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Efficiency Evaluation of Routing Protocols in Manets

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Abstract—*Routing in mobile ad-hoc networks is a very complex problem, especially when node movement is very high. To achieve a better network performance, it is mandatory to identify the network circumstances and appropriate routing protocols. Routing protocols plays a vital role a routing process in ad-hoc networks. AODV (Ad-hoc on demand Distance Vector), DSR (Dynamic Source Routing), and DSDV (Destination-Sequenced Distance-Vector) are the well familiar routing protocols which are mostly used in mobile ad-hoc networks. In this paper, we analysed these routing protocols by considering several performance metrics like throughput, end-to-end delay, normalized routing load, received packets at various speeds and pause times.*

Keywords*:-NRL, pause time, speed, AODV, average throughput, PDR, E2E delay*

1. INTRODUCTION

A wireless multi-hop network is a network of nodes which are connected by wireless communication links, the links are most often implemented with digital packet radios. Nodes must make use of intermediate nodes to forward packets to the intended destination node, because a node cannot directly communicate with all the nodes in the network. A node is a communication device that is capable of sending, receiving, and relay packets. An optimal routing metric has a potential to improve performance of a wireless network.

A number of routing protocols were analysed with mobile ad hoc networks (MANETs). These existing routing protocols have been compared by different scholars in the literature, but the manner in which they were compared was not consistent, which makes it difficult to draw conclusions as to which routing protocol works best for Mobile Ad-hoc Networks (MANETs).some research work described a comparison on DSR and AODV routing protocols only, while other research papers described a comparison work based only a few performance metrics. The actual thing is that, network performance depends upon so many metrics and factors, which must be considered. For example speed is an important factor in mobile ad-hoc networks. At higher speeds, the routing links may be broken down and performance will be degraded. The goal of this research work is to evaluate the performance of existing routing protocols at different network conditions for Mobile Ad-hoc Networks with a view to select an optimal one. The goal of this work was achieved by evaluating the performance of existing routing protocols through NS2 simulation, and recommendation of design criteria for designing an optimal routing metric for MANETs. In this paper, we analyse the performance of AODV, DSR, and DSDV routing protocols and also same time, we have compared all these routing protocols with each other in respect of several performance parameters. Varying the pause times and speeds, we simulate each protocol at network simulator-2.35 (NS-2.35).

Rest of this paper is contributed as: section 2 research methodology used for evaluation of performance. Results and discussion part is elaborated in section 3. Section 4 concludes the paper.

2. RESEARCH METHODOLOGY

We have written tcl scripts for AODV, DSR, and DSDV routing protocols. We have taken five nodes in a network.For creating the node speeds and pause times; we have used the setdest command in NS-2 at Linux platform.

Pause times were taken as 10s,20s,30s,40s,50s,60s,70s,80s, and 90sin different tcl scripts. Speeds were taken as 10,20,30,40,50,60,70,80.90(m/s). First, we execute tcl file by taking the speed 20 as constant, but with varying the pause times for all tcl scripts. In second stage, we updated tcl scripts with constant pause time i.e. 10s, but at varying the speeds from 10 to 90 m/s. simulation time for all the scripts were taken as 90s only with constant network size i.e. 808×602. Traffic generated was total based on CBR packets. Three UDP connections were established for transferring the packets. Several other parameters were taken as depicted in table 1.

Table 1: Simulation Parameters

Parameter	Description
Udp packet size	1500 bytes
CBR start time	1
CBR stop time	8
Mac Protocol type	MAC/802.11
Channel type	wireless channel
Propagation model	TwoRayGround

Queue type	DropTailPriQueue
Link layer type	LL
Antenna type	Omni Antenna
Max packets in queue	50
Antenna type	Omni Antenna
Routing protocols	DSDV, DSR, AODV

The sample setdest commands are given as below:

setdest –v 1 –n 5 –p 10 –M 20 –t 90 –x 808 –y 602

setdest –v 1 –n 5 –p 20 –M 20 –t 90 –x 808 –y 602

setdest –v 1 –n 5 –p 10 –M10 –t 90 –x 808 –y 602

setdest –v 1 –n 5 –p 10 –M 20 –t 90 –x 808 –y 602

We updated these scripts with different speeds, pause times, we executed all tcl scripts at NS-2.35 platform, and taken simulation experience in nam window of NS-2.35. For calculating performance metrics like average throughput, end-to-end delay, normalized routing load etc., we have written awk scripts. By executing awk scripts on various trace files created by tcl scripts, we have collected all results and recorded the data in tabular forms. For visualizing the results, we have used origin software.

3. RESULTS AND DISCUSSION

We have simulated three routing protocols (AODV, DSR, and DSDV) in NS-2.35.All results are recorded in tables (table 2-table 11). Here we analysed all results and data by considering different routing and network metrics. Visualization work is carried out through figures (figure 1-figure 10).

Table 2: Pause time Vs E2E delay

PAUSE_TIME	DSDV	DSR	AODV
10	1033	1054.64	972.448
20	749.289	761.968	1098.63
30	544.421	552.11	728.633
40	797.19	779.01	1606.04
50	1055.34	1076.49	1354.96
60	411.234	417.828	978.223
70	1516.072	526.507	483.203
80	486.754	436.449	484.003
90	487.008	496.708	480.871

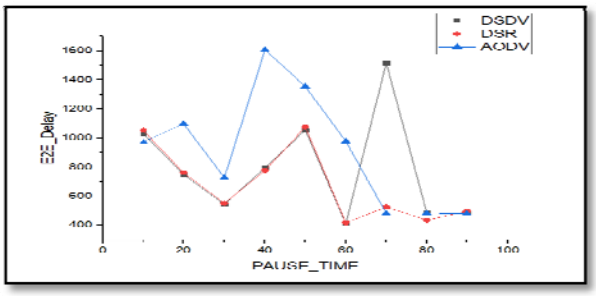

Figure 1: Pause time Vs E2E_Delay

When we compare, pause time Vs E2E delay, at lowest pause time, AODV performs better than DSDV and DSR. But at mid pause time (50), the DSDV performance is good. At the pause time 90, the AODV outperforms.

Table 3: Pause Time vs Received packets

Pause_Time	DSDV	DSR	AODV
10	7533	7515	7647
20	8418	8439	7305
30	3869	3823	5765
40	5633	5691	3033
50	6938	6937	6441
60	789	739	252
70	8915	8915	8679
80	8928	8928	8927
90	8914	8914	8924

Analysing pause time Vs received packets, from initial pause time (10) to highest pause time (90), AODV outperforms. For Pause times (70-90), received packets by DSDV and DSR are same. Almost, received packets performance for both the protocols (DSDV, DSR) is same.

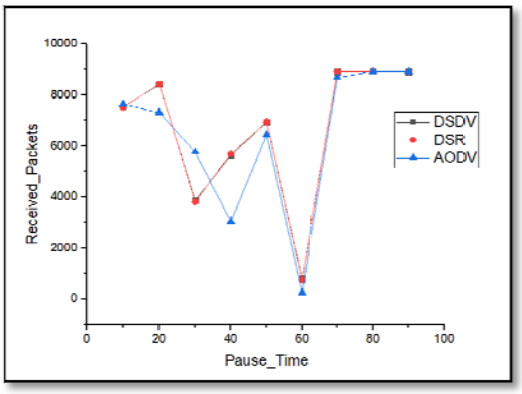

Figure 2: Pause_Time Vs Received_Packets

Table 4: Pause time Vs Normalized routing load

Pause_Time	DSDV	DSR	AODV
10	.006	.006	.010
20	.006	.006	.014
30	.013	.014	.024
40	.009	.009	.011
50	.006	.006	.006
60	.053	.053	.290
70	.005	.005	.005
80	.004	.004	.004
90	.004	.004	.006

Analysing the pause time Vs normalized routing load, the NRL for DSDV and DSR is same at pause times 10-90s. The normalized routing load for AODV is maximum at pause time 10-90s as compared to DSDV and DSR routing protocols.

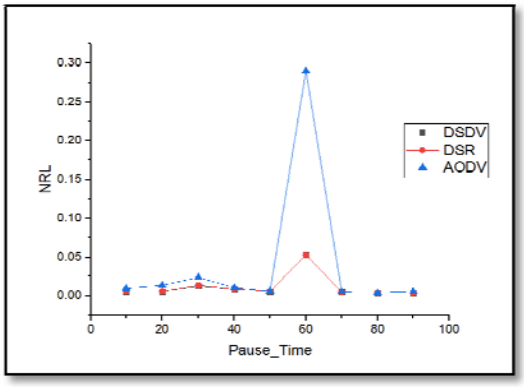

Figure 3: Pause_Time Vs NRL

Table 5: Pause time Vs Packet delivery fraction

Pause_Time	DSDV	DSR	AODV
10	443.09	444.15	436.48
20	396.51	395.52	427.65
30	862.70	873.08	578.98
40	592.54	586.51	1100.49
50	481.09	481.16	518.21
60	4516.64	4516.64	13245.24
70	374.40	374.40	384.58
80	373.86	373.86	373.90
90	374.44	374.44	374.03

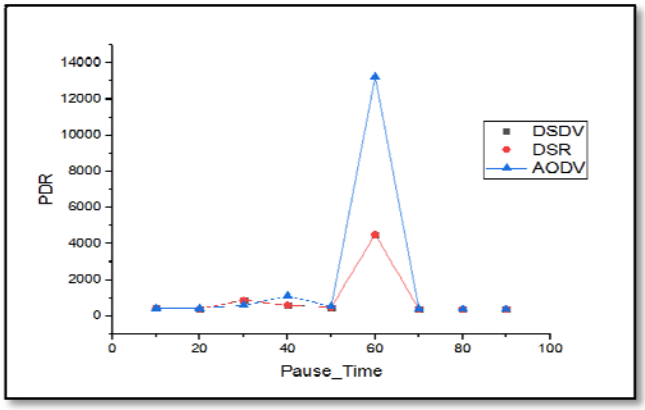

Figure 4: Pause_Time Vs PDR

Table 6: Pause time Vs Throughput

Pause_Time	DSDV	DSR	AODV
10	669.61	608.03	679.8
20	748.28	750.16	693.84
30	471.01	374.44	512.46
40	500.74	505.2	269.62
50	616.76	606.68	572.56
60	65.69	65.69	22.41
70	792.45	792.46	771.48
80	793.64	793.64	798.58
90	792.37	792.37	793.25

Analysing pause time Vs average throughput, the average throughput for DSDV and DSR is approximately same. AODV routing protocol outperforms even though at highest pause time. Also average throughput is better at lowest pause time.

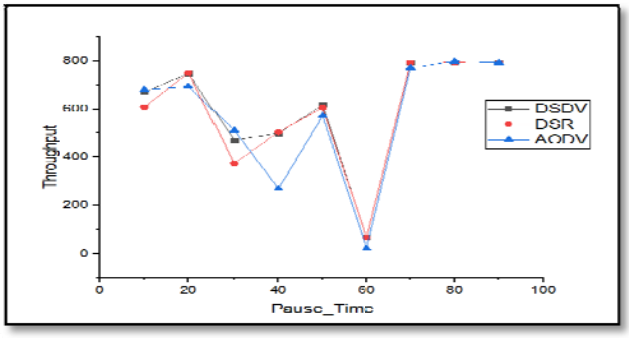

Figure 5: Pause_Time Vs Throughput

Table 7: Speed Vs Throughput

Speed	AODV	DSR	DSDV
10	257.78	300.82	380.34
20	364.99	416.26	476.48
30	321.02	316.11	106.67
40	658.49	647.58	656.78
50	705.80	670.53	743.45
60	622.94	635.59	496.78
70	418.40	601.07	424.21
80	382.74	345.84	387.88
90	297.71	368.39	376.85

Also, we analysed the comparison of AODV, DSR, and DSDV at different speeds (10-90). When we analyse speed Vs throughput, overall average throughput for DSDV is best. At average speed, the average throughput for AODV, DSR, and DSDV routing protocols is maximum.

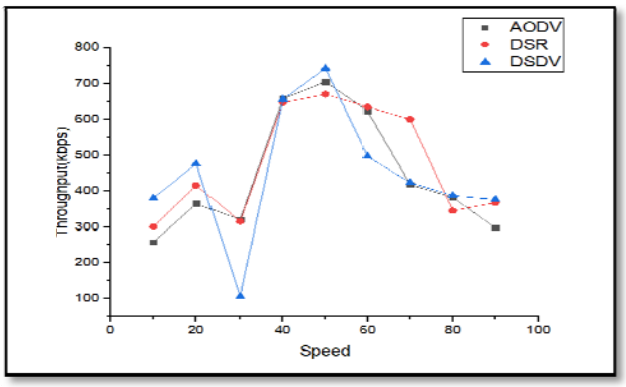

Figure 6: Speed Vs Throughput

Table 8: Speed Vs Normalized Routing Load

Speed	AODV	DSR	DSDV
10	.051	.066	.017
20	.019	.031	.009
30	.038	.115	.047
40	.025	.014	.009
50	.015	.010	.006
60	.013	.012	.009
70	.030	.016	.011
80	.063	.049	.013
90	.067	.040	.022

Analysing speed Vs NRL, at lowest speed, the normalized routing load for DSR is highest. But at higher speeds, the NRLs for AODV and DSDV are maximum and minimum respectively. At average speed, normalized routing load is at lower level for all three routing protocols.

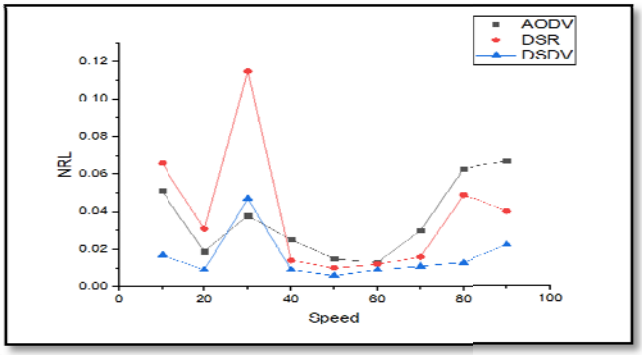

Figure 7: Speed Vs NRL

Table 9: Speed Vs Packet delivery ratio

Speed	AODV	DSR	DSDV
10	1513.74	1296.74	1313.06
20	813.11	712.90	635.53
30	924.34	938.64	2781.50
40	450.57	458.17	451.79
50	420.38	442.50	399.12
60	479.98	470.44	603.91
70	789.11	493.61	699.46
80	797.56	858.05	795.47
90	1345.89	1044.69	1296.19

Analysing speed Vs PDR, at lowest speed, the packet delivery ratio for AODV is higher. At average speed, PDR for all three protocols is lowest. At highest speed, AODV outperforms as packet delivery ratio. PDR for DSDV is highest at speed 20.

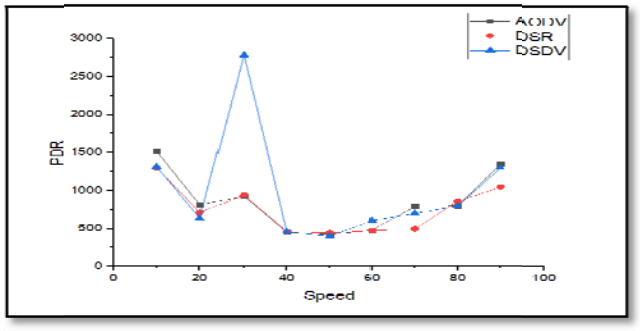

Figure 8: Speed Vs PDR

Table 10: Speed Vs Received Packets

Speed	AODV	DSR	DSDV
10	2205	2574	2542
20	4105	4682	5252
30	3611	3556	1200
40	7408	7285	7388
50	7940	7543	8363
60	6954	7095	5527
70	4707	6762	4772
80	4185	3890	4196
90	2480	3195	2360

Analysing speed Vs received packets, received packets at average speed is highest for all three protocols. At highest speed, received packets by DSR are more. Performance of DSDV is lowest at highest speed.

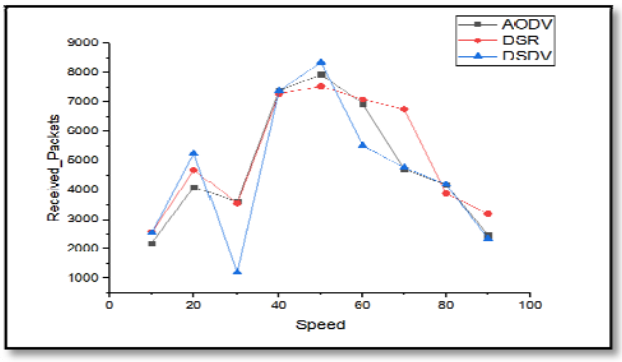

Figure 9: Speed Vs Received_Packets

Table 11: Speed Vs E2E delay

Speed	AODV	DSDV
10	1351.12	706.198
20	760.976	667.242
30	947.475	1093.18
40	634.256	489.721
50	722.12	700.358
60	480.269	560.262
70	743.564	716.887
80	778.709	586.649
90	954.004	289.686

We also compared AODV and DSDV for end-to-end delays at different speeds. End-to-end delay for AODV is high at low speed. End-to-end delay for DSDV is low at higher speeds.

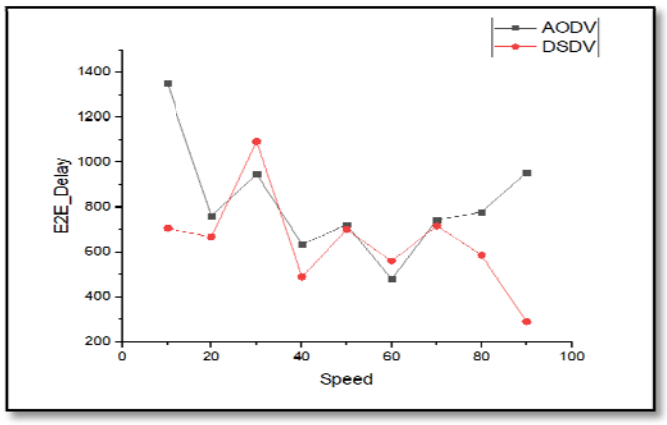

Figure 10: Speed Vs E2E_Delay

4. CONCLUSION

We have analysed AODV, DSR, and DSDV routing protocols at different pause times and speeds. When we analysed with metrics pause time Vs E2E delay, pause time Vs normalized routing load and pause time Vs received packets, AODV outperforms. By considering the metrics speed Vs throughput at higher speeds, speed Vs NRL, DSDV is best routing protocol. When we analysed the performance of AODV, DSR by considering metrics speed Vs received packets at higher speed, DSR routing protocol outperforms. At last, we compared DSDV and AODV in respect of speed Vs end-to-end delay at higher speed, DSDV outperforms.

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