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Ccomparison Of AODV With TORA and DSDV Routing Protocols In AD HOC Networks

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1. Introduction

The rapid development of technology has resulted increase in the applications of Personal Digital Assistants devices such as tabs, mobile phones ect. which made wireless networks a necessity for these devices to communicate and exchange data efficiently. One of the major types of wireless networks is Mobile Ad-Hoc networks. Mobile Ad hoc Networks (MANETs) is a type of wireless networks which consist of a collection of wireless mobile nodes forming a self-configured and self-organized network without any need for using existing infrastructure or centralized administration.

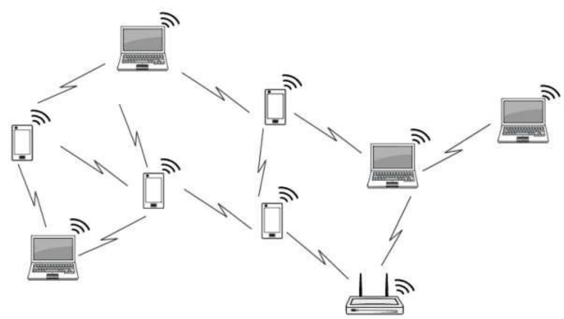

Figure 1.1: MANETs Communication Model

In this report,we will be providing a comparison of the performance MANETs routing protocols AODV with TORA,DSDV over IEEE 802.11.

2. Setup and Results discussion

Routing is one of the challenges in networks for sending data from source node to destination node due to high dynamic topology changes, limited resources(bandwidth ,memory ,CPU), link failure caused by node mobility, limited battery power on mobile nodes, energy consumption due to routing computation etc.[?] Therefor routing protocols algorithms are proposed to overcome most of the MANETs challenges .The main method for evaluating the performance of a routing protocol of MANETs is simulation. The choice of similator for AODV,DSDV,TORA routing protocols is NS2. The performance is recorded taking different number of nodes. The nodes are placed randomly in the network with random way point model of movement with packet size of 256 bytes. The resulted parameter leads to the conclusion that one specific routing protocol performs better or otherwise worst. Those parameters are as follows:

- Packet Delivery Ratio which is calculated as :

$$\frac{Numberofpacketreceived}{Numberofpacketsent}$$

- Average end-to-end delay which is calculated as :

$$\frac{Durationofpacket}{TotalNumberofConnections}$$

- Throughput (Kbps) which is calculated as :

$$\frac{TotalPacketSizeReceived \times 8}{Totalsimulationtime}$$

2.1 AODV TORA comparison

To evaluate the performance of the routing protocols AODV and TORA we executed two simulation scenarios. In these scenarios we compared routing protocols under IEEE 802.11 using node density 5,10,15,20 with mobility speed in the interval [0,5] m/s in the first scenario,and [0,20] m/s in the second scenario to observe the effects of speed on the efficiency of the routing protocol. Network size is 500x500m with the addition of other changing parameters described in the next sections. The evaluation of performances in terms of the End-to-End delay(sec) , throughput (bits/sec) , Packet Delivery Ratio.

2.1.1 Scenario -1: small zone /low mobility

The following table gives the simulation parameters used during the simulation for the scenario 1.

Parameter	value
Propagation	Two Ray Model
Antenna model	Omni Antenna
Simulation time (sec)	100
Wireless nodes number	5,10,15,20,30
Nodes speed (m/s)	[0,5]
Mac layer protocol	IEEE 802.11
Channel settings	auto configuration
Transmission range	250 m
Network size	500x500
Number of connections	Numberofnodes/2
Packet size	256 bytes
Queue length	50 packets

2.1.1.1 Results discussion

The following figures show the observed behavior of AODV and TORA protocols with respect to varying number of nodes.

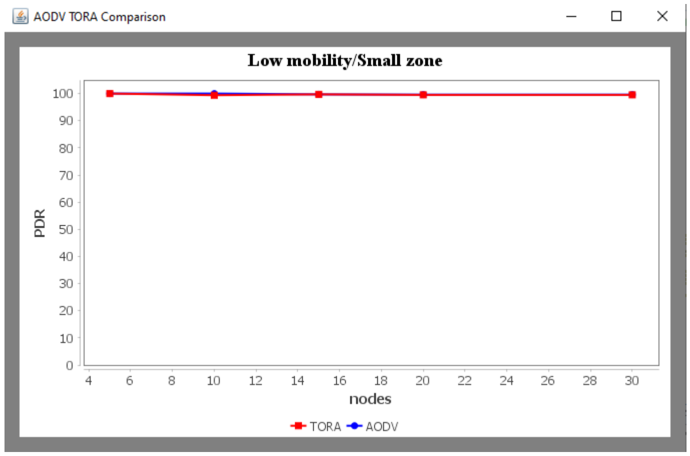

Figure 2.1: Packet Delivery Ratio for scenario 1-1 in function of Node Density

The figure 2.1 represents PDR in function of varying number of nodes. It is clear that both AODV and TORA have PDR that reaches 100 % due to predictable topology which is a result of low mobility,which means it is rare for a node to exit the communication range.

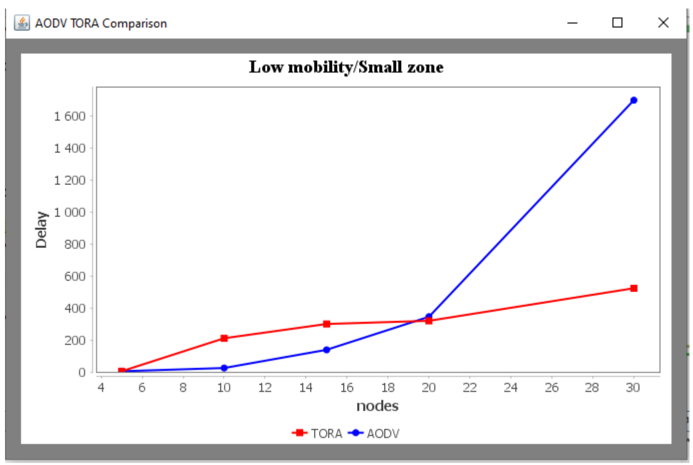

Figure 2.2: End to End Delay for scenario 1-1 in function of Node Density

The figure 2.2 shows End-to-End delay of each transmitted data packets during the simulation time as a function of node density. From the graph, we can observe that AODV protocol has a minimum E2E-delay when the number of nodes is less than 20 because of the choice of optimal next hop and the small size of network,however TORA performance in that interval was less because of the computation of links, in addition to the fact that TORA does not have priority for the shortest path which resulted the higher delay. In the second interval,[20,30] we notice that AODV's delay increased,because of the increasing size of network which results more queuing,more routing,more hops which resulted the delay,while in TORA the delay is smaller because of the random input of nodes,which have resulted them to be close to each other, resulting less hops than AODV.

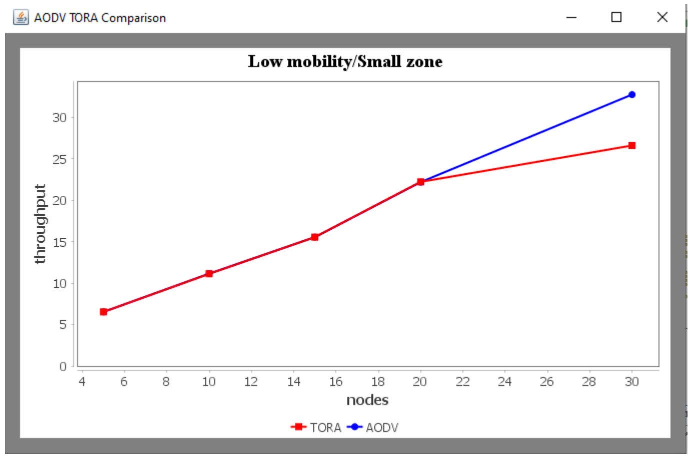

Figure 2.3: Throughput for scenario 1-1 in function of Node Density

The figure 2.3 demonstrates the throughput in (bits/sec) was calculated for TORA,AODV protocols as a function of node density. we observed that for both protocols the throughput increases with node density increase.

2.1.2 Scenario -2: small zone /High mobility

The following table gives the simulation parameters used during the simulation for the scenario 2.

Parameter	value
Propagation	Two Ray Model
Antenna model	Omni Antenna
Simulation time (sec)	100
Wireless nodes number	5,10,15,20,30
Nodes speed (m/s)	[0,20]
Mac layer protocol	IEEE 802.11
Channel settings	auto configuration
Transmission range	250 m
Network size	500x500
Number of connections	Numberofnodes/2
Packet size	256 bytes
Queue length	50 packets

2.1.2.1 Results discussion

The following figures show the observed behavior of AODV and TORA protocols with respect to varying number of nodes for the high mobility scenario.

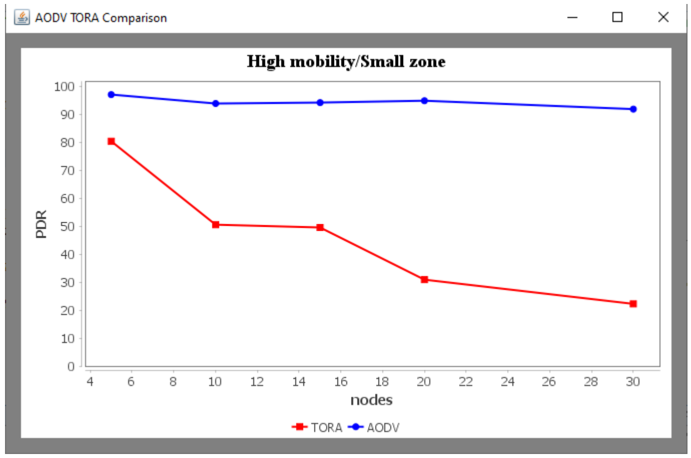

Figure 2.4: Packet Delivery Ratio for scenario 2-1 in function of Node Density

The figure 2.4 demonstrates the PDR percentage for TORA,AODV protocols as a function of node density. We notice that AODV protocol performs better under the high speed of nodes,while TORA has low performance in high mobility scenario. The reason for TORA's low performance is the computation of heights especially in a high mobility network,and the difficulty of finding the optimal next hop.

while AODV responds quickly to the topological changes in the network and updating only the nodes that may be affected by the change, using the RRER message. The Hello messages, which are responsible for the route maintenance, are also limited so that they do not create unnecessary overhead in the network.

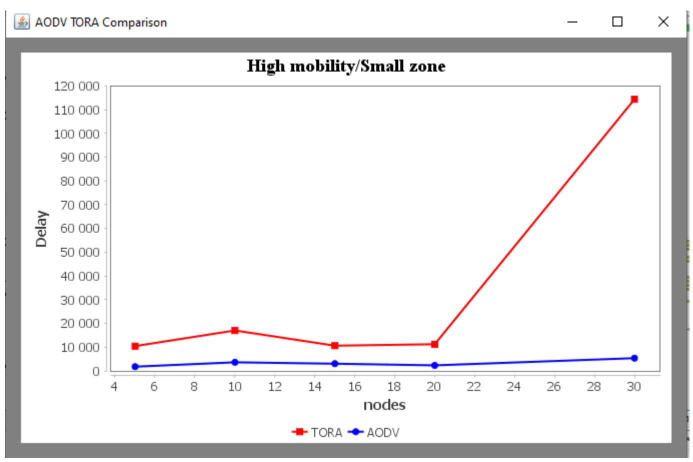

Figure 2.5: End to End Delay for scenario 2-1 in function of Node Density

The figure 2.5 shows End-to-End delay of each transmitted data packets during the simulation time as a function of node density. We observe from the graph that TORA's performances are low when it comes to Delay,which is a result for not being able to find the shortest path to the destination,or the best next hop.While AODV results better performances in delay because of path updates,and the choice of the optimal route to the destination.

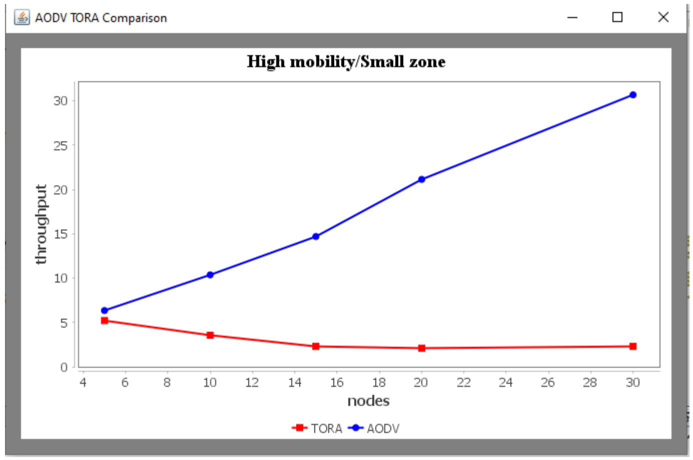

Figure 2.6: Throughput for scenario 2-1 in function of Node Density

The figure 2.6 demonstrates the throughput in (bits/sec) was calculated for TORA,AODV protocols as a function of node density. We notice the increase of throughput for AODV which indicates the success rate of packets arrival,while TORA's throughput decreases because of packet loss and low pdr.

2.2 AODV DSDV comparison

In this section,we will be comparing the performances for the reactive routing protocol AODV,and the proactive routing protocol DSDV executing four simulation scenarios. In these scenarios we compared routing protocols under IEEE 802.11 using node density 10,20,30,60,80,100 with mobility speed in the interval [0,5] m/s in the low mobility scenarios,and [0,20] m/s in the high mobility scenarios to observe the effects of speed on the efficiency of the routing protocol. Network size is 500x500m for the small zone scenarios, and 1000x1000m in the large zone scenarios.

2.2.1 Scenario -1: small zone /Low mobility

The following table gives the simulation parameters used during the simulation for the scenario 1.

Parameter	value
Propagation	Two Ray Model
Antenna model	Omni Antenna
Simulation time (sec)	100
Wireless nodes number	10,20,30,60,80,100
Nodes speed (m/s)	[0,5]
Mac layer protocol	IEEE 802.11
Channel settings	auto configuration
Transmission range	250 m
Network size	500x500
Number of connections	Numberofnodes/2
Packet size	256 bytes
Queue length	50 packets

2.2.1.1 Results discussion

The following figures show the observed behavior of AODV and DSDV protocols with respect to varying number of nodes for the low mobility/small zone scenario.

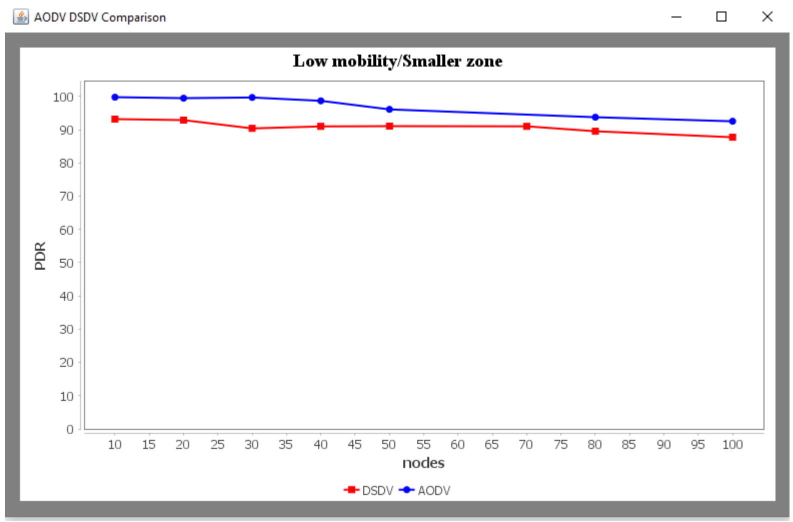

Figure 2.7: Packet Delivery Ratio for scenario 1-2 in function of Node Density

The figure 2.7 demonstrates the PDR percentage for DSDV,AODV protocols as a function of node density. We notice that AODV protocol has high PDR,while DSDV has considerable but inferior PDR because of the increasing overhead with the inscrease of number of nodes.

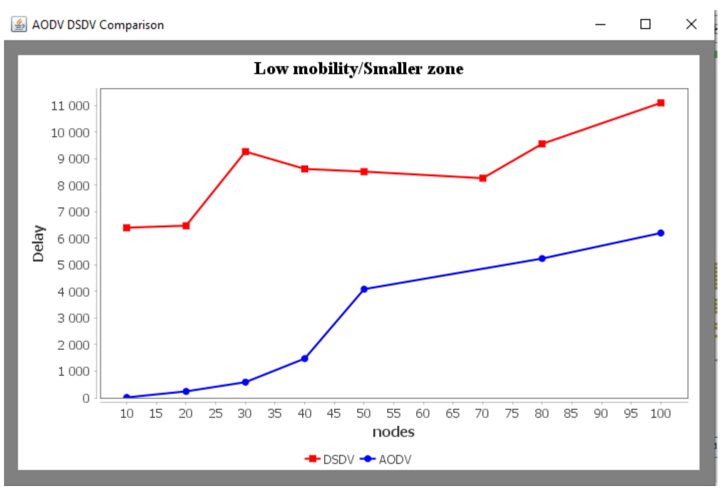

Figure 2.8: End to End delay for scenario 1-2 in function of Node Density

The figure 2.8 shows End-to-End delay of each transmitted data packets during the simulation time as a function of node density. We notice from the graph the increase of DSDV delay,while AODV increase delay still inferior than DSDV. The reason for DSDV considerable delay is the increasing volume of the routing tables which results more computation for the routes. AODV is less in comparison to DSDV since it is a reactive protocol,and routes are created on demand which is a faster process in this scenario.

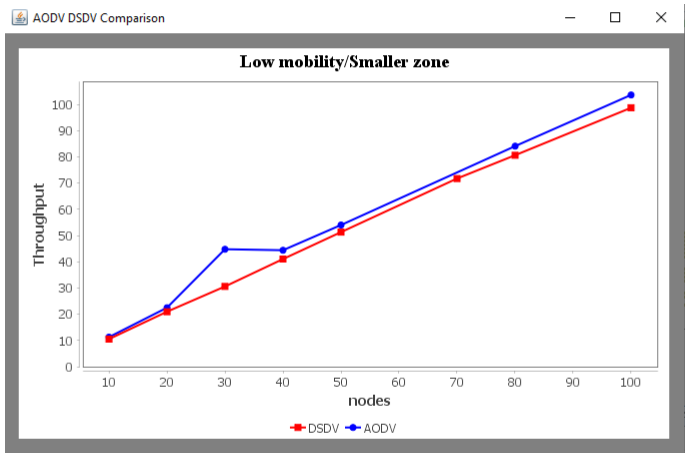

Figure 2.9: Throughput for scenario 1-2 in function of Node Density

The figure 2.9 demonstrates the throughput in (bits/sec) was calculated for DSDV,AODV protocols as a function of node density. It shows similar results,however AODV's throughput is superior because of the higher PDR,while in DSDV more packets are sent and get dropped, therefore, it has low throughput as compared to AODV.

2.2.2 Scenario -2: small zone /High mobility

The following table gives the simulation parameters used during the simulation for the scenario 1.

Parameter	value
Propagation	Two Ray Model
Antenna model	Omni Antenna
Simulation time (sec)	100
Wireless nodes number	10,20,30,60,80,100
Nodes speed (m/s)	[0,20]
Mac layer protocol	IEEE 802.11
Channel settings	auto configuration
Transmission range	250 m
Network size	500x500
Number of connections	Numberofnodes/2
Packet size	256 bytes
Queue length	50 packets

2.2.2.1 Results discussion

The following figures show the observed behavior of AODV and DSDV protocols with respect to varying number of nodes for the high mobility/small zone scenario.

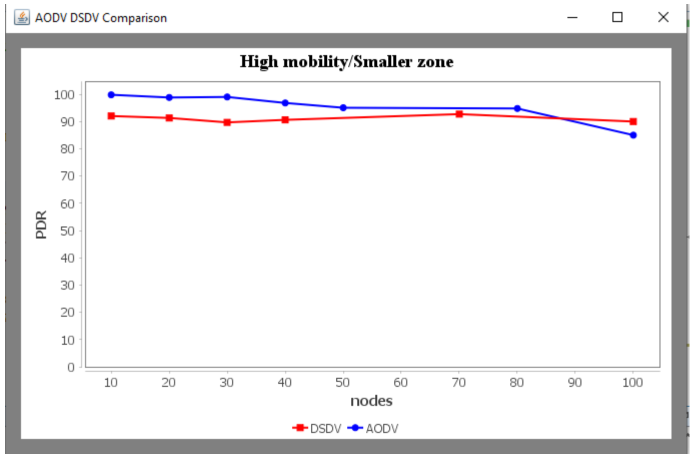

Figure 2.10: Packet Delivery Ratio for scenario 2-2 in function of Node Density

The figure 2.10 demonstrates the PDR percentage for DSDV,AODV protocols as a function of node density. We notice that AODV protocol has higher PDR when less than 80 nodes,while DSDV kept stable performances around 90% during the simulation. For AODV,PDR decreases as the number of nodes is increased,As the packets move from to destination the collision between packets occur due to traffic causing loss of packets. Moreover, the mobility of nodes may lead nodes to move out of network and thus the packets can't reach the desired node.

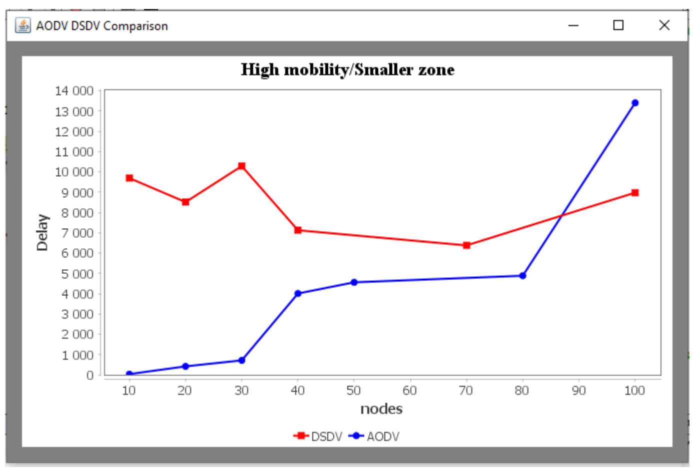

Figure 2.11: End to End Delay for scenario 2-2 in function of Node Density

The figure 2.11 shows End-to-End delay of each transmitted data packets during the simulation time as a function of node density. We notice that DSDV has superior delay than AODV when number of nodes is less than 80. The reason for DSDV's huge delay is computation of routes,while in AODV has inferior delay,however when passes 80 nodes,it increases because of collisions which cause loss of packets and re-transmissions.

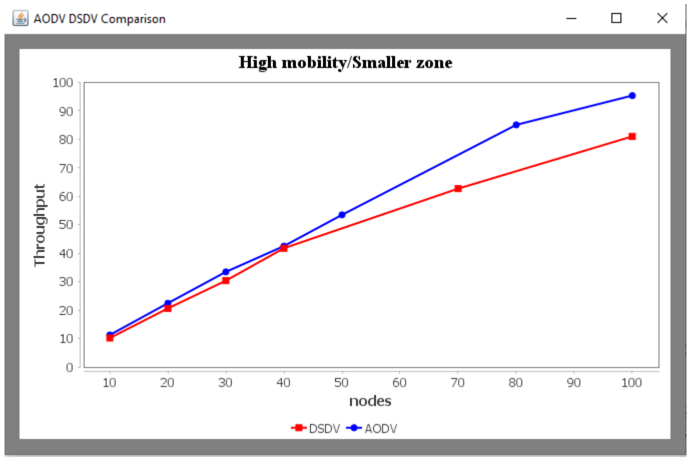

Figure 2.12: Throughput for scenario 2-2 in function of Node Density

The figure 2.12 demonstrates the throughput in (bits/sec) was calculated for DSDV,AODV protocols as a function of node density. We observe that DSDV performs less when it comes to throughput, the reason is as the number of nodes increases, more routing information will be transmitted, consuming a portion of the useful throughput bandwidth. Thus, reducing the throughput.

2.2.3 Scenario -3: Large zone /High mobility

The following table gives the simulation parameters used during the simulation for the scenario 1.

Parameter	value
Propagation	Two Ray Model
Antenna model	Omni Antenna
Simulation time (sec)	100
Wireless nodes number	10,20,30,60,80,100
Nodes speed (m/s)	[0,20]
Mac layer protocol	IEEE 802.11
Channel settings	auto configuration
Transmission range	250 m
Network size	1000x1000
Number of connections	Numberofnodes/2
Packet size	256 bytes
Queue length	50 packets

2.2.3.1 Results discussion

The following figures show the observed behavior of AODV and DSDV protocols with respect to varying number of nodes for the high mobility/large zone scenario.

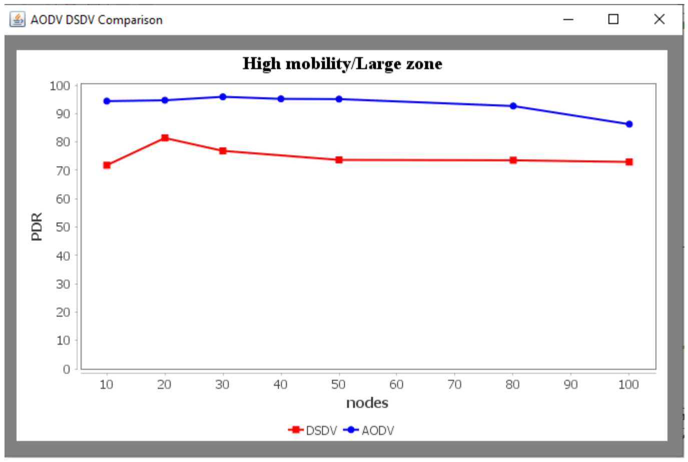

Figure 2.13: Packet Delivery Ratio for scenario 3-2 in function of Node Density

The figure 2.13 demonstrates the PDR percentage for DSDV,AODV protocols as a function of node density. We notice from the graph,that AODV outperformed DSDV in a high mobility and large zone environment because of the efficiency of route maintenance,while in DSDV the routing is more difficult since mobile nodes exit the transmission range quickly which may result sending the data packets before convergence of routes.

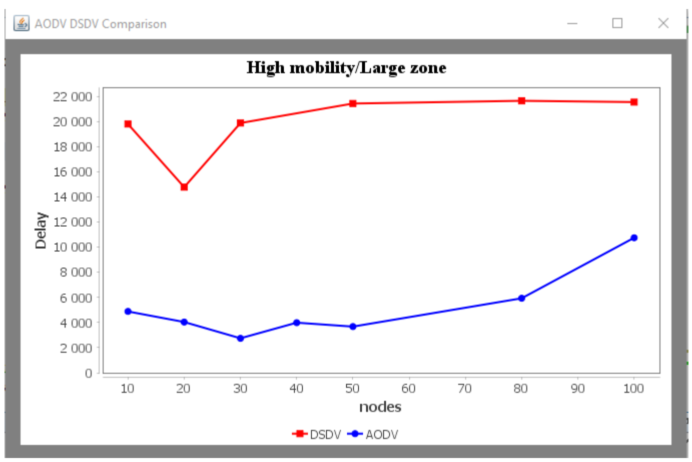

Figure 2.14: End to End delay scenario 3-2 in function of Node Density

The figure 2.14 shows End-to-End delay of each transmitted data packets during the simulation time as a function of node density. From the graph we observe that DSDV has less optimal delay,which is because of route computation since the protocol is table driven and packets loss.while AODV has the optimal delay.

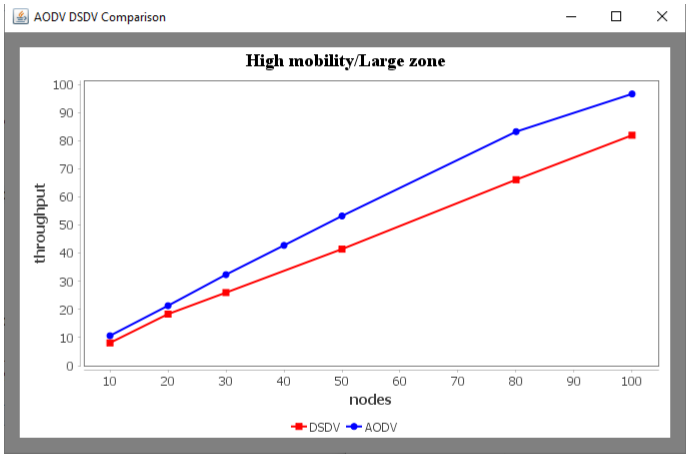

Figure 2.15: Throughput scenario 3-2 in function of Node Density

The figure 2.15 demonstrates the throughput in (bits/sec) was calculated for DSDV,AODV protocols as a function of node density. We observe from the graph that DSDV has inferior throughput than AODV which is because of low PDR,and packets loss.

2.2.4 Scenario -4: Large zone /Low mobility

The following table gives the simulation parameters used during the simulation for the scenario 1.

Parameter	value
Propagation	Two Ray Model
Antenna model	Omni Antenna
Simulation time (sec)	100
Wireless nodes number	10,20,30,60,80,100
Nodes speed (m/s)	[0,5]
Mac layer protocol	IEEE 802.11
Channel settings	auto configuration
Transmission range	250 m
Network size	1000x1000
Number of connections	Numberofnodes/2
Packet size	256 bytes
Queue length	50 packets

2.2.4.1 Results discussion

The following figures show the observed behavior of AODV and DSDV protocols with respect to varying number of nodes for the low mobility/large zone scenario.

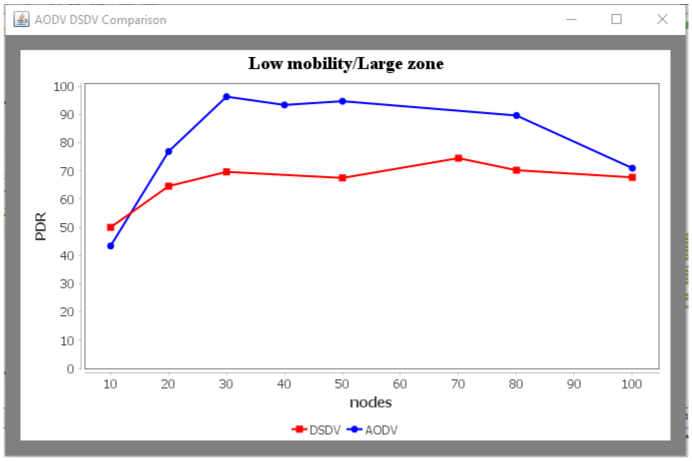

Figure 2.16: Packet Delivery Ratio for scenario 4-2 in function of Node Density

The figure 2.16 demonstrates the PDR percentage for DSDV,AODV protocols as a function of node density. From the graph we observe the increase in PDR, which is because of increase of number of nodes which allowed more next hops,we notice after that a decrease which is caused by collisions and packets loss. While DSDV kept a slight increase in the beginning which is caused by increase of next hops,then kept stable performance during the simulation.

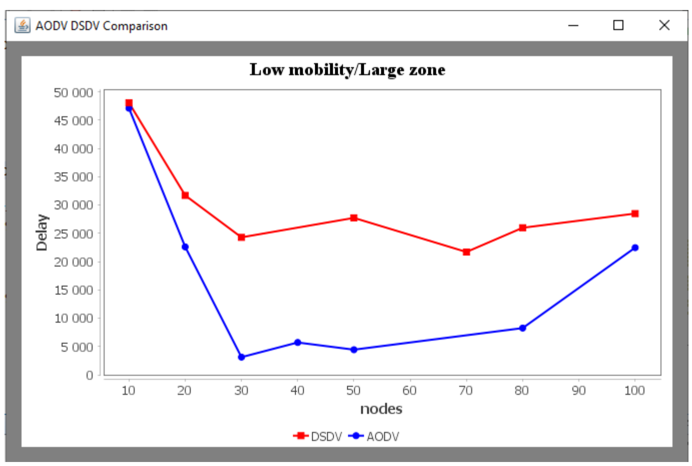

Figure 2.17: End to End Delay for scenario 4-2 in function of Node Density

The figure 2.17 shows End-to-End delay of each transmitted data packets during the simulation time as a function of node density. From the graph we notice that both protocols had considerable delays in the beginning which is because of lack of nodes in the transmission range,then decreases with more nodes in the range. We notice that AODV outperforms DSDV in delay,The reason for superior delay for DSDV is packets loss,route breakage.

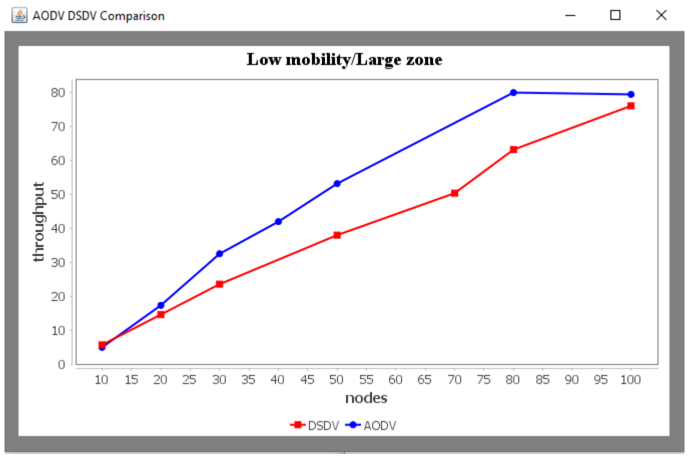

Figure 2.18: Throughput for scenario 4-2 in function of Node Density

The figure 2.18 demonstrates the throughput in (bits/sec) was calculated for DSDV,AODV protocols as a function of node density. From the graph we observe that AODV has higher throughput because of higher PDR,and less packet loss than DSDV.

3. Conclusion

In this report, we demonstrated a comprehensive performance evaluation of MANETs routing protocols such as proactive (DSDV), reactive (AODV, TORA). The performance evaluation calculated in terms of various performance parameters such as average end to end delay, throughput, packet delivery ratio. The simulation results suggest that each protocol performs well in some scenario yet has some drawbacks in other cases. In terms of throughput, AODV performance is better than others whereas, TORA and DSDV perform poorly sometimes. Another disadvantage of DSDV is that the number of dropped packets is also significantly higher,and the enormous delay for TORA's routing protocol.

Bibliography