well as a new unique sequence number for the new route broadcast [2]. Wireless networking is an emerging technology that allows users to access information and services electronically, regardless of their geographic position. Wireless networks can be classified in two types:

1.1 Centralized approach Or Infrastructure Networks

Infrastructure network consists of a network with fixed and wired gateways. A mobile host communicates with a bridge in the network (called base station) within its communication radius. The mobile unit can move geographically while it is communicating. When it goes out of range of one base station, it connects with new base station and starts communicating through it. This is called handoff. In this approach the base stations are fixed.

1.2 Decentralized approach or Infrastructure less (ad-hoc) Networks

In contrast to infrastructure based wireless network, in ad-hoc networks all nodes are mobile and can be connected dynamically in an arbitrary manner. A MANET is a collection of wireless mobile nodes forming a temporary

network without using any existing infrastructure or any administrative support. The wireless ad-hoc networks are self-creating, self-organizing and self-administrating. The nodes in an ad-hoc network can be a laptop, cell phone, PDA or any other device capable of communicating with those nodes located within its transmission range. The nodes can function as routers, which discover and maintain routes to other nodes. The ad-hoc network may be used in emergency search-and-rescue operations, battlefield operations and data acquisition in inhospitable terrain. In ad-hoc networks, dynamic routing protocol must be needed to keep the record of high degree of node mobility, which often changes the network topology dynamically and unpredictably.

II. PROTOCOL SPECIFICATION

The routing protocol decides how the routes will be discovered in the network. The change in MANET topology may be very fast and unpredictable. Also, MANET nodes are considered vulnerable to failure [2]. A routing protocol must be able to cop up with these mobile nodes. Now a day, building or even choosing a perfect protocol for the network is a big challenge. So, simulation is performed to check the characteristics of a particular protocol while changing the load and other features of the network. If the protocol is performing well under certain conditions, we can choose those protocols to implement in our network. The protocols evaluated in this paper can be described as follows:

A) Proactive Protocols: In proactive approach, tables for each node are maintained. These tables specify the neighbour of the nodes, routes and distances between them. Here nodes have to maintain all entries in the tables. It does not matter that the routes are demanded or not. It is also possible that those routes are never being demanded. Then there is no use of making such unused routes. However, table is maintained to speed up the response time. But proactive protocols are not suitable for the large network as they have to maintain each and every nodes position which may result in very large sized tables.

1) Destination-sequenced distance vector (DSDV):

DSDV is one of the most well-known table-driven routing algorithms for MANETs. The DSDV routing algorithm is based on the classical Bellman-Ford Routing Algorithm (BFRA) with certain improvement [3]. Every mobile station maintains a routing table with all available destinations along with information like next hop, the number of hops to reach to the destination, sequence number of the destination originated by the destination node, etc. DSDV uses both periodic and triggered routing updates to maintain table consistency. Triggered routing updates are used when network topology changes are detected, so that routing information is propagated as quickly as possible. Routing table updates can be of two types – "full dump" and, "incremental". "Full dump" packets carry all available routing information and may require multiple Network Protocol Data Units (NPDU); "incremental" packets carry only information changed since the last full dump and should fit in one NPDU in order to decrease the amount of traffic generated. Mobile nodes cause broken links when they move from place to place. When a link to the next hop is broken, any route through that next hop is immediately assigned infinity metric and an updated sequence number. This is the only situation when any mobile node other than the destination node assigns the sequence number.

Sequence numbers assigned by the origination nodes are even numbers, and sequence numbers assigned to indicate infinity metrics are odd numbers. When a node receives infinity metric, and it has an equal or later sequence number with a finite metric, it triggers a route update broadcast, and the route with infinity metric will be quickly replaced by the new route. When a mobile node receives a new route update packet; it compares it to the information already available in the table and the table is updated based on the following criteria:

If the received sequence number is greater, then the information in the table is replaced with the

- Information in the update packet.
- Otherwise, the table is updated if the sequence numbers are the same and the metric in the update packet is better.

2) Optimized Link State Routing (OLSR):

OLSR is the optimization of classical link state routing protocol, LSR. Here, each node selects a set of neighbour nodes as 'multipoint relays' (MPR). Only the nodes which have been selected as MPR are responsible for forwarding the broadcasted messages during the flooding process. Number of nodes and packets, which involve in routing, are reduced in OLSR. Also the node has to report only to its MPR selectors. So, partial link state information is distributed in the network. This protocol always provides optimal routes in terms of number of nodes in the route. It is best suited for the large and dense networks.

B. Reactive Protocols: Reactive protocols try to find out and set up routes once demanded. No table is maintained here. So, they save lots of overhead of maintaining tables and routes. But it increases the time period for searching the routes and hence data packets transmission. The delay is more before data transmission because it has to wait until any route is found. As the request/reply packets are flooded in the network in finding the route, they are not optimal at bandwidth utilization. But these are more scalable to the topology change, hence more suitable for highly mobile networks. Also for large networks, we don't need to maintain information for every table and this increases the scalability of the network.

1) Dynamic Source Routing (DSR): In DSR, a route is established by flooding the route request messages. A route cache is maintained in which the recent routes are being cached. Whenever there is a need of a route, and if the route is in

cache, it is returned immediately without the need of moving up to the destination. This mechanism of "Route Discovery" and "Route Maintenance" are the major components of DSR. It eliminates the periodic update feature of DSDV and other Proactive routing protocols. DSR allows the senders to select and control the route. It avoids the "counting to infinity" problem avoiding the loop.

2) Ad-Hoc on-Demand Distance Vector (AODV): AODV combines the route discovery and route maintenance features of DSR and hop by hop routing sequencing number and periodic updating of packets feature of DSDV. When a route is demanded and if it is not available, a route request (RREQ) message is generated and flooded in a limited way to its neighbour. When this RREQ reaches to its destination or to the node which is having the route cached to the destination, we can say that the route is found. Then, a connection is setup between the source and destination using this route. After this, the packet can be transferred to the destination. AODV is highly adaptive to the dynamic networks and also enjoys loop free routing like DSR. It detects the latest route. But if the source sequence number is old, it can lead to inconsistent routes.

Performance Evaluation Metrics:

In our research study four different quantitative metrics have been used to compare the QoS of routing protocols against mobility of the nodes and traffic load conditions. The four important performance metrics are considered for evaluation of these routing protocols are as follows-

1. **Packets Dropped** - Some of the packets generated by the source will get dropped in the network due to high mobility of the nodes, congestion of the network etc.

2. **Packet Delivery Ratio -** The ratio of the data packets delivered to the destinations to those generated by the CBR sources. It is the fraction of packets sent by the application that are received by the receivers

3. **Normalized Routing Overhead -** The number of routing packets transmitted per data packet delivered at the destination. Each hop-wise transmission of a routing packet is counted as one transmission. The routing overhead describes how many routing packets for route discovery and route maintenance need to be sent in order to propagate the data packets

4. **Optimal Path Length -** It is the ratio of total forwarding times (depends on number of hops) to the total number of received packets. Optimal path length increases as the number of hops on optimal path increases.

III. MOBILITY MODEL

Mobility model describes the movement pattern, speed and location variation of the mobile users. It simply tells about the movement behaviour of the users. In order to evaluate the performance of mobile wireless systems, the realistic mobility model is very crucial and difficult aspect of simulation. But mobility model can create a scenario similar to the realistic environment. To evaluate the performance of a protocol for an ad hoc network, the protocol should be tested under realistic conditions. For this an accurate mobility model must be chosen. Random waypoint mobility model allows the nodes to move randomly and independent of each other. In this model, nodes can also pause for few seconds. The mobile hosts pauses in one location for a certain period of time. That time is known as pause time. It is the important feature of this mobility model because if the nodes are always moving, their neighbours will change too frequently to make a session for transmitting the packets. The routes can be broken in the middle of transmission if the node moves out of the range too frequently. Then the source node has to reinitiate the whole routing process again. Hence, it's a better practice to take the benefits of pause time and give the nodes sufficient time for the packet propagation. In this paper, we are taking different pause times such as 0, 20,40,60,80 and 100. Here "0" indicates no pause time means high mobility. It means that the nodes will pause for selected pause time in the network and then it moves to the next location.

IV. SIMULATIONS AND RESULTS

In this paper, MANET network is simulated over Peer-to-Peer network and UDP traffic for the comparison and analysis of QoS of a Network by using Network Simulator (NS-2.35). The protocols are compared on the basis of various parameters form application layer and transport layer. The simulation is performed by varying the number of connections in between 10-40 and varying number of pause times such as 0, 20, 40, 60, 80 and 100 and max number of nodes are constant to 50 for both scenarios. It is smoothly noted that how the protocol behaviour changes when the load and mobility increases on the network. The proactive protocol used DSDV. Reactive protocols include DSR, and AODV. These are compared on the basis of various performance metrics: packet dropped, routing overhead, Packet delivery ratio and Path length. All protocols are compared
on the outcome of all these parameters.

Simulation 1: Simulation Results and Effect of Mobility

To analyse the effect of mobility, pause time was varied from 0 seconds (high mobility) to 100 seconds (low mobility). The number of nodes is taken as 50 and the maximum number of connection as 20 and other network
parameters are considered as in the table 1. Graphs shown in Fig (1 to 4) show the effect of Mobility for DSDV, DSR and AODV protocols with respect to various performance metrics.

Table 1: Simulation Parameters

Serial No.	Parameters	Value
1	Number of nodes	50
2	Simulation Time	200sec
3	Area 500*500m	500*500m2
4	Max Speed	20 m/s
5	Traffic Source	CBR
6	Pause Time (sec)	0,20,40,60,80,100
7	Packet Size	512 Bytes
8	Packets Rate	4 Packets/s
9	Max. Number of connections	20
10	Bandwidth	10 Mbps
11	Delay	10ms
12	Mobility model used	Random way point

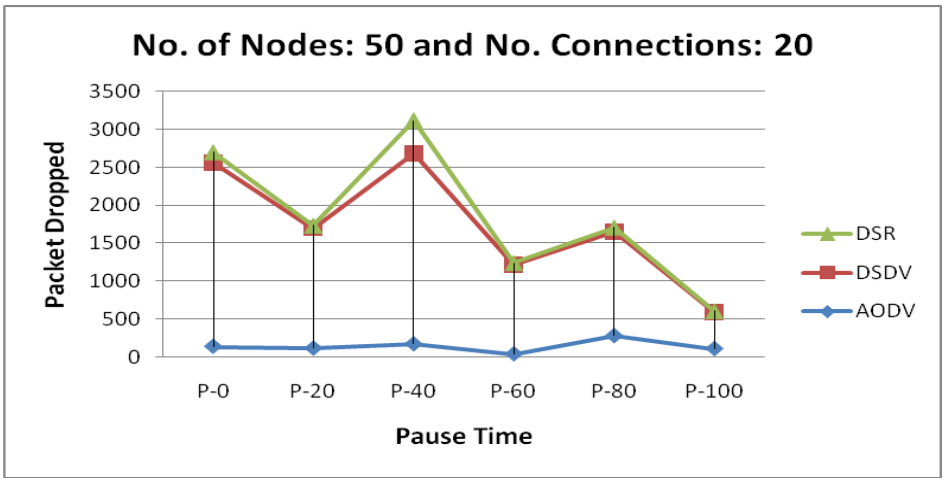
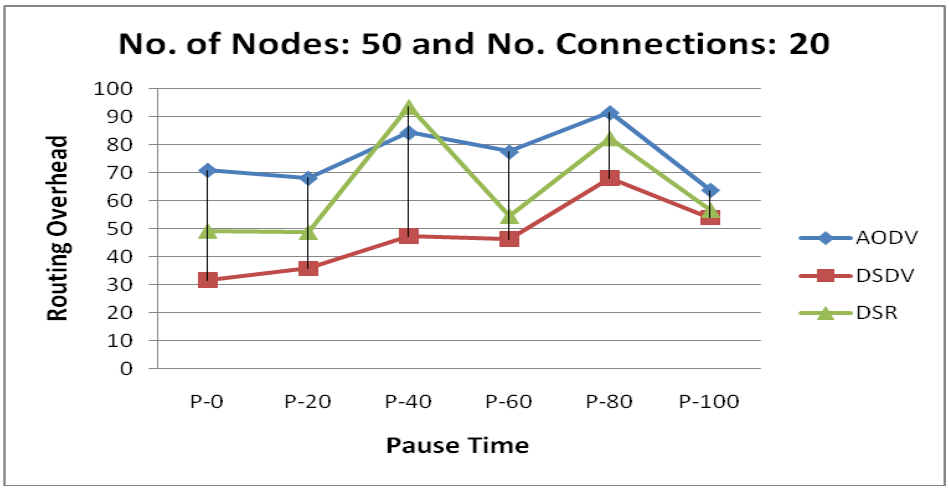


Figure: 1



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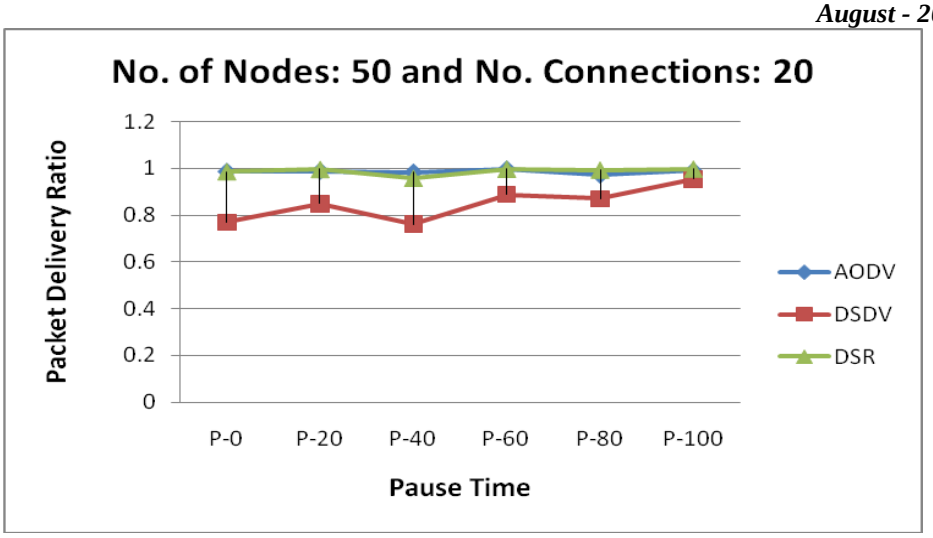

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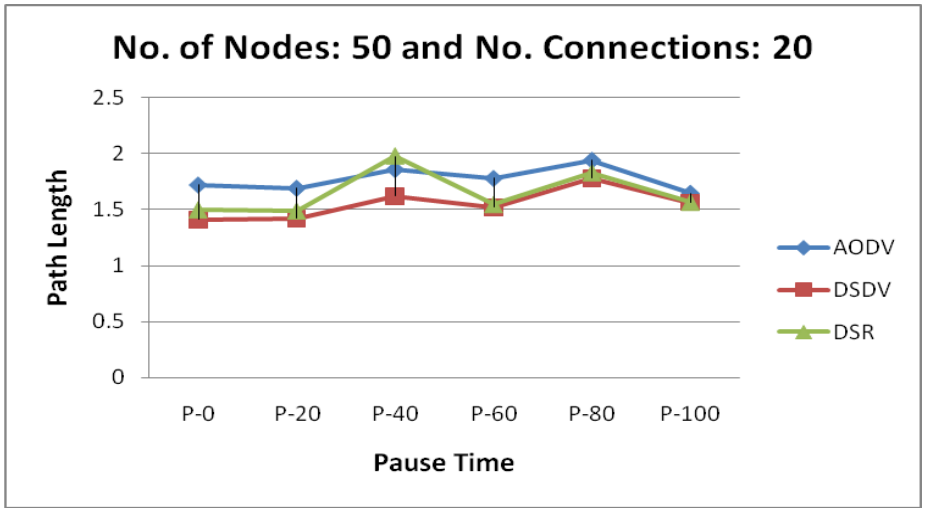


Figure: 4

From figure (1 to 4) shows a comparison between the routing protocols as a function of Pause times or we can say as a function of different mobility of nodes. From these graphs we can conclude simulation results as follows: in case of packet dropped ratio AODV give best performance.in case of routing overhead DSDV has better performance.in case of packet delivery ratio DSR & AODV both have better performances and DSDV performs better in terms of optimal path irrespective of variation in mobility as the nodes in DSDV always hold the optimal path to every other destination in their routing tables and the routing table is periodically updating.

Simulation 2: Impact of number of connections (traffic load):
In this simulation number of node is constant to 50 and use varying number of connections such as 10, 20, 30, 40 and other network parameters are considered as in the table 2.

Table 2: Simulation Parameters

Serial No.	Parameters	Value
1	Number of nodes	50
2	Simulation Time	200sec
3	Area 500*500m	500*500m2
4	Max Speed	20 m/s
5	Traffic Source	CBR
6	Pause Time (sec)	0
7	Packet Size	512 Bytes

8	Packets Rate	4 Packets/s
9	Max. Number of connections	10, 20 , 30 , 40
10	Bandwidth	10 Mbps
11	Delay	10ms
12	Mobility model used	Random way point

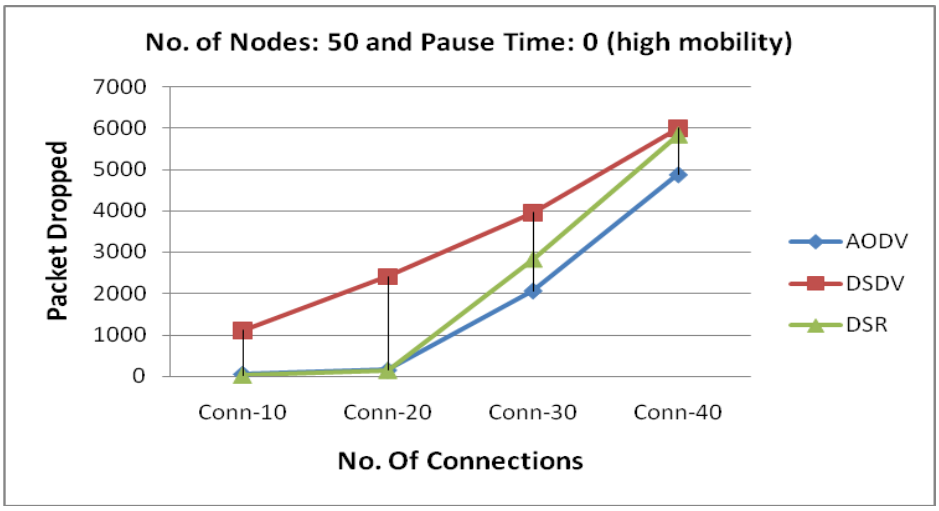
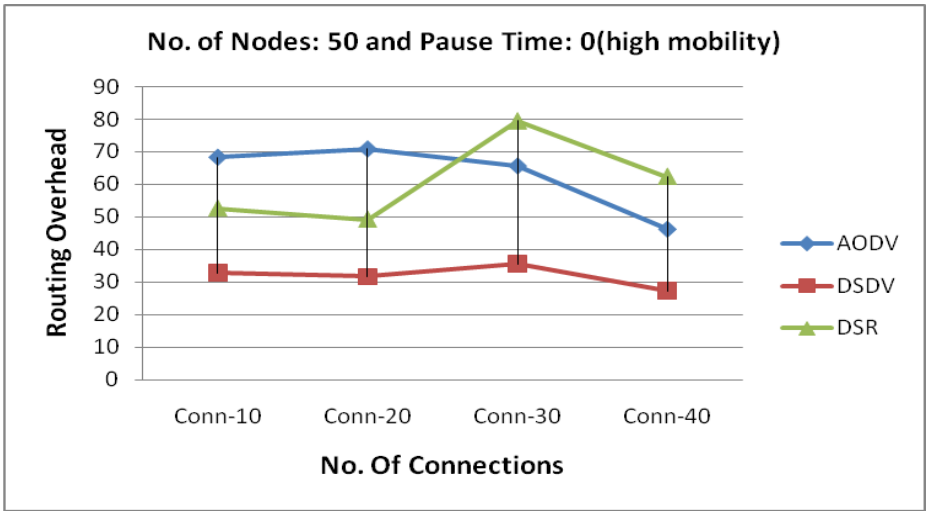


Figure: 5



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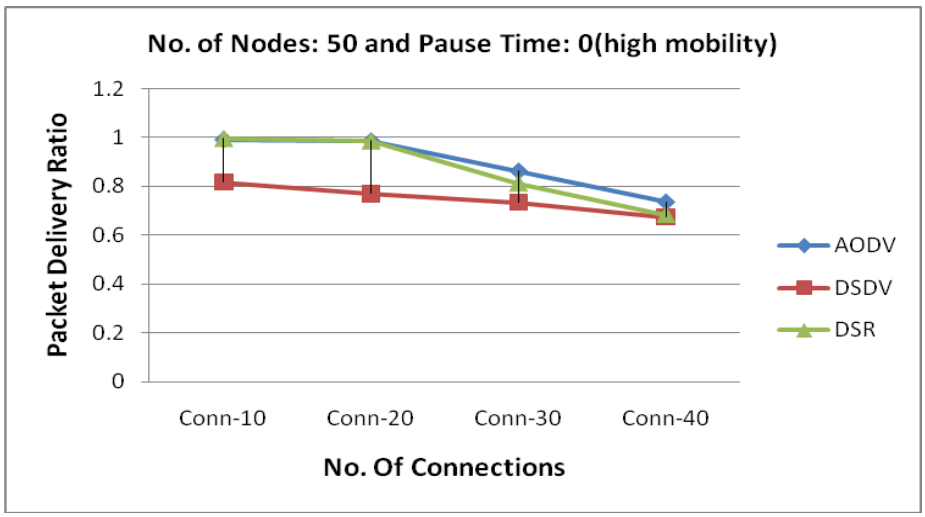

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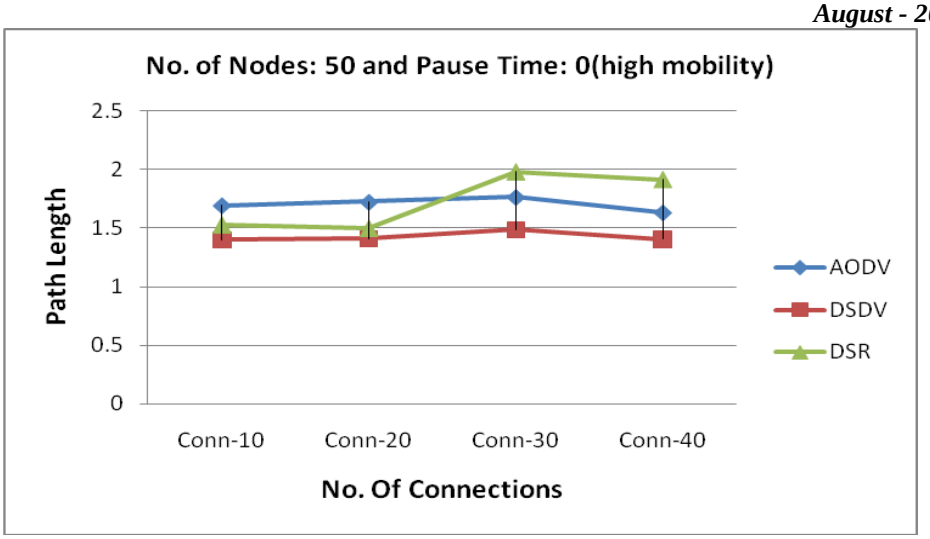

Figure: 8

From figure (5 to 8) shows a comparison between routing protocols as a function of different traffic load. From these graphs we can conclude simulation results as follows: in case of packet dropped ratio we can see that it increases as number of connection increases for all routing protocols. In case of routing overhead DSDV give better performance. Packet delivery ratio decreases as number of connections increases and DSR and AODV relatively perform better as compare to DSDV. Optimal path length varies as the traffic load varies. DSDV performs better in terms of optimal path irrespective of variation in traffic load as the nodes in DSDV always hold the optimal path to every other destination in their routing tables and the routing table is periodically updated. Optimal path length of DSR is less compared to AODV at moderate traffic, but at high traffic DSR has a more optimal path length compared to AODV. This is due to probable number of hops go high with increasing traffic.

V. CONCLUSION

This paper is an attempt to evaluate QoS (Quality of services) of three commonly used mobile ad-hoc routing protocols namely AODV, DSDV and DSR. Performance evaluation did in NS-2simulator by doing many simulations. Comparison was based on Packet dropped ratio, routing overhead, Packet delivery ratio and optimal path length. Simulation results are shown by many figures.by using simulation results we can understand that DSDV gives better results in wide range of simulation conditions.

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