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Performance Comparison of AODV, DSDV and DSR Protocols in Mobile Networks using NS-2

R. F. Sophia Pearlin[1*] and G. Rekha[2]

[1]Communication and Networking, KLNCIT, Madurai - 630612, Tamil Nadu, India; sopreeth@gmail.com
[2]Department of ECE, KLNCIT, Madurai - 630612, Tamil Nadu, India; pdm.rekha@gmail.com

Abstract

Background/Objective: To ensure about which protocol is best for mobile networks by comparing the performances of DSR, DSDV and AODV protocols using NS-2. **Method/Statistical Analysis:** The functionalities of the three protocols have been compared by the three performance metrics such as Packet Delivery Ratio, Control Overhead and End to End Delay for the changing scenario. **Findings:** By comparing the packet delivery, it is clear that DSDV protocol is not good but, by comparing the control overhead, DSDV has very high control overhead than DSR and AODV protocols. AODV protocol performs well in some cases but considering the overall performances, DSR performs good than AODV protocol. **Improvements/Applications:** The protocols design will be improved to adapt themselves for all the changing scenario of the networks and this will be helpful in many applications such as military applications, emergency rescue operations, exploration missions etc.

Keywords: AODV, Control Overhead, DSDV, DSR, End to End Delay, Mobility, Packet Delivery Ratio, Packet Size, Time Interval

1. Introduction

An adhoc wireless network is an accumulation of one or more devices armed with wireless networking and communications facility. These armed devices can communicate with other devices or nodes those who are in their radio range or in other outside radio ranges. For relaying or forwarding the packets from source to destination, an intermediate node can be used. Usually, the adhoc wireless networks are adaptive and self organizing networks. These networks does not have any centralized administration. The word "ad hoc" refers to "can take different forms" and "can be networked, mobile or standalone".

These mobile adhoc networks are more dynamic in nature so that the routing protocols should be more adaptable to the changing topologies and to the changing connectivity of the network. These ad hoc networks can find its applications in military, exploration missions and in emergency rescue operations. These can be useful for some other commercial applications also. The following sections will be discussing about the MANET routing protocols, simulation model, performance matrices and finally conclusion.

2. Manet Routing Protocol

So many different criteria are there for classifying and designing the routing mechanisms for manets[1,2]. For example, what are all the routing mechanisms has to be exchanged and how it should be exchanged, when and how the routes has to be toted up etc?

2.1 Table-Driven Routing Protocols

These routing mechanisms are the natural elongation of the routing protocols for the wired networks. In table driven mechanisms, each node will be having one or more routing tables that contains the routing information of any other nodes in the network. These routing protocols

*Author for correspondence

are always adaptive to the changing topologies of the networkby updating the routing tables for the changing environment. These mechanisms are more convenient for networks which are larger, as they maintain so much entries for every node in the network. This increases the bandwidth in the network. Destination Sequenced Distance Vector (DSDV) routing is an example for table driven routing protocol.

2.2 Destination-Sequenced Distance-Vectors Routing (DSDV)

DSDV is one of the table driven routing protocol which is based on Bellman - Ford routing algorithm. This Bellman - Ford routing algorithm has a routing loop problem which gets solved by DSDV[3]. For solving this problem, it uses sequence number for each entry in the routing table. If the link is present, then the sequence number will be even. If the link is not present, then the sequence number will be odd. These numbers are usually generated by the destination and the generators should send this sequence number along with the next update. This protocol can disperse the information of routing between nodes by the full dumps or by smaller incremental updates.

2.3 On-Demand Protocols

On – demand protocols are also called as reactive routing protocols. In this on - demand routing, whenever a source node desires for a route, then this mechanism creates route for it. When a node needs a route to reach the destination, a process of route discovery gets initiated. This computes all possible routes. After the discovery and establishment of the route, it gets maintained by the route maintenance procedure. This protocol is suitable for larger networks. Examples are Ad - hoc On demand Distance Vector (AODV) routing and Dynamic Source Routing (DSR).

2.4 Ad-Hoc On Demand Distance Vector (AODV)

AODV is an example for reactive protocols. In AODV routing mechanism, each node is maintaining a routing table which consists of next hop IP and destination addresses and also their sequence numbers[4-7]. Along with these information, the routing table also consists of lifetime information, distance to destination and precursor nodes list. A node sends a route request (RREQ) packet for initiating the route discovery process. The source node will be sending the route request packet to its neighbor until it finds the destination or it finds an alternate route to reach the destination. AODV ensures that all nodes in the network are loop free. After receiving the RREQ packet, the destination responds it with a route reply (RREP) packet to the source. Then the node updates the routing table information once it finds the better route.

2.5 Dynamic Source Routing (DSR)

DSR algorithm is one of the important on demand routing protocol in adhoc networks. This type of protocol uses only less bandwidth in networks where the mobility is low[3,8,7]. This is one of the efficient and simple routing protocol for adhoc networks. There are two phases in this protocol. They are route discovery phase and route maintenance phase. The source node will first search for the route cache to reach the destination. If it does not find any route cache, then the node initiates the process of route discovery, which is executed by a route request message to find the route to reach the destination. After finding the route, the node responds with the route reply packet which consists of the routing information required by source. Using this newly discovered route, the data packets can be forwarded to the destination. DSR can be able to support rapid topology changes.

3. Simulation and Comparison

NS2.34 has been used for the simulation of AODV, DSDV and DSR routing mechanisms. It is a network simulator which can be intelligible easily and it is used to favor all types of networks. This simulator is also known as discrete event driver simulator because it can able to start and stop the packet transmission at the specified time[9-11].

We have taken nodes range in the scenario as 20, 30, 40, 50, 60 and the source node is 0 and the destination node is 2. Node 2 is moving in nature, so path to the destination is changing every time. The following figures Figure 1, 2, 3, 4, 5 will be showing creation of nodes in the scenario.

Thus the nodes have been created in the scenario and then the transmission is also done between the nodes 0 and 2. Then these 3 protocols were compared based on 3 functional parameter metrics given below.

Figure 1. Creation of 20 nodes in the scenario.

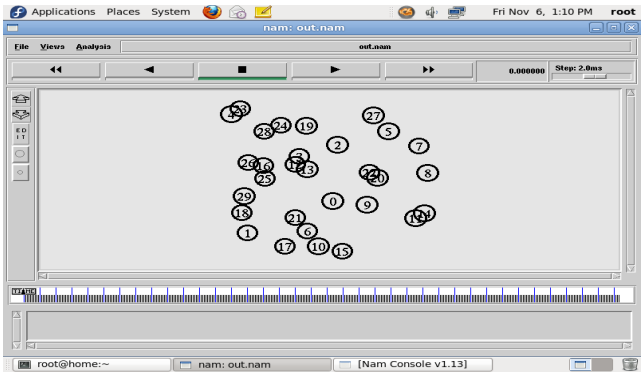

Figure 2. Creation of 30 nodes in the scenario.

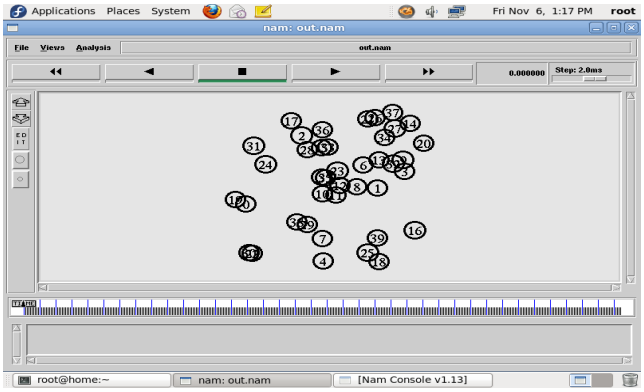

Figure 3. Creation of 40 nodes in the scenario.

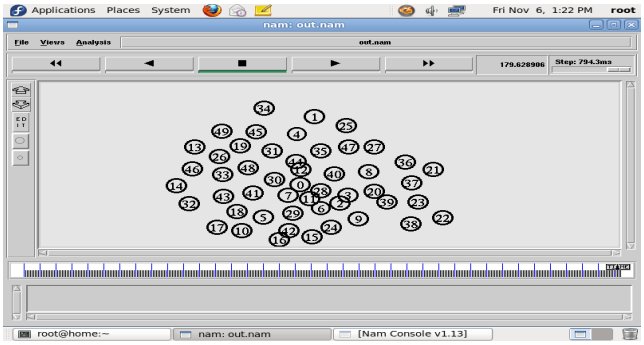

Figure 4. Creation of 50 nodes in the scenario.

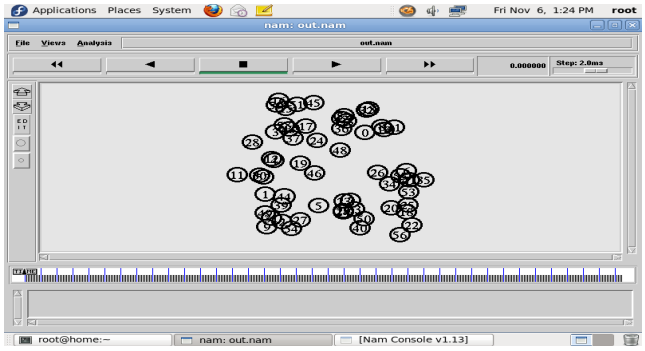

Figure 5. Creation of 60 nodes in the scenario.

3.1 Packet Delivery Ratio:

Packet Delivery Ratio (PDR) is defined as the ratio of how much of packets sent by the source to the how muchof packets received by the destination. The measurement of loss rate is done here. For a good network connectivity, a great packet delivery ratio is needed.

3.2 End-to-End Delay:

End-to-End delay is defined as the average network time that the network forwards the packet from the source to the destination. This includes all the delaysthat are available inthe network.

3.3 Control Overhead:

Control overhead is defined as the extra time that it takes to transmit the data on aswitched network. Some packets usually requires the extra formatting information which decreases the overall transmission speed of theraw data.

Now the performance metrics for the three protocols to the scenarios with changing number of nodes are given in the following Figure 6, 7, 8, 9, 10. At first, AODV protocol is used in the changing scenario and the performance metrics are simulated as follows

Similarly, by changing the number of nodes in the scenario. We can get the following results.

Secondly, by using DSDV protocol in the changing scenario, the performance metrics results are given in the following Figure 11, 12, 13, 14, 15.

Then, at last, by using the DSR protocol in the changing scenario, the performance metrics results have been given in the following Figure 16, 17, 18, 19, 20.

Thus, the protocols such as AODV, DSDV, DSR have been simulated in the scenario of changing number of nodes and got the performance metrics also. The following will give the performance comparison of the three

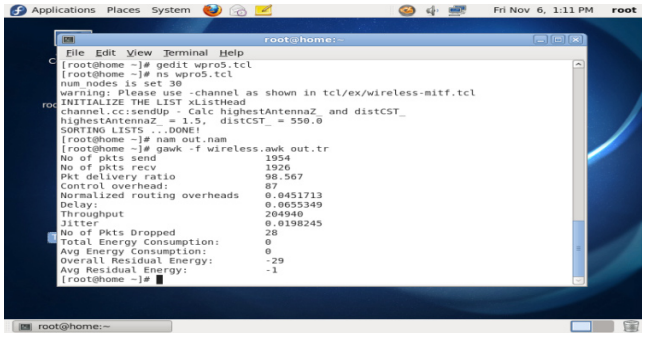

Figure 7. Performance metrics of AODV protocol when the number of nodes is 30.

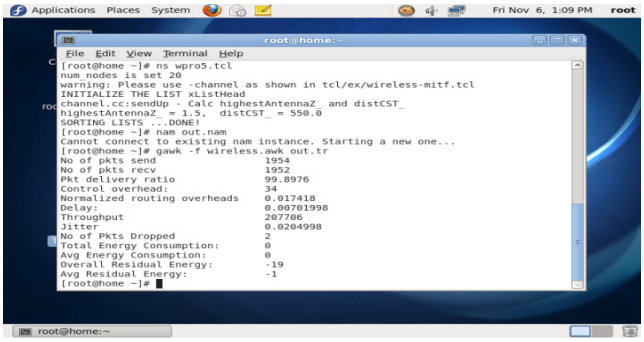

Figure 6. Performance metrics of AODV protocol when the number of nodes is 20.

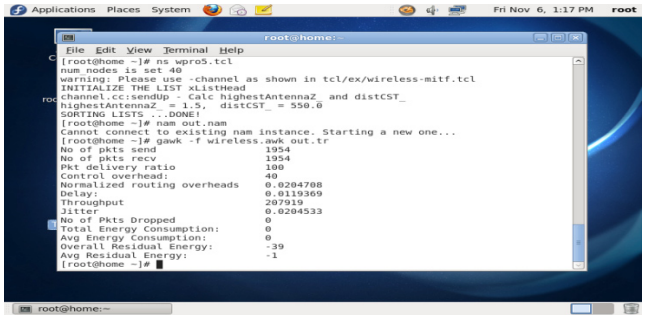

Figure 8. Performance metrics of AODV protocol when the number of nodes is 40.

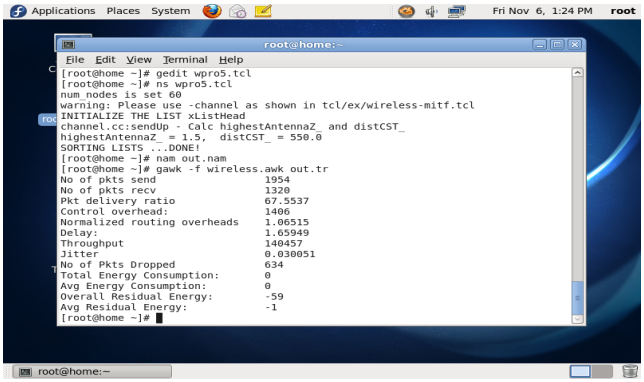

Figure 10. Performance metrics of AODV protocol when the number of nodes is 60.

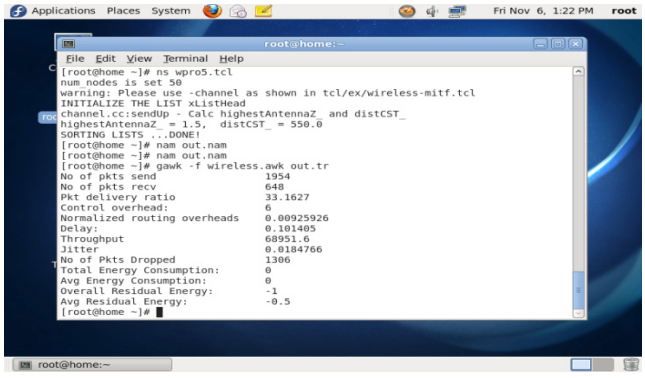

Figure 9. Performance metrics of AODV protocol when the number of nodes is 50.

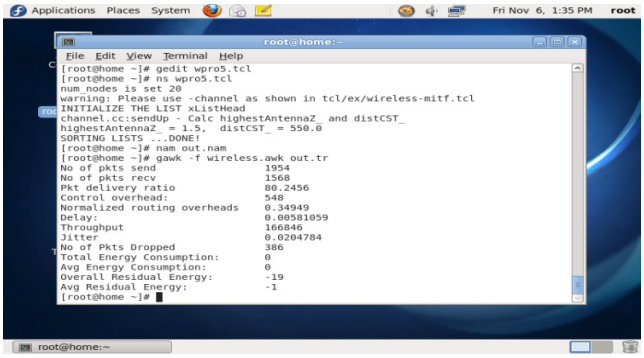

Figure 11. Performance metrics of DSDV protocol when the number of nodes is 20.

protocols by its end to end delay, packet delivery ratio and the control overhead with respect to the changing number of nodes.

The tabulations are given in the following Table. 1, 2, 3.

Performance comparison of the three protocols by the graphical representation is shown in Figure 21, 22,23.

By comparing the packet delivery ratio of the three protocols, DSR and AODV routing protocols can deliver more packets than DSDV routing protocol. The comparison of the three protocols by its end to end delay implies that end to end delay is outrageous in AODV followed by DSR and DSDV, which have the lowest and most stable End to End Delay in mobility. By increasing number of nodes, increases the end to end delay in AODV. In DSR and DSDV, there is slightly lower delay compared to AODV. The comparison of three protocols by its control

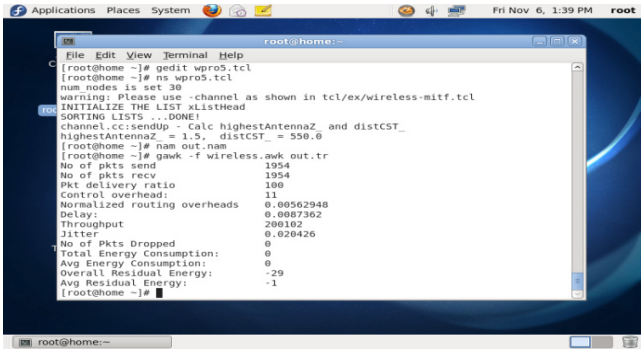

Figure 12. Performance metrics of DSDV protocol when the number of nodes is 30.

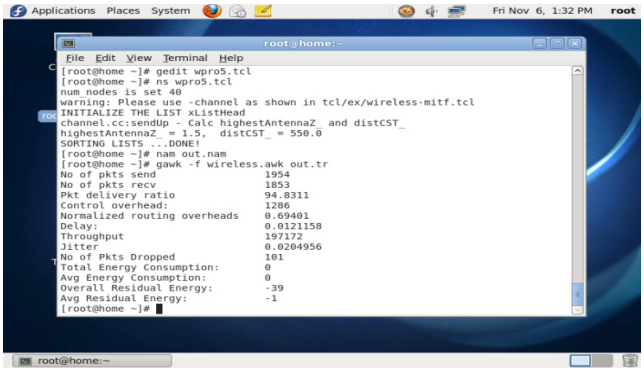

Figure 13. Performance metrics of DSDV protocol when the number of nodes is 40.

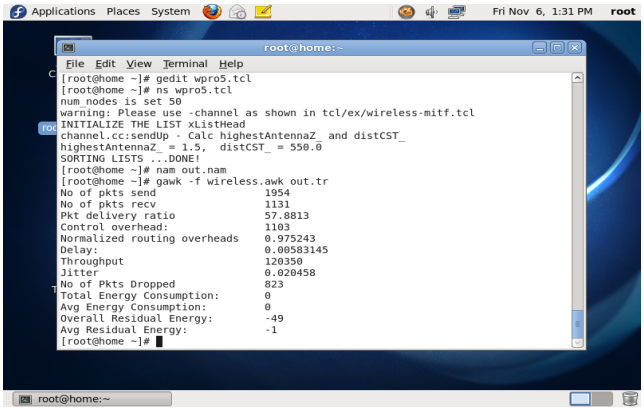

Figure 14. Performance metrics of DSDV protocol when the number of nodes is 50.

overhead shows that DSDV has huge control overhead because it updates the routing table periodically in the network. Then AODV is slightly lower than the DSR and DSDV, because it is having lower control overhead than the two other routing protocols.

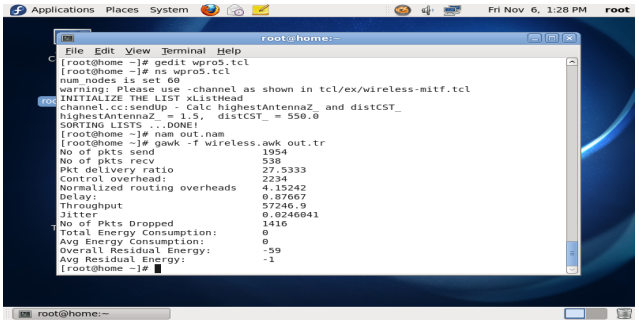

Figure 15. Performance metrics of DSDV protocol when the number of nodes is 60.

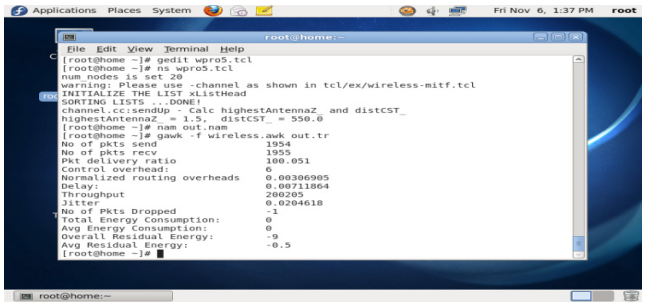

Figure 16. Performance metrics of DSR protocol when the number of nodes is 20.

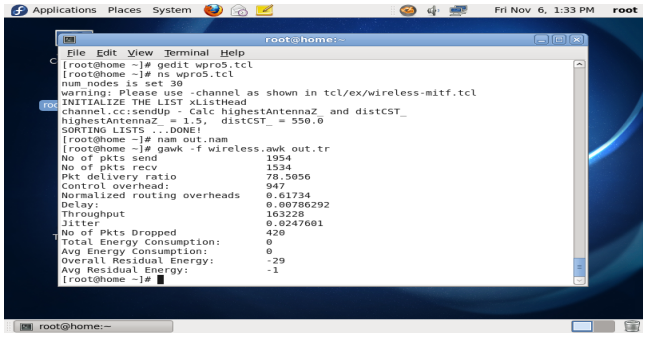

Figure 17. Performance metrics of DSR protocol when the number of nodes is 30.

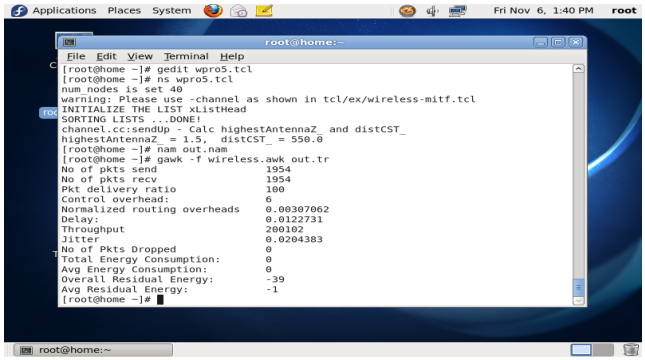

Figure 18. Performance metrics of DSR protocol when the number of nodes is 40.

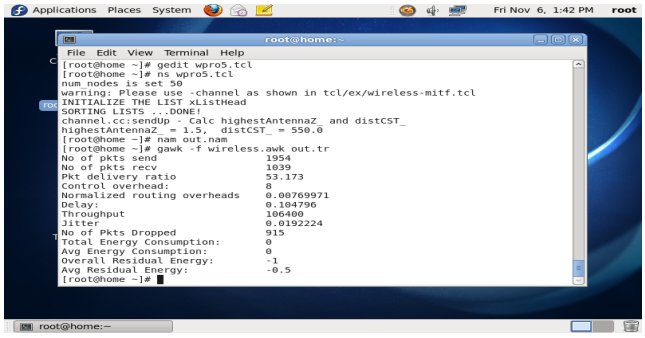

Figure 19. Performance metrics of DSR protocol when the number of nodes is 50.

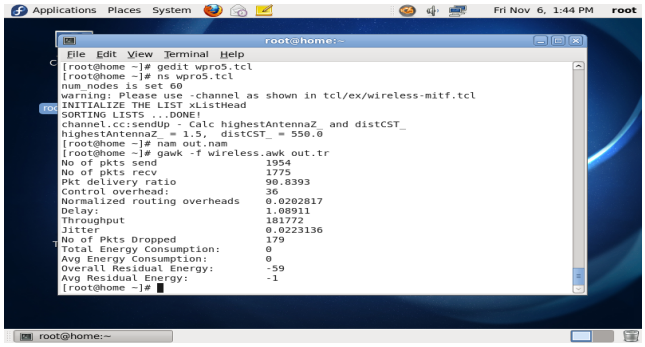

Figure 20. Performance metrics of DSR protocol when the number of nodes is 60.

Table 1. Performance metrics for AODV protocol

AODV PROTOCOL			
No. of nodes	Packet Delivery Ratio	End to end delay	Overhead
20	99.8976	0.00701998	34
30	98.567	0.0655349	87
40	100	0.0119369	40
50	88.6387	0.6616	103
60	67.5537	1.65949	1406

Table 2. Performance metrics for DSDV protocol

DSDV PROTOCOL			
No. of nodes	Packet Delivery Ratio	End to end delay	Overhead
20	80.2456	0.00581059	548
30	78.5056	0.00786292	947
40	94.8311	0.0121158	1286
50	51.433	0.0221576	1814
60	27.5333	0.87667	2234

Table 3. Performance metrics for DSR protocol

DSR PROTOCOL			
No. of nodes	Packet Delivery Ratio	End to end delay	Overhead
20	100.051	0.00711864	6
30	100	0.0087362	11
40	100	0.0122731	6
50	99.6929	0.154969	126
60	90.8393	1.08911	36

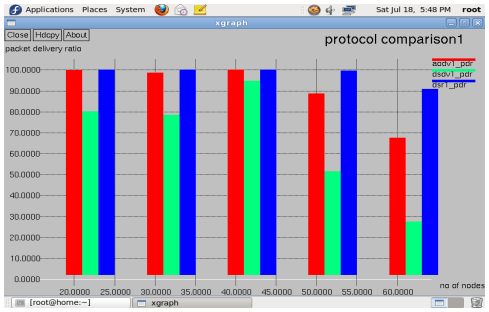

Figure 21. Packet Delivery Ratio Vs number of nodes.

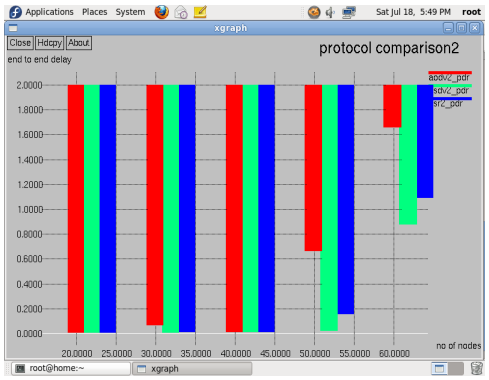

Figure 22. End to end delay vs. number of nodes.

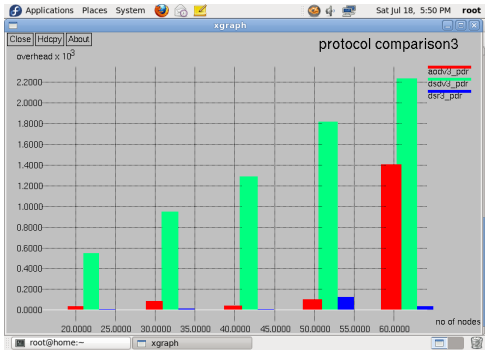

Figure 23. Control overhead Vs number of nodes.

4. Conclusion

From all the tabulations and graphs, it is clear that AODV and DSR are performing their best at their less packet sizes and at their less number of nodes in the scenario. DSDV protocol is not as good as the DSR and AODV because it has a very low packet delivery ratio. But it is having high control overhead. By comparing the end to end delay, DSR protocol is performing best then other protocols.

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