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Simulation-based performance analysis of routing protocols in Mobile Ad-hoc Network

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ABSTRACT
Mobile ad hoc networks (MANETs) are a predominant area for wireless network analysis and development. As the quality of mobile devices and wireless networks has increased significantly in recent years, ad hoc wireless networks have become one of the most active and dynamic areas of communications and networks. An ad hoc mobile network is an associated autonomous collection of mobile devices (laptops, sensitive phones, sensors, etc.) that communicate with each other over wireless links and come together in a highly distributed manner to provide the necessary networking practice within of the fixed network and fast infrastructure. Typically, nodes in an ad hoc network configuration act together as routers, while being free to roam while everyone else acts. Ad hoc networks are suitable for use in locations where infrastructure is not available or where it is not cost effective to provide it. All of the above there are some limitations which are need to consider while establishing adhoc wireless network such as frequent topology change and limited battery power of mobile devices.
This dissertation presents a simulation and performance analysis of MANET protocols, namely Ad-hoc on-demand distance vector routing (AODV), dynamic provisioning routing (DSR), and destination sequenced distance vector routing (DSDV) with Network Simulator (NS) -2 tool.

I. INTRODUCTION

Adhoc wireless networks are a prevalent technology that enables users to electronically access information and services at any time, regardless of their geographic location. For the purpose of understanding the Wireless networks can be seen as of two basic types – first one as the infrastructure-based wireless network and the other one may termed as wireless network without infrastructure, also known as an ad hoc network.

Wireless networks with Infrastructure is comprises of routers and switches as nonmovable device with which mobile nodes in the network connect within the network given parameters. In

this type of wireless network the mobile nodes of the located in the network are connected to the nearby base station, the radius of which covers the area in which the mobile nodes are located. Whenever the mobile node happens to leaves the range of a base station, its command is transmitted to a new base station covering the area into which the node has entered or is going to be entered. Cellular technology is a good example of this type of network.

Another type of wireless network is a wireless network with no infrastructure or an ad hoc network. The term ad hoc means a temporary solution, so ad hoc network tends to mean a temporary network. In this type of network, the nodes or connecting devices tend to move back and forth, which is why the configuration is also referred to as an ad-hoc mobile network in the abbreviation MANET.

Mobile adhoc network or MANET is a type network without infrastructure that comprises of many movable computer devices such as smartphones. These movable computer devices or we can say mobile nodes may talk to each other via wireless medium i.e. use of certain range of frequency and that is too without the use of a any antecedently established network infrastructure or any supervisory management which manages all the task on behalf.

The mobile or movable nodes which make up the mobile ad hoc network may be a laptop, smartphone, smartwatch, printer, router, switche, etc. All these nodes talk to each other by making

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use wireless connections in order to exchange information and data. These networks have dynamic configuration as topology keep on changing due to the movement of nodes with in the given network. These are further characterized by frequently and automatically changing topology and a configuration without any previously existing infrastructure.

II. OBJECTIVE

The objective of this dissertation is to manifest the performance of the existing routing protocols of the Mobile adhoc networkfor various network configuration using the Network Simulator(NS)-2 tool. For mobile adhoc networkinfrastructure many routing protocols have been proposed and developed. Out of those routing protocols some are selected here for analysis and evaluating the performance for various configuration. The protocols that have consider for analysisare - Dynamic Source Routing (DSR), Ad-Hoc On-demand Distance Vector routing (AODV) and Destination Sequenced Distance Vector routing (DSDV).

Dynamic Source Routing protocol (DSR): It is one of the widely used reactive type of protocol as it offers simple and efficient routing services to the network. It quickly adapt to the regularly expanding or changing topology of the network. It features with such that offers little or no overhead on the network[8].

As it is an on-demand protocol, it does not maintain the route to the nearby stations at all time. Whenever a data packet is available with this protocol to reach to a certain destination, It first flood the network with the information seeking data packet to get the exact address of the destination. And if the direct path is not possible to the destination node then the address of the intermediate node is extracted and the information packet is delivered to that node. The intermediate node further replicate the same process to find the exact destination address.

Dynamic source routing protocol primarily performs the two main task namely – "Route Discovery and Route Maintenance"

Route Discovery: In this the protocol the when a sender node want to send data packets to other unknown node in the network then it try to find the path along the destination route first.

In route discovery process the Dynamic source routing protocol make use of two types of messages namely route request message and route reply messages to find the route to the destination in the network. These messages are propagate to and fro to the source and destination in protocol's header section.

Route Maintenance: In this the sender, which has established the link with the destination and continue to send the data packets, regularly monitors the established link whether it is broken or not. The link got destroy due to the frequently changing topology. If the link is broken then other available path to the destination is explored.

Ad hoc On-Demand Distance Vector (AODV): AODV is a routing protocol used in adhoc wireless network. This protocol is consider as successor to the dynamic source routing protocol. This protocol offers fast adjustment to the frequently changing topology. It also proposes to find out the unicast route to the destination node in the adhoc network[9].

This protocol proposes to remove the demerits of DSR. In dynamic source routing protocol the complete path of the destination node or intermediate destination node is append to the header of the packet itself which ultimately increases the size of the packet and also contribute to make the network process slow. But in AODV this path information is stored in a separate table instead of storing it to the header of the packet.

To keep the updated path information, AODV keeps a routing path table at every participating node in the adhoc wireless network. This routing table comprises of three fields namely – next hop node, hop count and sequence number.

The advantageous feature of AODV protocol is that it make use of sequence number. The sequence number help it to keep the updated route information. This number can be understand as a timestamp to measure the updation of the route.

Like the dynamic source routing protocol, AODV also depends on the two mechanisms namely – "Route Discovery and Route Maintenance"

Route Discovery: In this the protocol the when a sender node want to send data packets to other unknown node in the network then it try to find the path along the destination route first.

Route Maintenance: In this the sender, which has established the link with the destination and continue to send the data packets, regularly monitors the established link whether it is broken or not. The link got destroy due to the frequently changing topology. If the link is broken then other available path to the destination is explored.

Both of the above tasks are carried on by the protocol when there is demands of such, otherwise the nodes are keep on sleep mode.

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Furthermore, there is no any kind of regular packet advertisement involved in this routing protocol
In route discovery process where dynamic source routing protocol make use of two types of messages namely route request message and route reply messages to find the route to the destination in the network, the AODV uses one additional type of message known as route error message.

- Route request message (RREQ) is used to traverse the path in order to find the route to the destination.
- Route reply message (RREP) is used when the exact destination is found and to identify itself RREP is sent back to RREQ generator.
- Route error message (RERR) is used to acknowledge or advertise any link breakage in the network.

The sequence number used in the AODV protocol algorithm is of great importance. This sequence number gets updated in mainly two cases. This sequence number updated automatically just before the creation of RREQ message and before just the creation of RREP message.

Destination Sequenced Distance Vector Routing (DSDV): Destination Sequenced Distance Vector (DSDV) is proactive type of protocol that is used in adhoc wireless network. Though it is a proactive protocol i.e. a table driven protocol, so the nodes in adhoc wireless network which uses it need to maintain a routing table. The participating node require to update this routing table on a regular basis. The nodes update their routing table by sharing the information to their peer node[10].
This protocol can be consider as an update or advance version of the classical Routing Information Protocol. The advance feature that differentiates it from RIP is that it avoids the state of looping in the adhoc network.
The routing table of a node contains the information about the other peer nodes that are currently reachable and also the number of intermediate nodes required to reach to a particular node. In order to uniquely identify each row entry of the table a special number is assigned to the each row known as sequence number. This sequence number helps to identify such row entry which is not updated for long time. This sequence number gets updated automatically when there is an update in the row. By using this sequence number the protocol become able to know which entry is fresh and which one become stale. With the help of this feature it avoids the formation of loop in the network.
In process to update the routing table, the participating nodes receive multiple update packets from the nearby linked nodes. Those update packets may be parted into two categories –

- Full Dump Packet: By using this update packet, the node simply broadcast the exact copy of its routing table to the neighbouring nodes. As the whole routing table is flooded, it increases the overhead in the network.
- Incremental: In this type of update packet only those rows or routing table flooded which is update recently. It requires less network resources as only few rows of the table require to be forwarded instead of whole table as in the case of full dump.

The participating nodes in the adhoc wireless setup which tends to establish a link among themselves keep broadcasting the required information of the routing table at periodic interval of time.
Since every participating node has to share their routing table information with the peer node, in that process the nodes happen to receive multiple update packets from the same node. In this scenario the packet with the least or an update from the previous sequence number is accepted and kept to the routing table as update entry.
At all things consider, DSDV requires less amount of memory as compared with its counterparts such as RIP and also it offers loop free path to all the nodes participated in the adhoc wireless network.

III. SIMULATION METHODOLOGY

To analyse the performance each consider routing protocol a special and widely used simulator called “Network Simulator (NS) - 2” is being used. The process of simulation can easily be understood from the given flow diagram in figure 1. First we design the test cases of the network for the model to simulate the given protocol working.

After the simulation gets completed a distinct file is generated known as “Trace File”. This file is used to analyse and calculate the different metrics of a given protocol.

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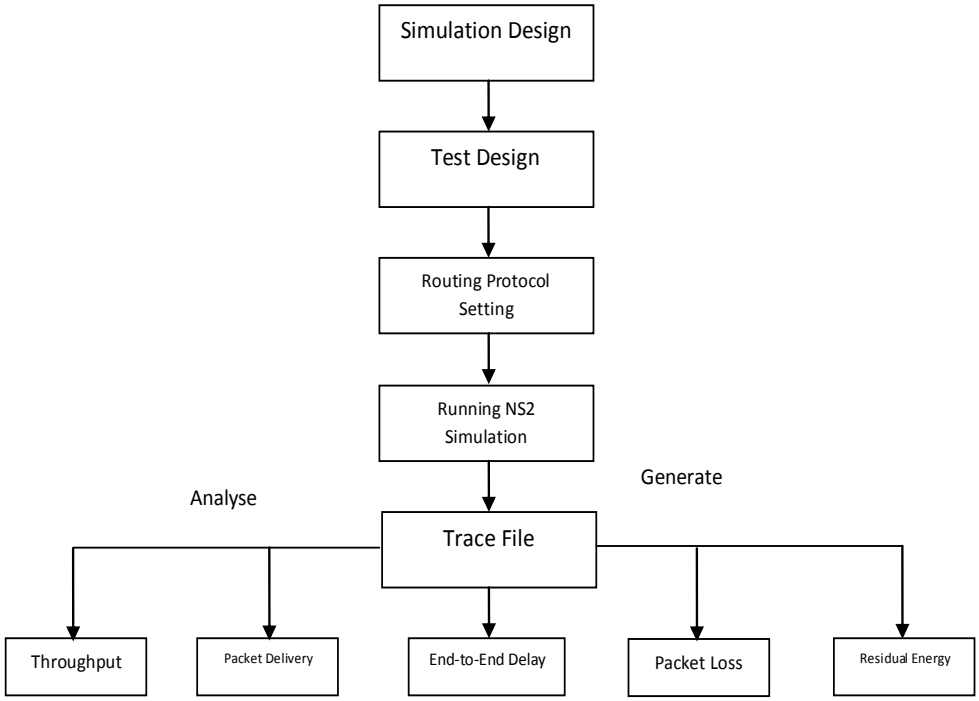

Figure 1: Simulation Flow diagram

IV. SIMULATION ASSUMPTIONS

Three routing protocols were used as to run the simulation model using ns2 simulator. Different size of network is developed for assessing the performance of protocol under a given circumstances. The network size varies from 20 nodes to 80 nodes. The mobile nodes are further allowed to move with speed of 10 m/s to 20 m/s. each participating node has a pause time of 2 ms. The traffic type that I used for the network is CBR(constant bit rate). Further each node is also equipped with constant energy sources. The whole simulation is carried out in 300s. Below given table list all the particulars of each and every node –

Simulation Particulars	
Analysed Protocols	AODV, DSR, DSDV
Total Simulation Time	300s
No. of Nodes in	20,40,65,80
Speed of Nodes	10-15-20 m/s
Mobility Model Used	Random Waypoint
Traffic Type Used	CBR
Used Packet Size	512 bytes
Connection Bandwidth	10 pkts/sec
Pause Time	2s
Node Energy	10 Joules per node
Receive Power of Node	300 mW
Transmit Power of	800 mW

Table 1: Simulation assumption data

V. PERFORMANCE PARAMETERS

In order to assess the performance of a protocol there are certain parameter or metric available which can be consider to find out best available protocol for a given type of adhoc wireless network. Those are summarises below -

- Throughput: This is one of the basic and prime metric to assess the performance of any

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protocol whether it is used for wired network or wireless medium of network. It is defined as the amount of data packets received to the data packets sent over a given amount of time. It is measure in bits per second.

- Delay: It is defined as the total amount of time taken by data packet to reach the destination node.This metric is crucial for delay-sensitive applications such as video streaming and voice calling over internet etc. as these application will be of no use if there are delay.
- End-to-End Delay: It is defined as the amount of time taken by packet with unique ID to reach the destination node sent from the source node. Thismetric aggregate all delays that may occur in the course of packet transmission from one node to others in the network. The other delay may include – retransmission delay route discovery delay, queuing delay etc.

In order to evaluate the average end-to-end delay All the incurred delays are aggregated for each and every packet that are sent successfully from one node to other and then divided by the number of data packets received.

- Packet Delivery Ratio: It is an important metric for MANET performance evaluation. It can be defined as the ratio of all the packets received at the destination node to the data packets sent by the source nodes.

VI. SIMULATION RESULT

After running awk scripts for AODV, DSR and DSDV protocols following results shows against different parameters for different set of mobile nodes (20, 40, 65, 80) which can be tabled for easy understanding and enumeration -

Varying Traffic	Packt Loss	Packet loss ratio	Packet delivery ratio	Average end-to-end Delay (ms)	Average throughput (Kbps)
20	346	12.96	87.04	238.94	0.120049
40	141	10.08	89.92	321.84	0.06392
65	148	10.36	89.64	317.69	0.06477
80	97	9.42	90.58	498.28	0.047119

Table 2: Different parameters readings for AODV protocol

Varying Traffic	Packt Loss	Packet loss ratio	Packet delivery ratio	Average end-to-end Delay (ms)	Average throughput (Kbps)
20	26	1.02	98.98	534.32	0.133702
40	16	0.60	99.40	478.39	0.141476
65	16	0.58	99.42	543.72	0.145892
80	19	0.75	99.25	752.37	0.133406

Table 3: Different parameters readings for DSR protocol

Varying Traffic	Packt Loss	Packet loss ratio	Packet delivery ratio	Average end-to-end Delay (ms)	Average throughput (Kbps)
20	273	12.84	87.16	164.24	0.098417
40	141	10.08	89.92	321.84	0.06833
65	63	7.55	92.45	218.58	0.039844
80	50	6.30	93.70	278.51	0.036083

Table 4: Different parameters readings for DSDV protocol

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And then we can plot the line graph from these tables. We could clearly see as in figure-2 that average throughput of the network fall down gradually for DSDV protocol while in the case of AODV, the average throughput remains constant for mobile nodes 40 and 65, but it also decreases if we increase the number of mobile nodes.

The DSR performs better than the rest two protocols in case of average throughput metric

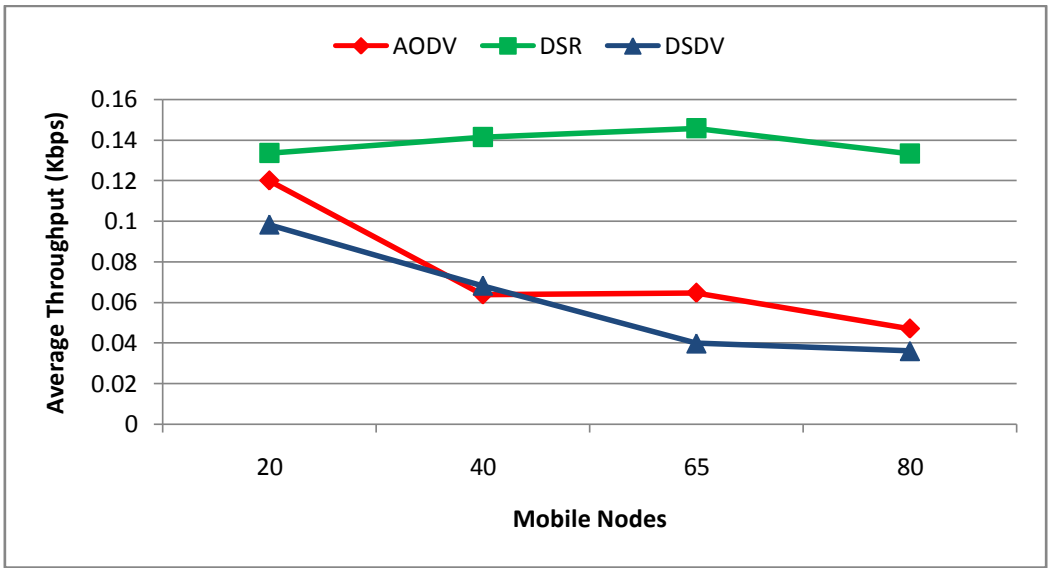

Figure 2: average throughput graph.

While executing the script for Packet Delivery Ratio (PDR), we found that DSR performs way better than the rest of the two protocol i.e. DSDV and AODV.

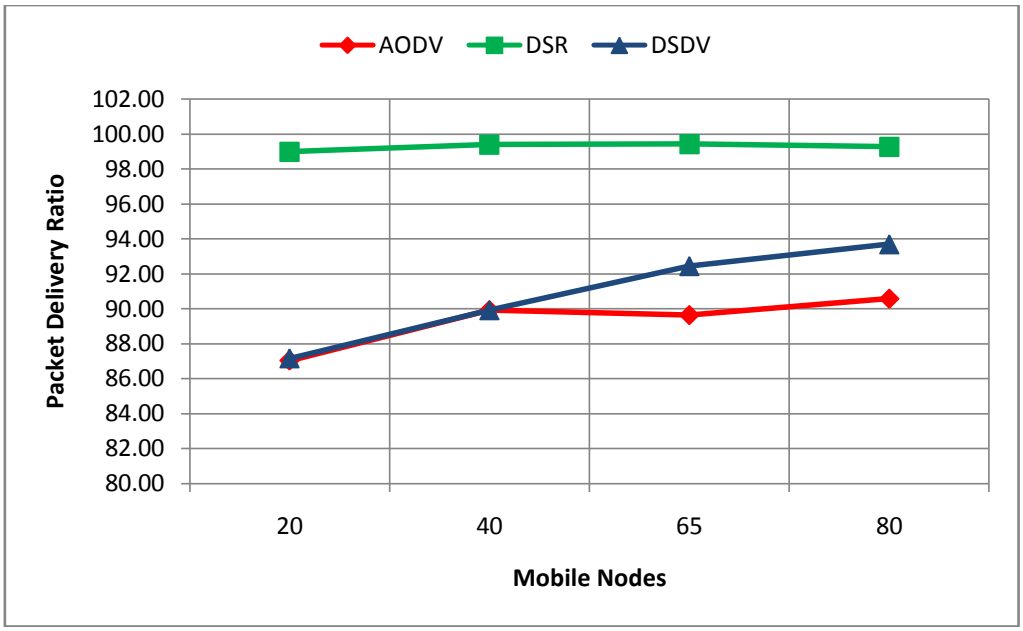

Figure 3: Packet Delivery Ratio (PDR) graph.

While evaluating Residual Energy for the mobile nodes, we observed that the energy of the nodes in case of DSDV remains high as compared to the AODV and DSR protocol shown in figure 4.At some point the AODV and DSDV line graph becomes collinear.

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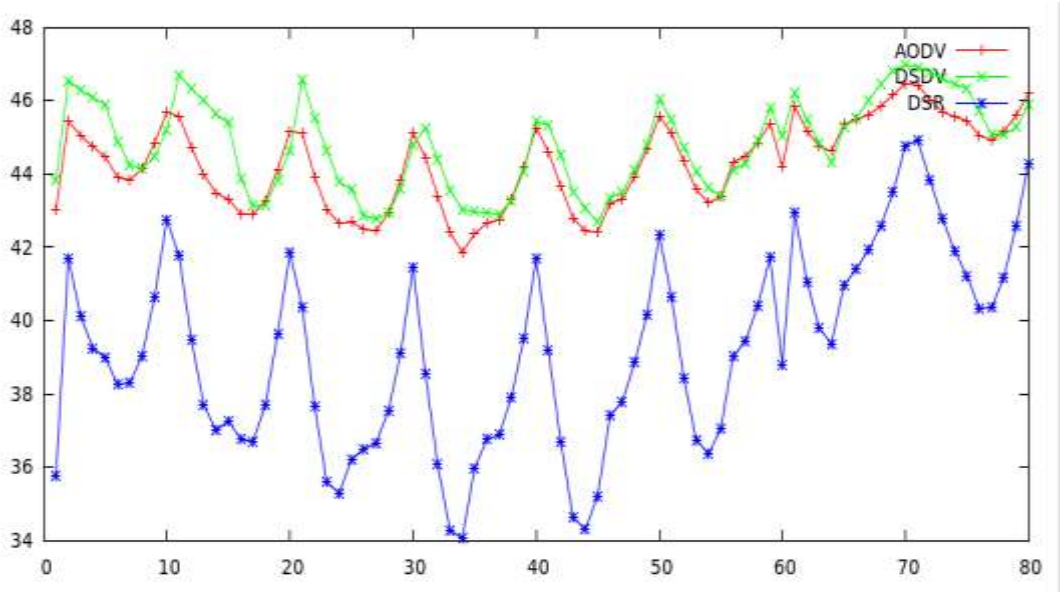

Figure 4: Residual Energy graph.

When we look at the end-to-end delay graph in figure 5, we could clearly see that delay remains high for DSR as compared to AODV and DSDV.

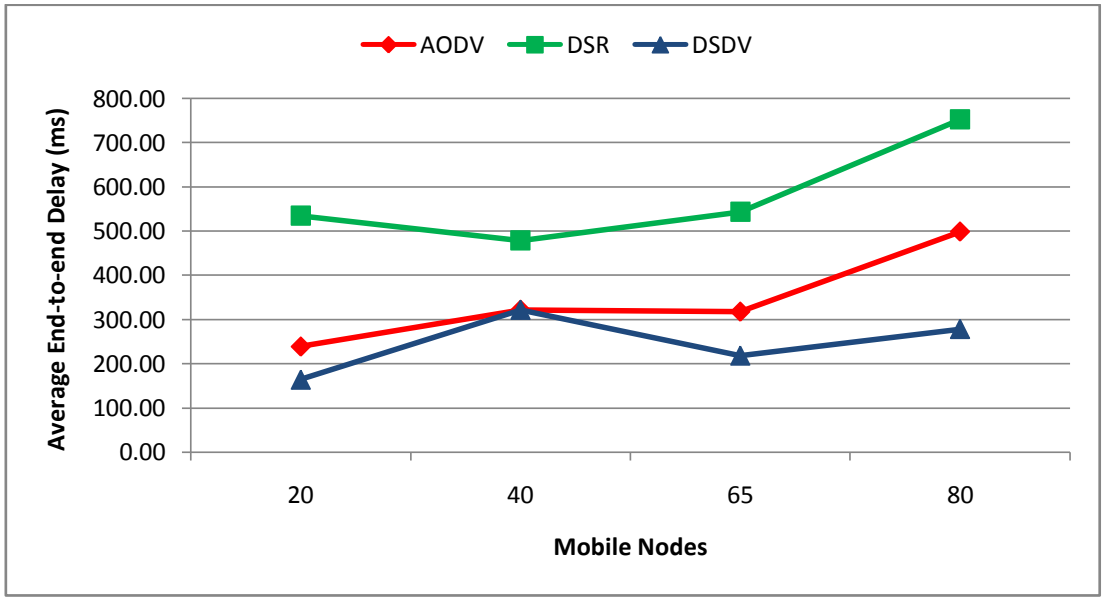

Figure 5: Average end-to-end Delay(ms) graph.

From packet loss graph in figure 6, we could observe that number of packets lost during transmission remains low for the DSR protocol throughout the different traffic arrangements. While the packet loss remains high for lower number of mobiles and comparatively low for greater number of mobile nodes for AODV and DSDV protocols.

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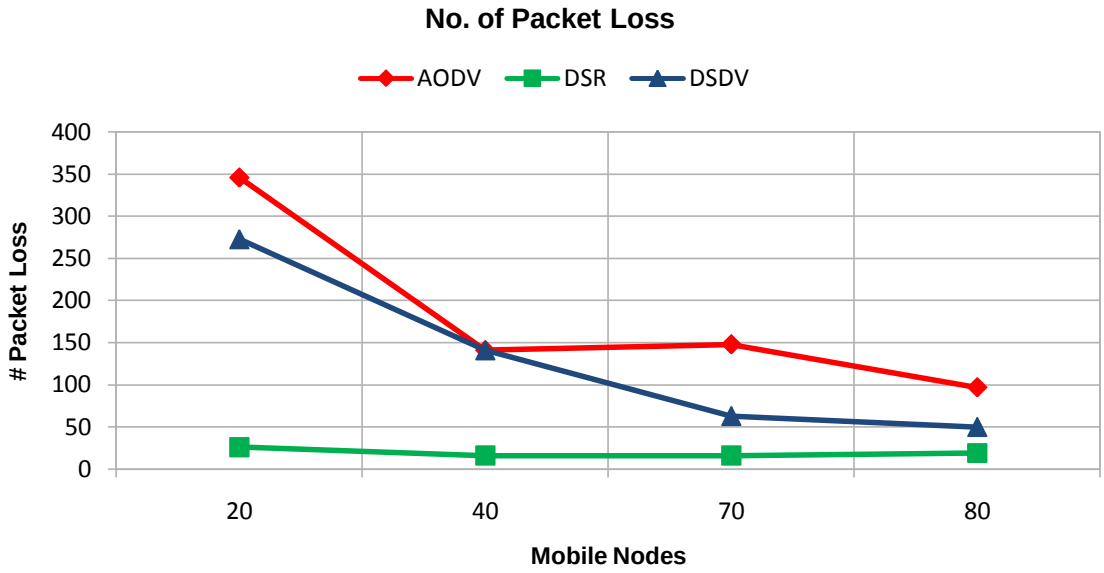

Figure 6: Packet loss graph.

VII. ANALYSIS AND RESULT

In this dissertation we compare the both reactive and proactive type of protocols. The different scenarios were made in the NS2 simulator. The simulator runs for 300 secs and different trace files were generated from which different tables and graphs were plotted for analysis and calculation

We take a scenario where we consider varied number of mobile nodes. These varied mobile nodes are simulated using Ad-hoc On Demand Distance Vector (AODV), Dynamic Source Routing (DSR) and Destination- Sequenced Distance Vector (DSDV) using CBR traffic application which were checked by different parameters such as Throughput, Residual Energy, Packet Delivery Ratio, Packet Loss Ratio, End-to-End Delay etc.

Average Throughput: The performance of DSR increases upto certain number of nodes and then after decreases, In AODV throughput remains constant between nodes 40 and nodes 65 and start declining if we go for higher number of nodes. But in case of DSDV it decreases gradually with the increases number of nodes.

Packet Delivery Ratio: The performance of DSR remains high and constant with the increasing number of mobile nodes. While the other two considered protocols lag behind.

Residual Energy: All protocols performs equally in respect of residual energy parameter.

End-to-End Delay: Performance of DSR increases with increasing number of mobile nodes, same case can also be observed in AODV. The performance of DSDV remains low as compared to DSR and AODV.

Packet Loss Ratio: In this parameter also the DSR performs better than the rest two protocols. The packet loss remains low as we increase the nodes. Packet loss in AODV remains high as compared to DSDV.

VIII. CONCLUSION

DSR shows the best performance with its ability among all three considered protocols to maintain connection by periodic exchange of data required for TCP network. DSR performs best in the case of Packet Delivery Ratio, End-to-End Delay, Packet Loss Ratio. AODV and DSDV performs slightly better than the DSR in case of residual energy. But overall, from the above research work performance of DSR is considered best for real time and TCP network.

REFERENCES

[1] JeorenHoebeke, Ingrid Moerman, Bart Dhoedt and Piet Demester“ An Overview of Mobile ad hoc Netwroks: Applications & Challenges .

[2] Krishna MoorthySivalingam, “Tutorial on Mobile Ad-Hoc Networks”, 2003.

[3] R. Ramanathan and J. Redi, “A Brief Overview of ad-hoc networks: challenges and Directions,” IEEE Commun. Mag., vol. 40, no. 5, May. 2002.

[4] M. Grossglauser and D. Tse, “Mobility increases the capacity of ad hoc wireless networks”,IEEE/ACM Transactions on Networking, Vol. 10, No. 4, August 2002.

[5] Carlos T. Calafate, M. P. Malumbres, P. Manzoni," Performance of H.264 compressed video streams over 802.11b based MANETs," In the Proceedings of the 24th International Conference on Distributed Computer System Workshops, March 2004, pp. 776-781

[6] Elsa Mac´ıas, Member, IAENG, Alvaro Su´arez, Member, IAENG, J. Mart´ın and VaidySunderam," Using OLSR for Streaming Video in 802.11 Ad-Hoc Networks to Save Bandwidth." IAENG International Journal of Computer Science, Vol. 33, No. 1, 2007

[7] Jose L. Muñoz *, Oscar Esparza, Mónica Aguilar, Victor Carrascal, Jordi Forné," RDSR-V. Reliable Dynamic Source Routing for video-streaming over mobile ad hoc networks." Journal of computer networks, 2010, Vol. 54, pp.79–96

[8] RFC 3561 (was draft-ietf-manet-aodv) Ad hoc On-Demand Distance Vector (AODV) Routinghttps://datatracker.ietf.org/doc/html/rfc3561

[9] RFC 4728 (was draft-ietf-manet-dsr) The Dynamic Source Routing Protocol (DSR) forIPv4https://datatracker.ietf.org/doc/rfc4728/

[10] Destination-Sequenced Distance Vector (DSDV) Protocol by Guoyou He.