Performance Analysis of AODV, DSDV and DSR MANET Routing Protocols using NS-2

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Abstract

Essentially, an ad hoc network is a collection of wireless mobile nodes that form a temporary network dynamically without the use of existing network infrastructures. Several routing protocols such as Dynamic Source Routing (DSR), Ad Hoc on-Demand Distance Vector Routing (AODV) and Destination-Sequenced Distance Vectors (DSDV) have been implemented. MANETs are able to support both large and small scale network topology. In this paper, we have analyzed the comparative performance of AODV, DSDV and DSR routing protocols in different wireless sensor network scenarios using various performance metrics like no. of dropped packets, end to end delay and throughput. Using NS2 simulation we observed that AODV protocol performs better than DSDV and DSR in grid topology.

Keywords – AODV, DSR, DSDV, NS-2, MANET.

1. Introduction

Wireless sensor network consists of large number of selforganized autonomous sensor nodes. Nodes of these networks are able to move and synchronize with their neighbors. Mobility allows connections in the network to change dynamically, and nodes can be added and removed at any time. As an indispensable part of the ad-hoc network, routing protocol assists the sensor nodes to discover multi-hop paths and to forward packages to destinations correctly. As a result, it greatly affects the performance of the entire network. In this paper, we analyze and compare the performance of three prevalent MANET protocols i.e. AODV (Ad-hoc On-Demand Distance Vector), DSDV (Destination Sequence Distance Vector)and DSR (Dynamic Source Routing) using Network Simulator 2.

2. Previous Work

Various Researches have been done in MANET routing protocols with various performance matrices. Some of them which influences and motivated us towards this research study are as follows:

[I] J. Rahman, M. Hasan and M. Islam studied and showed the performance comparison of MANET routing protocols in 2012 and observed that DSDV perform better in the high density networks or the network.

[II] I. Vijaya and A. Rath, studied and analyzed that the performance of the network in 2011 and observed that Correlation between the two sets of results is found to be satisfactory enough to validate the simulation process.

[III] Gupta, M. and Kumar, S done the simulation and comparison of MANET routing protocols in Ad Hoc networks in 2015 and observed that DSR have minimum packet loss than AODV and DSDV.

[IV] Sureshkumar, A., Ellappan, V. and Manivel, K. analyzed the performance of MANET protocols in 2017 and observed that AODV continues enhancing with denser mediums and at quicker speeds.

3. Routing Protocols in MANET

IETF developed protocol for Mobile Ad hoc Network. In MANET, there are two types of MANET routing protocols – proactive (DSDV) and reactive (DSR and AODV). The brief details of such protocols are as follows:

3.1 Destination Sequenced Distance Vector (DSDV)

DSDV stands for Destination Sequenced Distance Vector. In this type of protocol each node contains a routing table containing all the routes for each node in the network. Each routing table contains two matrices hop count and neighbor. The DSDV maintain routes in its routing tables that are not being utilized. Routing tables are requested from neighbors periodically, and the routes are updated as necessary. Advantage of DSDV is that it avoids loop formation; DSDV contains sequence number in each routing table in the order of information of routing. The routes that possess the more new number of sequence are used. In case the sequence number is older the packet is discarded. Disadvantage of DSDV is it overloaded with routing information due to periodically routes updating. The DSDV serves like base of operation of others protocols.

3.2 Ad-hoc On-demand Distance Vector (AODV)

AODV protocol stands for on demand routing protocol. AODV combines the capabilities of Route Discovery and Route Maintenance. Only routes between nodes that are desired by source nodes are built, and these routes are maintained as long as source nodes need them. When a link fails, an intermediate forwarding node can initiate a route rediscovery to the destination. This process is typically known as “local repair,” in which the intermediate node upstream of the link failure sends out a RREQ, the TTL of which is set to the remaining hop distance to the destination, added with an increment value. During route rediscovery, data packets are buffered at this node and sent after the route is repaired. If after some timeout, no route to the destination could be found, the buffered data packets would be dropped, and a Route Error (RERR) message would be sent to the source, which then attempts a source-initiated route discovery.

3.3 Dynamic Source Routing (DSR)

DSR stands for Dynamic Source Routing that uses source routing. Each packet that is routed contains an ordered list of nodes that it will pass through. Advantage of DSR is that routing node not need to maintain updated routing information. In DSR, periodic route updates and neighbor detection are eliminated to minimize bandwidth consumption. Route Discovery and Route Maintenance are the two basic mechanisms of DSR operation. The Dynamic Source Routing protocol is a typical example of the on-demand protocols, where each data packet carries in its header the complete ordered list of nodes the packet passes through. This is done by having each node maintain a route cache that learns and caches routes to destinations. Some on-demand routing protocols are extensions of table-driven protocols.

4 Simulation Setup

Following three tools are used to simulate the result:

1. NSG – In Fig 4.1 you will find a Java application that is a NS2 scenarios generator. Wired and wireless TCL scripts can be generated by NSG 2.1 for NS2.Some major functions of NSG2 includes creation of wired and wireless nodes with connection between nodes using links with the implementation of agents and finally creating applications.
2. NS 2 – NS2 stand for Network Simulator 2. The simulator is aimed at networking research [Fig 4.2], provides substantial support for simulation of TCP, routing, and multicast protocols over wired and wireless (local and satellite) networks.
3. Tracegraph – NS2 trace files can be read with tracgraph [Fig 4.3] software. Tracegraph is linux based software used to generate number of dropped packet information, average end to end delay, number of generated packets and number of forwarded packets by reading trace file. When we run tracegraph it opens three windows. The first window is for the selection of trace file (.tr) which is created by NS 2. The second window displays the

graphs for various performance characteristics such as throughput, end-to-end delay and so on in 2D and 3D. third window is for simulation information in which we can see packet delivery information, packed loss, end to end delay information for source, sink and routers.

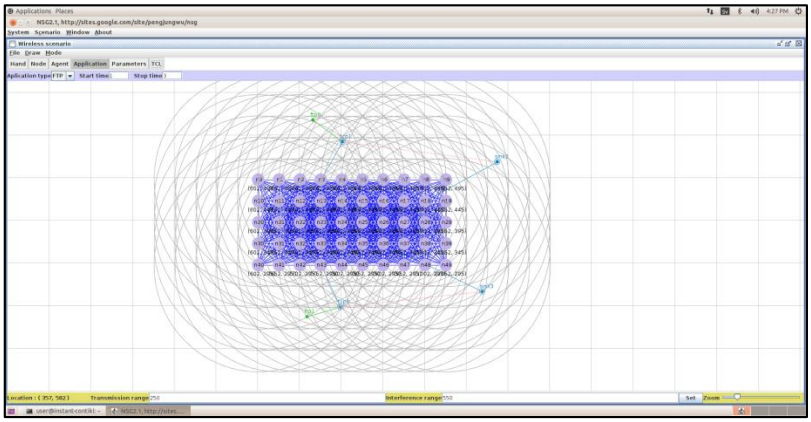

Fig 4.1 – Topology Creation using NSG

TABLE 4.1 - SIMULATION DETAILS

Simulator	NS-2.35
Protocols	DSDV, AODV and DSR
No. of Nodes	10
Topology	Horizontal & Vertical
Simulation Time	100 Seconds
Traffic Type	CBR
Propogation Model	Two Ray ground
Max Packet in Queue	20
MAC Protocol	IEEE 802.11
Packet Size	1000 Bytes
Connection Rate	4 Packets/Sec
Time Interval	0.005 Seconds
Vertical Distance	200
Horizontal Distance	200

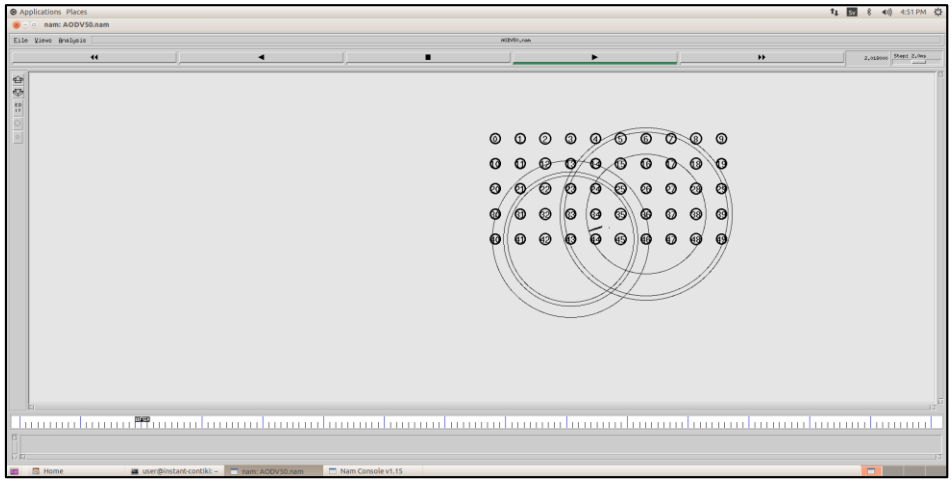

Fig 4.2 – NS-2 Simulation for AODV

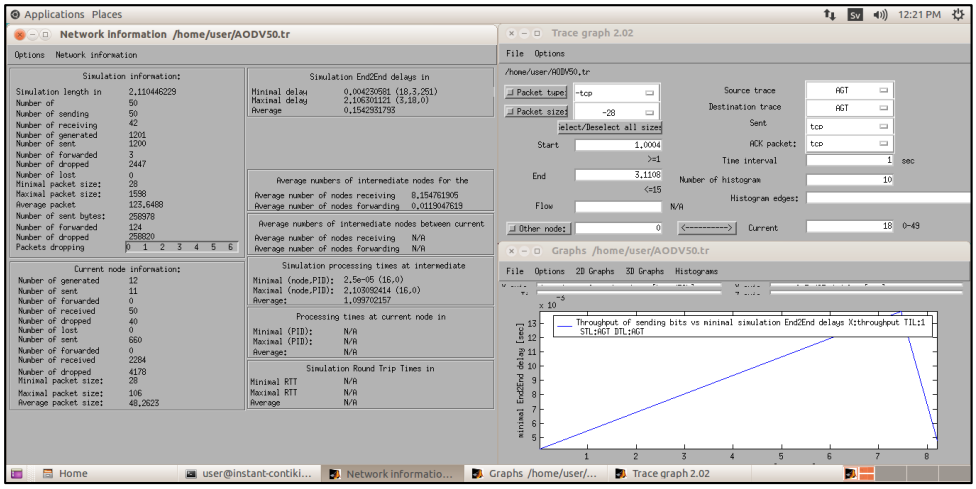

Fig 4.3 – Trace File Reading by Tracegraph Tool

5 Results

Finally our Simulation Results are the outcome of the following performance metrics which applied to compare the routing protocol performances. TABLE 5.2 is showing the Comparison of DSDV, AODV & DSR using performance metrics like Throughput, End to End Delay & No. of Dropped Packets.

[I] Average Throughput: The total data packet transferred from source node to sink node or it should be processed in a specified time period it is measured in kbps. “Fig 5.1” is showing the average throughput of MANET routing protocols. Here throughput of DSR is highest.

[II] Average End to End Delay: It can be defined as a measure of average time taken to transmit each packet of data from the source node to the destination node. “Fig 5.2” is showing the average E2E Delay of MANET routing protocols. The DSDV protocol shows the minimum end-to-end delay in seconds.

[III] Number of Dropped Packets: When a packet of data traveling across a network fails to reach its destination, packet loss occurs. “Fig 5.3” is showing comparison of dropped packets of MANET routing protocols and after simulation observed that packet dropping is less in AODV protocol.

TABLE 5.2 – Comparison of DSDV, AODV & DSR in terms of Throughput, End to End Delay & No. of Dropped Packets

Parameters	DSDV	AODV	DSR
Throughput	117.18 Kbps	125.97 Kbps	152.44 Kbps
End to End Delay	0.154 Sec	0.190 Sec	0.273 Sec
No. of Dropped Packets	2447	663	746

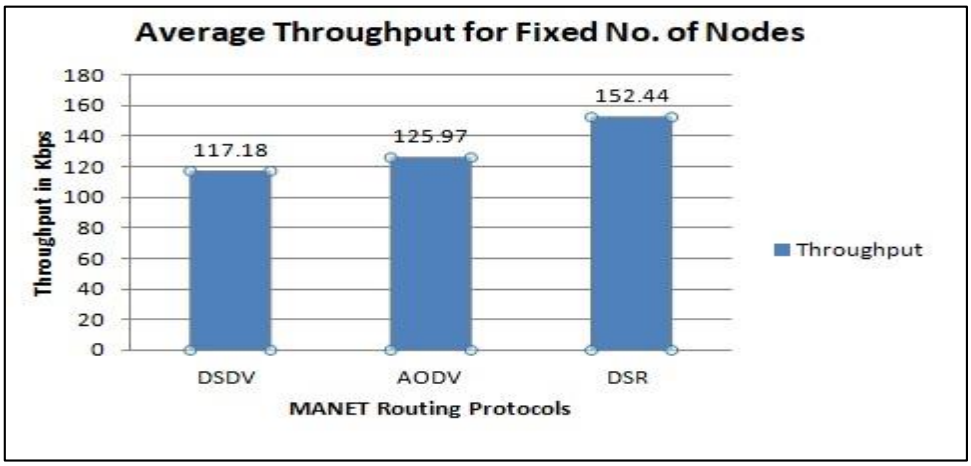

Fig 5.1 Average Throughput

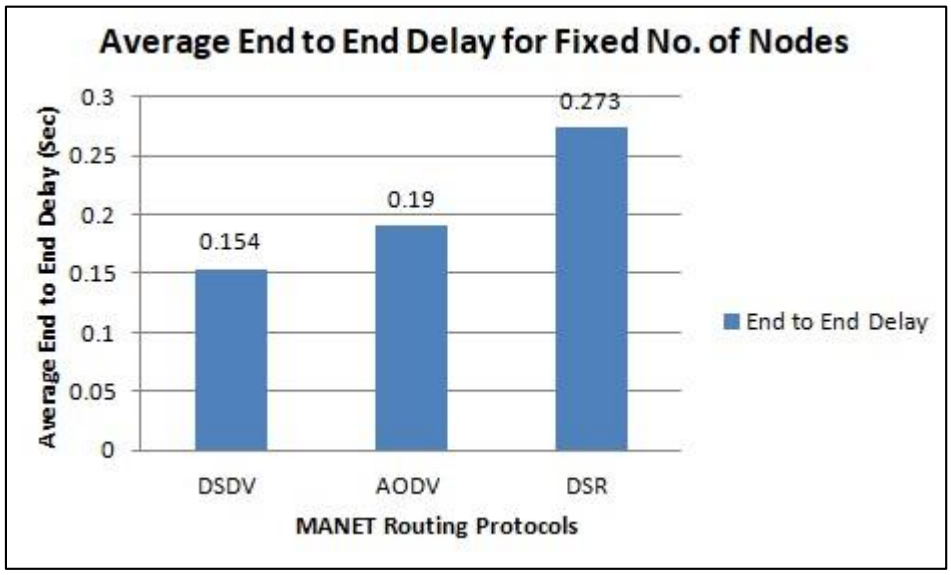

Fig 5.2 Average End to End Delay

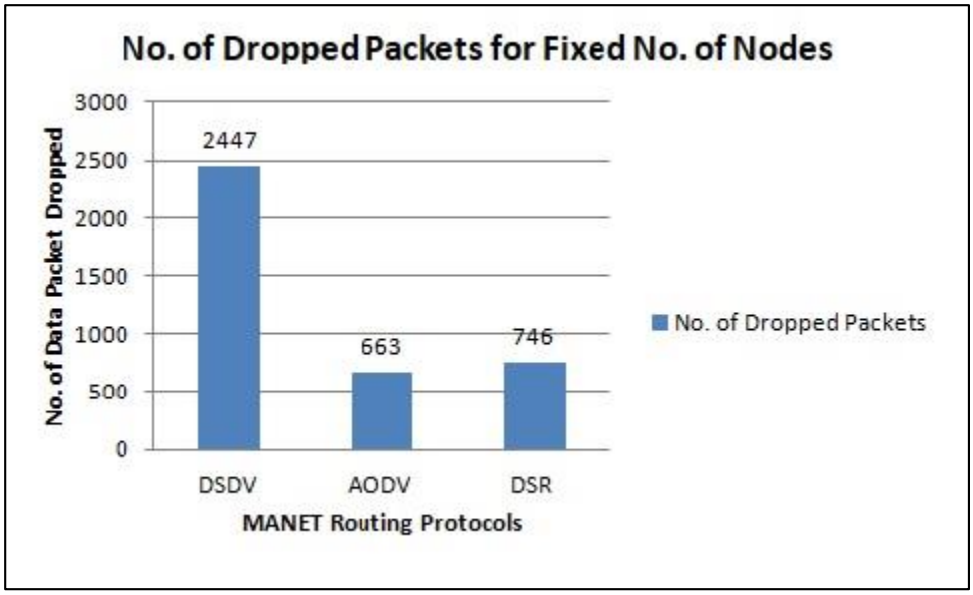

Fig 5.3 No. of Dropped Packets

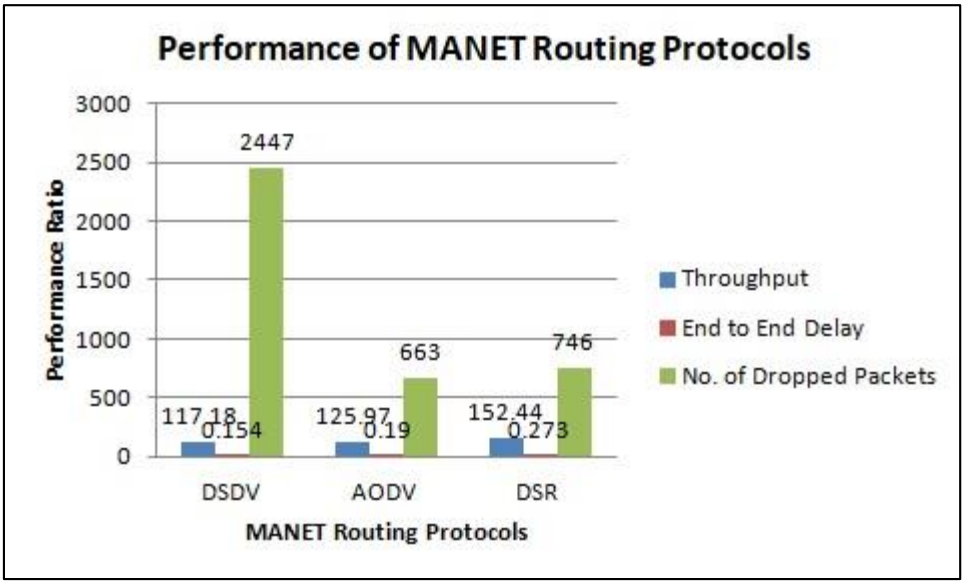

Fig 5.4 Overall Performance

6 Conclusion

In this Research study, three MANET routing protocols DSDV, DSR, and AODV are compared to evaluate and measure their efficiency. The “Fig 5.4” shown above represents the overall performance of MANET routing protocol simulation. Based upon grid topology we observed that AODV protocol is most suitable for small scale network. It is possible to extend the protocols for wireless sensor networks, vehicular Ad Hoc networks, and parameters to be evaluated in a comparative analysis of routing protocols.

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