Comparative Study of AODV, DSDV and DSR Protocol under various Network Sizes

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ABSTRACT
MANET stands for mobile ad-hoc network, it consists of mobile devices which are free to move arbitrary, and here inter-node connectivity may change frequently during normal operation. It has dynamic topology and no fixed infrastructure. Here all Network activities are executed by node themselves. It is widely used in military Battle field, sensor networks (to monitor environmental condition over large area), Vehicular ad hoc network, emergency operation (for disaster relief etc). There are certain limitation using MANET i.e. it has dynamic topology, limited security for data, limited bandwidth and routing problems. The main objective of this work is to compare and analyses the performance of routing protocols (AODV, DSDV and DSR) in terms of throughput rate, good-put, average End to End delay, packet drop, number of packets Send and number of packet received. The major goal of this study is to analyze the performance of well known MANETs routing protocol in case under low, medium and high density scenario. We find that the performance varies widely across different network sizes and results from one scenario cannot be applied to those from the other scenario. AODV performance is the best considering its ability to maintain connection by periodic exchange of information. As far as Throughput is concerned, AODV and DSR perform better than the DSDV even when the network has a large number of nodes. Overall, our simulation work shows that AODV performs better in a network with a larger number of nodes whereas DSR performs better when the number of nodes is small

General Terms
Routing Protocols, Performance Parameters, Mobile Ad hoc Networks.

Keywords
MANET; AODV, DSDV, DSR Routing Protocol; NS2; Throughput, good-put, packet delivery ratio

1. INTRODUCTION
Ad-hoc wireless networks [1, 2] [10] are increasing in popularity, due to the spread of laptops, sensor devices, PDAs and other mobile electronic devices. These devices will eventually need to communicate with each other. One of the important research areas in MANET [5, 6][12, 13] is establishing and maintaining the ad hoc network through the use of routing protocols. However there are so many routing protocols present, this project focus only considers AODV, DSR and DSDV for performance comparisons due to its familiarity among all other routing protocols. These routing protocols are analyzed based on the important metrics such as control overhead, throughput, packet delivery ratio and average end-to-end delay and is presented with the simulation results obtained by NS-2 simulator. Mobile Ad-hoc Networks have grown in popularity over the recent advancements in technology, as they possess the ability to provide instant wireless networking solution in places/situations where no pre-deployed infrastructure exists. MANET's prove to be an attractive solution in a wide range of environments ranging from scattered military deployment to simple network of a group of note books in an office meeting. In all cases, there is a need for a group of nodes (laptops, desktops, pdas, cell phones, etc.) to group together and create a network, which can offer services like file-sharing, messaging, resource sharing, etc. Hence the primary goal in a mobile network is to efficiently establish one or more routes between two nodes so that they can communicate reliably. MANET routing protocols classification and the functionality of the three familiar routing protocols DSDV, AODV and DSR. The overview of routing protocols, the simulation results and performance comparison of the three above said routing protocols. Simulation method involved varying number of the nodes. Comparisons of the overall performance of the three protocols AODV,DSR and DSDV based on the throughput, control overhead , packet delivery ratio and average end-to-end delay tables and showing concludes which protocols are better among these three routing protocol.

2. ROUTING PROTOCOLS
In this research work we perform the result based comparative study of AODV, DSDV and DSR routing protocols.

1) **AODV:** it stands for ad hoc on-demand distance vector. It is the reactive or on-demand driven routing protocol used in wireless sensor network, mobile ad hoc network, VANET [3, 4] etc. AODV is the network layer protocol used for routing. The detail about the AODV is given in [14, 15].

2) **DSDV:** it stands for destination sequence distance vector. It is the proactive or table driven routing protocol used in wireless sensor network, mobile ad hoc network, VANET etc. DSDV is the network layer protocol used for routing. The detail about the DSDV is given in [11].

3) **DSR:** destination sequence routing (DSR) is a simple and efficient routing protocol designed specifically for use in multi-hop wireless ad hoc networks of mobile nodes. It is the reactive or on-demand driven routing protocol. DSR allows the network to be completely self-organizing and self-configuring, without the need for any existing network infrastructure or administration. The detail about the DSR is given in [7].

3. PERFORMANCE METRICS

The following four metrics are used to evaluate the performance of the AODV, DSDV and DSR routing protocol in MANET.

a) **Average End to End Delay (AvgE2Ed):** this is the average of time taken (for transmission from source to destination) by packets that are received successfully at the destination node (in second).

b) **Average Throughput (AvgTP):** Bits/ Byte perSecond (kbps or KBps)

c) **Number of Packet Dropped:** count the number of packet dropped during the transmission due to the noise or any other issues.

d) **Goodput:** It is the application-level throughput (i.e. the number of useful information bits delivered by the network to a certain destination per unit of time). The amount of data considered excludes protocol overhead bits as well as retransmitted data packets. This is related to the amount of time from the first bit of the first packet sent (or delivered) until the last bit of the last packet is delivered

4. EXPERIMENTAL SETUP AND RESULTS ANALYSIS

We implemented the three widely used routing protocols AODV, DSDV and DSR in NS-2.35. Network Simulator [8, 9], NS-2.35 is a package of tools that simulates behavior of networks. Network Simulator is the widely used tool in the field of networking in the computer science and engineering. The experimental setup contains four major parts: TCL language for declaring the parameters for creating the environment, Ns all in one package used as library (source code of AODV, DSDV and DSR protocols), AWK script for calculating the performance parameter and NAM tool to visualize the network working in animation. The major network parameters like size of network, application traffic, network layer protocols, propagation model etc are given in Table 1.

Table 1. Simulation Parameters

Simulator	NS2(v-2.35)
Simulation Time	600
Number of nodes	3 to 300
Simulation Area	1000m x 1000m
Transmission Range	250m
Channel bandwidth	2Mbps
Propagation model	Two Ray Ground
Application Traffic	TCP
Packet Size	512 bytes
Traffic Rate	4 packet/sec
Pause Time	600
Network Layer Protocols	AODV, DSDV, DSR

The above experiment is executed 31 times (for number of nodes: 3 to 300) for each routing protocol. After simulation we get the result in the form of trace file and num file formats. Then we used AWK sell scripting language to calculate the value of four performance parameters as described above. The AWK script has three major sections: BEGIN section (declaration), action section and END section (print). In the action section we put the four formulas to calculate the four performance parameters given in section 3.

Tabular form of the obtained result for AvgE2Ed, AvgTP, packet dropped and goodput for three routing protocols AODV, DSDV and DSR are given in Table II, Table III and Table IV respectively. Each table shows the resultant values of corresponding performance parameters in the case of AODV, DSDV and DSR when the number of nodes varies from 3 to 300. On the basis of result given in Table II, Table III and Table IV we draw the excel graph for AvgE2Ed, AvgTP, packet dropped and goodput given in Figure 1, Figure 2, Figure 3 and Figure 4 respectively. In each figure graph show the comparative performance of all three routing protocols for corresponding performance parameters (AvgE2Ed, AvgTP, packet dropped and goodput).

Simulation result given in figure 2 shows that at some points (numbers of node) AODV has minimum AvgE2Ed. At some points (numbers of node) DSDV has minimum AvgE2Ed and at some points (numbers of node) DSR also has minimum AvgE2Ed. We can conclude this as a when the network is stable and number of node (network size) varies from small to large we cannot say AODV is best or DSR is best among three protocol. This is the actual result orient analysis. Form figure 2, figure 3 and figure 4 same conclusions are obtained as we obtain above.

Moreover, we take an average of 30 randomly generated scenarios (number of nodes) so to make a detailed performance analysis. We find that the performance varies widely across different network sizes and results from one scenario cannot be applied to those from the other scenario. AODV performance is the best considering its ability to maintain connection by periodic exchange of information. As far as Throughput is concerned, AODV and DSR perform better than the DSDV even when the network has a large number of nodes. Overall, our simulation work shows that AODV performs better in a network with a larger number of nodes whereas DSR performs better when the number of nodes is small. Average End-to-End Delay is the least for DSDV and does not change if the numbers of nodes are increased.

Table 2. AvgE2Ed

No. of Nodes	AODV	DSDV	DSR
NODE 3	242.36	134.32	150.71
NODE 4	208.9	141.49	259.95
NODE 5	164.84	102.65	193.3
NODE 6	169.19	149.83	159.02
NODE 7	254.81	182.63	132.54
NODE 8	254.81	113.09	160.75
NODE 9	151.52	96.57	86.61

NODE 10	150.24	146.14	62.51
NODE 11	150.24	109.39	113.51
NODE 12	129.46	160.9	87.49
NODE 13	153.5	155.29	184.4
NODE 14	129.24	89.19	151.8
NODE 20	290.36	136.46	74.01
NODE 30	206.56	113.57	137.23
NODE 40	147.6	396.87	208.52
NODE 50	186.19	256.81	391.69
NODE 60	178.52	178.22	299.36
NODE 70	163.25	225.14	163.97
NODE 80	140.59	91	132.68
NODE 90	352.11	111.39	84.17
NODE 100	143.17	78.44	368.32
NODE 120	365.41	378.33	372.06
NODE 140	377.5	289.86	109.08
NODE 160	170.02	253.1	134.28
NODE 180	153.84	203.55	220.73
NODE 200	144.55	134.32	334.48
NODE 220	365.29	208.19	129.54
NODE 240	504.84	268.41	299.16
NODE 260	247.53	165.95	126.84
NODE 280	133.23	190.02	178
NODE 300	396.85	308.14	123.14

Table 3. AvgTP

No. of			
Nodes	**AODV**	**DSDV**	**DSR**
NODE 3	341	593.49	552.59
NODE 4	401.41	601.72	313.26
NODE 5	408.48	651.76	498.13
NODE 6	480.08	602.13	498.63
NODE 7	342.89	479.67	140.03
NODE 8	342.89	664.4	664.65
NODE 9	541.34	665.25	663.13
NODE 10	539.32	658.26	665.45
NODE 11	539.32	661.5	661.65
NODE 12	540.4	305.03	662.23
NODE 13	542.96	663.83	660.19
NODE 14	541.27	667.85	664.73
NODE 20	90.46	663.11	306.17
NODE 30	58.55	114.28	664.85
NODE 40	196.71	139.02	329.61
NODE 50	66.16	123.65	220.27
NODE 60	88.56	646.46	340.15
NODE 70	162.19	144.04	663.74
NODE 80	262.22	540.44	663.87
NODE 90	127.29	533.09	664.65
NODE 100	259.8	22.97	219.08
NODE 120	225.38	199.15	223.16
NODE 140	227.19	191.47	665.32
NODE 160	123.32	340.78	663.96
NODE 180	537.45	261.57	81.84
NODE 200	681.58	593.49	333.08
NODE 220	207.33	138.34	665.21
NODE 240	170.57	204.83	291.22
NODE 260	340.07	62.32	664.45
NODE 280	682.17	68.69	121.79
NODE 300	31.69	20.11	664.12

Table 4. Number of Packet Dropped			
No. of Nodes	**AODV**	**DSDV**	**DSR**
NODE 3	13	21	1

NODE 4	19	22	0
NODE 5	37	12	1
NODE 6	30	23	0
NODE 7	20	30	0
NODE 8	20	20	0
NODE 9	35	12	0
NODE 10	37	24	0
NODE 11	38	22	0
NODE 12	35	34	0
NODE 13	36	8	0
NODE 14	36	13	0
NODE 20	21	3	0
NODE 30	44	19	0
NODE 40	105	7	0
NODE 50	64	18	0
NODE 60	85	9	0
NODE 70	183	18	0
NODE 80	58	6	0
NODE 90	70	10	0
NODE 100	52	22	0
NODE 120	14	25	0
NODE 140	10	18	7
NODE 160	18	13	19
NODE 180	24	52	0
NODE 200	9	21	0

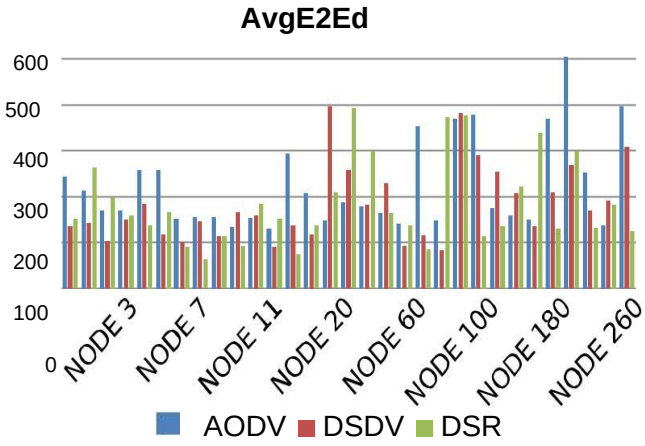
NODE 220	26	69	0
NODE 240	10	51	10
NODE 260	18	41	0
NODE 280	6	72	0
NODE 300	57	1	9

Table 5. GoodPut

No .of Nodes	AODV	DSDV	DSR
NODE 3	0.9966	0.9967	0.9978
NODE 4	0.9946	0.9966	0.9974
NODE 5	0.9942	0.9967	0.9979
NODE 6	0.9943	0.9963	0.9981
NODE 7	0.9933	0.9953	0.6667
NODE 8	0.9933	0.9517	0.9821
NODE 9	0.9569	0.9777	0.9811
NODE 10	0.9579	0.9623	0.9811
NODE 11	0.9558	0.9416	0.9812
NODE 12	0.9545	0.9942	0.981
NODE 13	0.9526	0.9597	0.9813
NODE 14	0.9525	0.9181	0.9811
NODE 20	0.7379	0.9987	0.6538
NODE 30	0.9691	0.9868	0.995
NODE 40	0.9411	0.8984	0.9728
NODE 50	0.8327	0.9073	0.9755
NODE 60	0.8321	0.9764	0.8883
NODE 70	0.8933	0.8895	0.994
NODE 80	0.9798	0.9906	0.994
NODE 90	0.9524	0.9904	0.981
NODE 100	0.9851	0.9273	0.9138
NODE 120	0.9946	0.9868	0.8639
NODE 140	0.9967	0.9365	0.9989
NODE 160	0.8682	0.9978	0.9989
NODE 180	0.9972	0.985	0.6364

NODE 200	0.9989	0.9967	0.9956
NODE 220	0.9912	0.9156	0.9989
NODE 240	0.9956	0.981	0.9974
NODE 260	0.9964	0.8915	0.9989

NODE 280	0.9989	0.9034	0.7638
NODE 300	0.9017	0.8837	0.9989



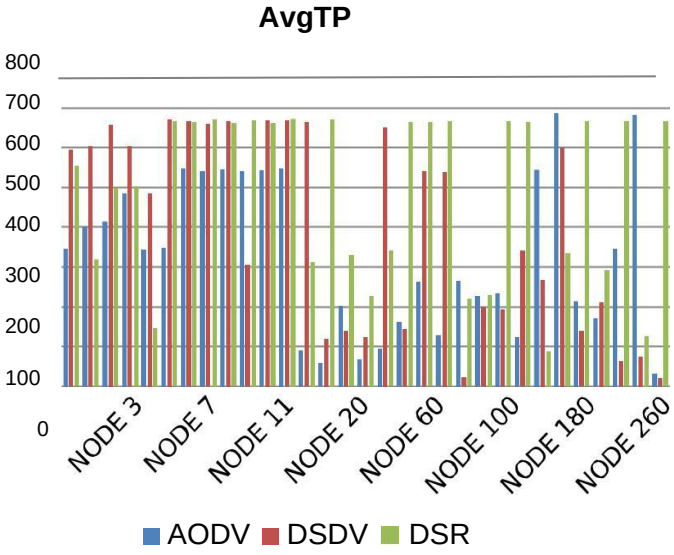


Fig 2: AvgTP vs Number of Nodes

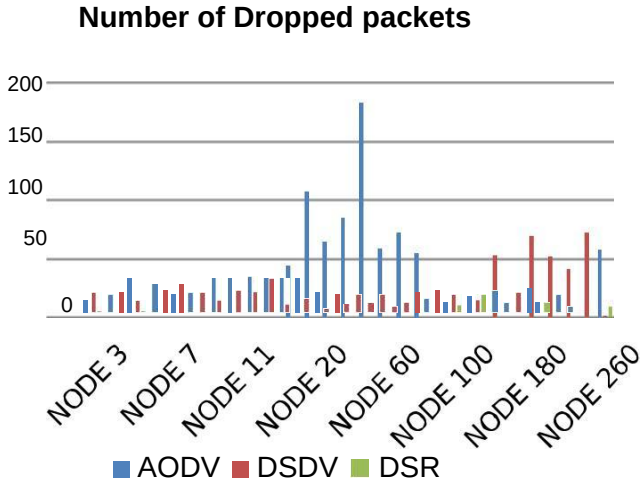


Fig 3: Number of packet dropped vs Number of Nodes

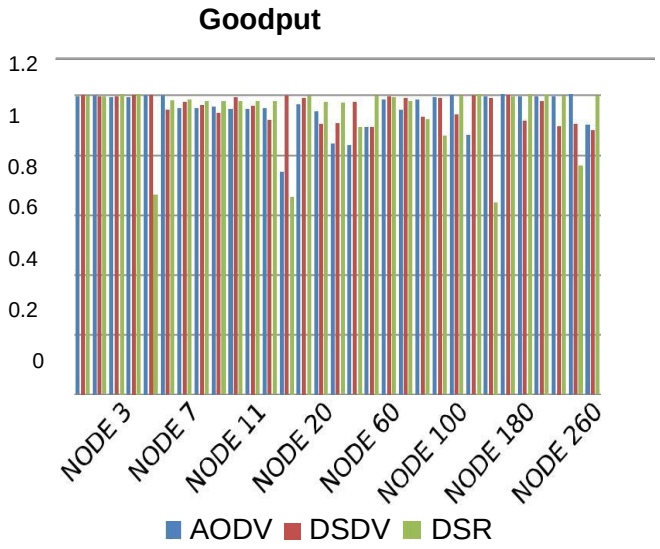


Fig 4: Goodput vs Number of Nodes

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