Evaluation of Mobile Ad Hoc Network with Reactive and Proactive Routing Protocols and Mobility Models

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Abstract - Wireless mobile nodes forms dynamically a temporary network without the support of any substantial infrastructure and central manager. Routing protocols in mobile ad hoc network helps mobile to send and receive packets. AODV, DSR (Reactive), and OLSR, DSDV, TORA (Proactive) protocols based on various mobility models [3] such as RPGM, CMM and RWP and to evaluate performance of 5 types of routing protocols (AODV, DSR, OLSR, DSDV and TORA) based on packet delivery ratio, average end to end delay, routing overhead and throughput. We will analyze and compare the performance of reactive and proactive routing protocols under different mobility models using NS-2 simulator in the area of 700 x 700 m2.

I. INTRODUCTION

We will use NS simulator for simulating different routing protocols [1, 2]. NS simulator uses a visual tool called NAM. NAM is a Tcl/TK based animation tool for viewing network simulation traces and real world packet trace data. I am using the topology of 700x700 m2 with 25, 50, 75,100 nodes we are increasing only total number of nodes with keeping the total area constant i.e. 700x700 m2, speed 20 ± 3 m/s , pause time 15 ± 3 s, packet size 512 B, simulation time is 300s and Traffic Node 10, 20 , 40, 60 respectively with 25, 50, 75,100 nodes in the simulation. The effect of mobility on the Packet Delivery Ratio, Average End-to-End delay, Normalized Routing Load and Throughput of the mobile ad-hoc network.

II. PACKET DELIVERY RATIO (PDR)

Packet delivery Ratio (PDR): this is the ratio of total number of packets successfully received by the destination nodes to the number of packets sent by the source nodes throughout the simulation. It also describes the loss rate that of the packets, which in turn affects the maximum throughput that the network can support. PDR is calculated with the help of following formula [3][4][5].
PDR= (Packets Received / Packets Sent)*100

III. AVERAGE END TO END DELAY:

Average end-to-end delay (AED): this is defined as the average delay in transmission of a packet between two nodes and a higher value of end-to-end delay means that the network is congested and hence the routing protocol does not perform well [6][7][8].

IV. NORMALIZED ROUTING LOAD:

This is calculated as the ratio between the numbers of routing Packets transmitted to the number of packets actually received (thus accounting for any dropped packets). The higher the NRL, the higher the overhead of routing packets and consequently the lower the efficiency of the protocol. It is defined as Number of routing packets “transmitted” per data packet “delivered” at destination. Each hop-wise transmission of a routing is counted as one transmission. It is the sum of all control packet sent by all node in network to discover and maintain route [8][9].
NRL is calculated by following formula
NRL = Routing Packet/Received Packets.

V. THROUGHPUT:

The average rate at which the total number of data packet is delivered successfully from one node to another over a communication network is known as throughput. The result is found as per KB/Sec [10][11][12]. It is calculated by

Throughput= (number of delivered packet * packet size)/total duration of simulation

RPGM MODEL				
	NUMBER OF NODE			
PROTOCOL	25	50	75	100
AODV	99.91	94.66	67.76	54.79
DSDV	91.67	92.71	74.34	62.62
TORA	92.33	95.26	72.74	65.31
OLSR	99.89	97.74	68.47	33.46
DSR	93.67	93.63	74.39	53.54

Table 1: PDR IN RPGM MODEL

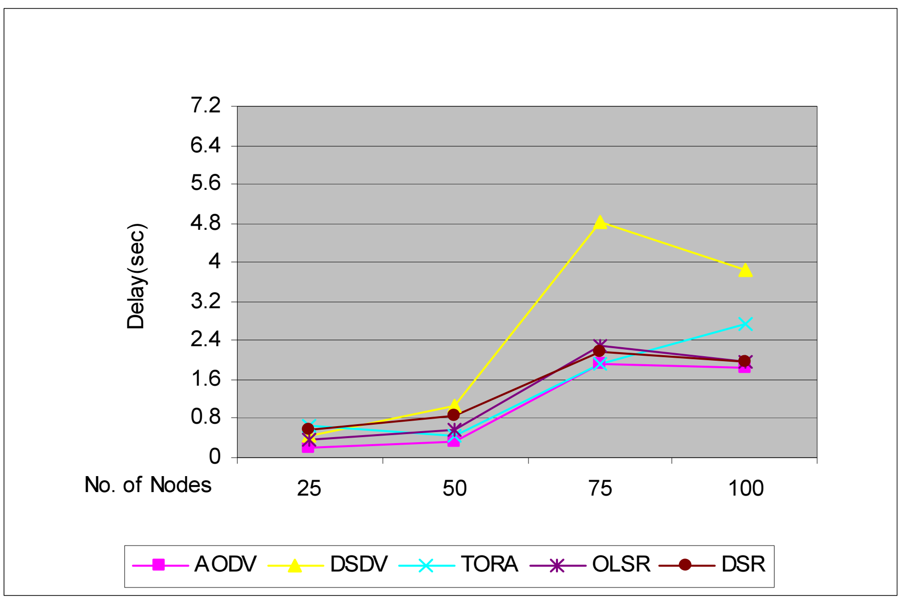

Figure 1 : PDR IN RPGM MODEL

VI. PERFORMANCE EVOLUTION OF PROTOCOLS WITH PDR IN RPGM MODEL

According to the graph the result shows that AODV plays a better roll in RPGM Model because it gives maximum PDR in the area of less number of nodes in the network but as the nodes increase the PDR decrease, then TORA is better than the others protocols [13,14,15,16,17].

CMM MODEL				
PROTOCOL	NUMBER OF NODE			
	25	50	75	100
AODV	98.79	97.68	84.55	76.43
DSDV	91.34	94.46	81.56	67.67
TORA	89.56	92.63	80.53	72.41
OLSR	98.74	96.81	54.59	38.98
DSR	92.72	95.69	83.36	78.48

Table 2: PDR IN CMM MODEL

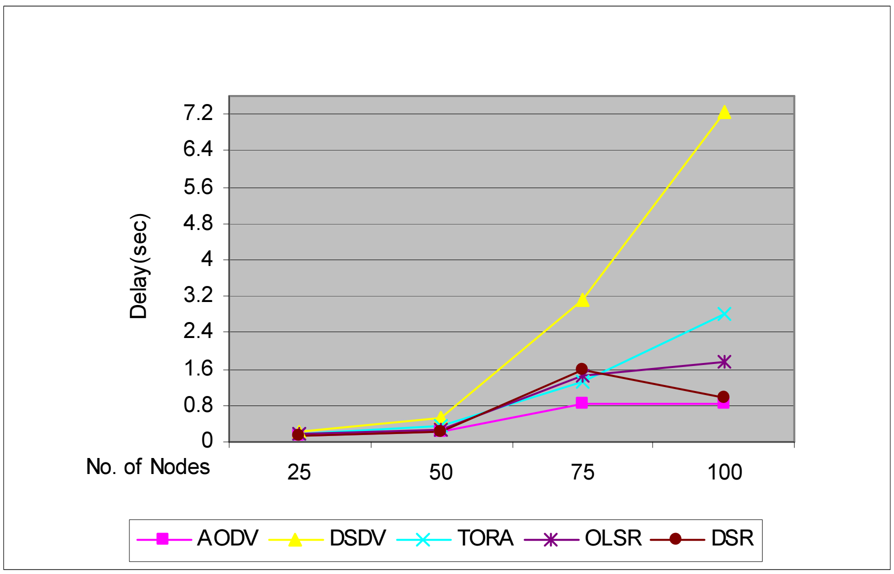

Figure 2: PDR IN CMM MODEL

VII. Performance Evolution of Protocols with PDR in CMM Model

According to the graph the result shows that DSDV gives the best performance in CMM Model. After that TORA gives better performance than the other protocols in CMM Model [18, 19, 20, 21, and 22].

RWP MODEL				
	NUMBER OF NODE			
PROTOCOLS	25	50	75	100
AODV	97.71	86.42	73.85	64.43
DSDV	81.91	47.82	47.72	14.73
TORA	79.92	34.81	27.87	10.77
OLSR	98.84	30.48	28.38	7.75
DSR	85.76	48.99	19.89	18.45

Table 3: PDR IN RWP MODEL

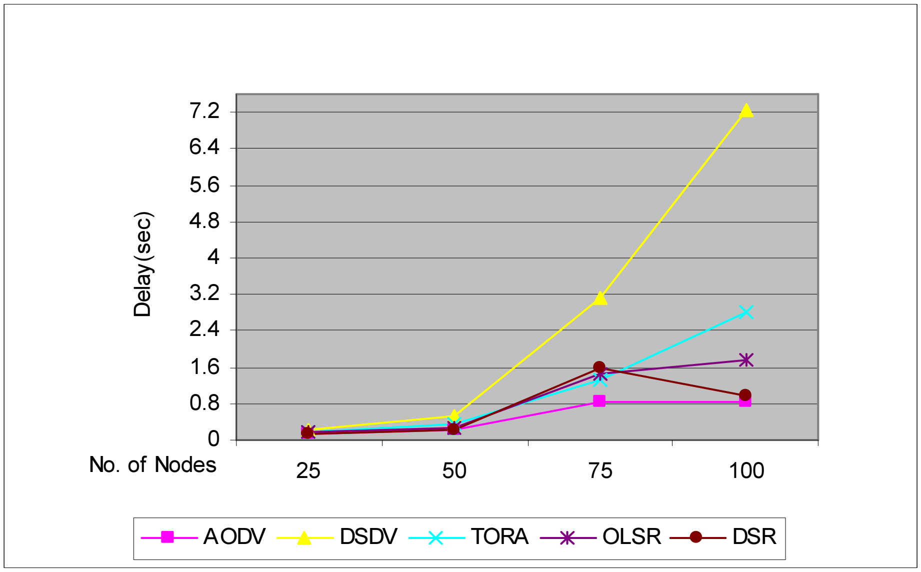

Figure 3: PDR IN RWP MODEL

VIII.PERFORMANCE EVOLUTION OF PROTOCOLS WITH PDR IN RWP MODEL

As we are getting the result from graph the best performance is given by the DSDV protocol after that TORA gives better performance than the others protocols because as the no. of nodes increase their performance decreases [23,24].

RPGM MODEL				
	NUMBER OF NODE			
PROTOCOL	25	50	75	100
AODV	1.06	1.11	1.85	2.23
DSDV	1.78	1.78	3.93	6.66
TORA	1.83	1.84	3.99	7.23
OLSR	1.53	1.85	2.35	6.82
DSR	1.17	1.21	6.56	9.76

Table 4: Normalized Routing Load in RPGM Model

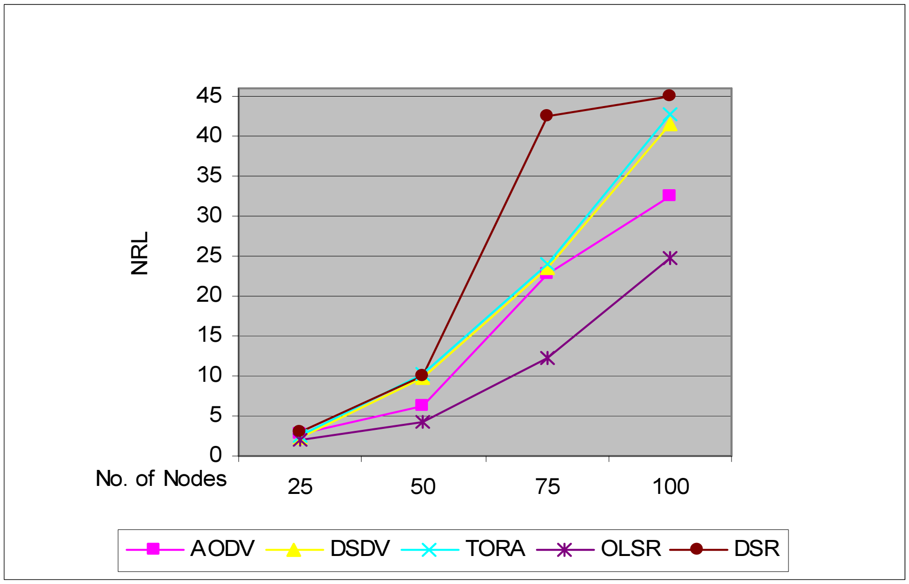

Figure 4: Normalized Routing Load In RPGM Model

IX. PERFORMANCE EVOLUTION OF PROTOCOLS WITH NORMALIZED ROUTING LOAD IN RPGM MODEL

As the result from the above graph As the no. of node increase the NRL is also increased. The maximum NRL is given by the DSR protocol but we are the minimum NRL by OLSR protocol in RPGM Model.

CMM MODEL				
PROTOCOL	NUMBER OF NODE			
	25	50	75	100
AODV	0.08	1.68	1.89	1.99
DSDV	1.46	1.79	2.38	2.37
TORA	1.51	1.84	2.44	2.54
OLSR	1.81	1.79	2.26	2.38
DSR	3.12	10.12	12.58	14.28

Table 5: Normalized Routing Load In CMM Model

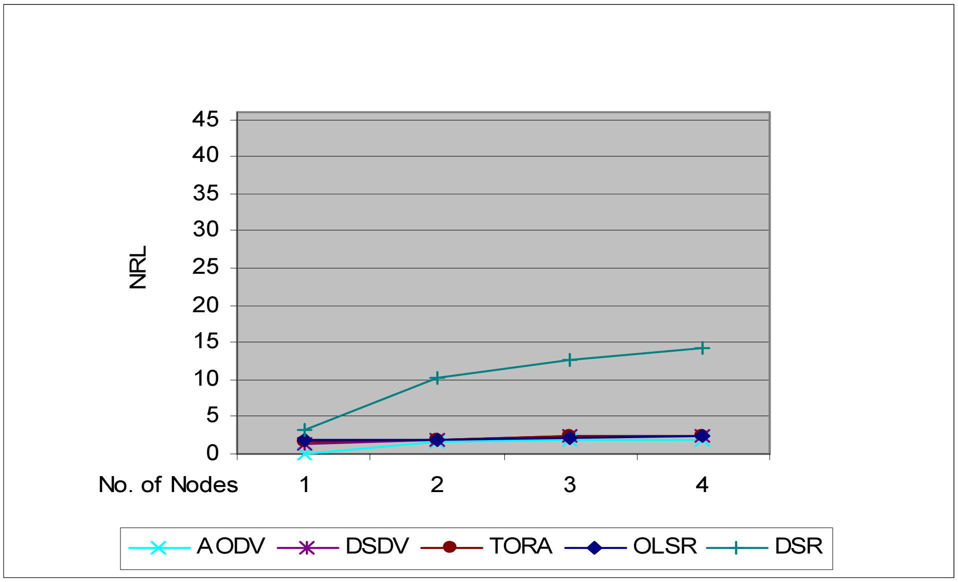

Figure 5: Normalized Routing Load In CMM Model

X. Performance Evolution of Protocols with Normalized Routing Load In CMM Model:

In CMM Model the DSR protocols has maximum NRL. But the others protocol has similar performance to each other.

RWP MODEL				
PROTOCOLS	NUMBER OF NODE			
	25	50	75	100
AODV	2.67	6.22	22.76	32.38
DSDV	2.34	9.87	23.46	41.44
TORA	2.46	10.24	24.07	42.82
OLSR	1.98	4.3	12.34	24.75
DSR	3.12	10.12	42.58	44.98

Table 6: Normalized Routing Load In RWP Model

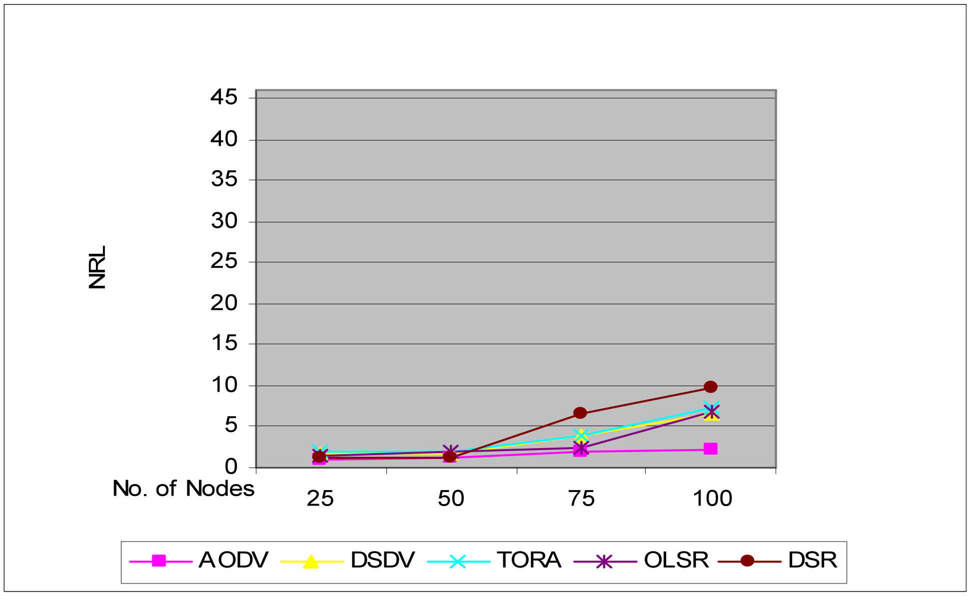

Figure 6: Normalized Routing Load In RWP Model

XI. Performance Evolution of Protocols with Normalized Routing Load In RWP Model

In RWP Model DSR protocols gives maximum NRL. And AODV has minimum NRL and other protocols have similar NRL to each other protocols.

RPGM MODEL				
	NUMBER OF NODE			
PROTOCOL	25	50	75	100
AODV	76.85	74.53	52.93	44.18
DSDV	59.14	63.5	54.26	37.49
TORA	47.83	52.5	31.76	28.15
OLSR	76.83	76.96	53.91	26.98
DSR	60.04	64.57	54.29	31.68

Table 7: Throughput In RPGM Model

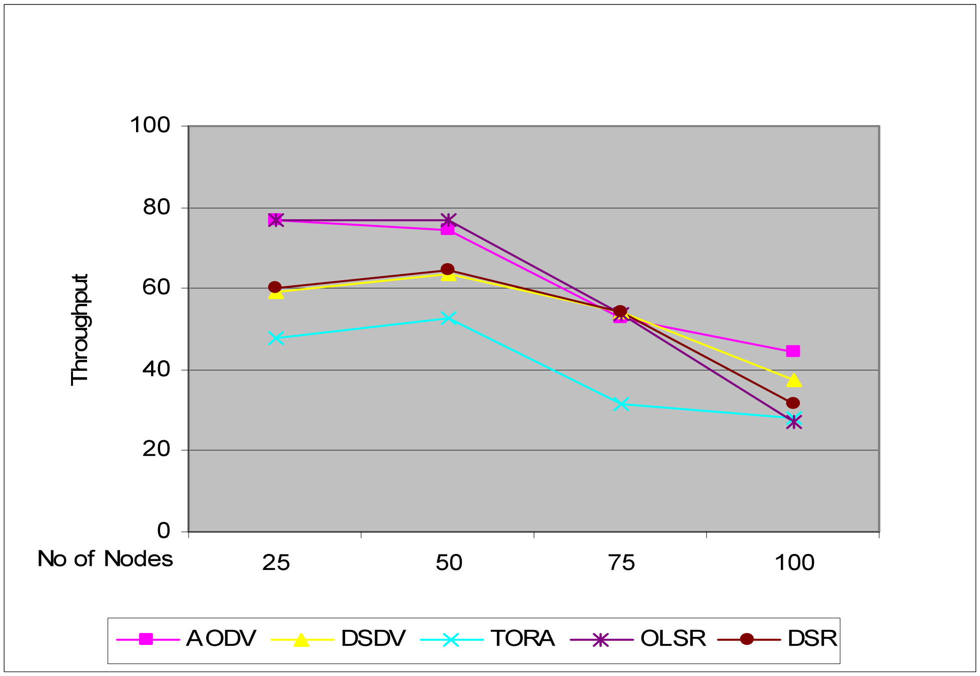

Figure 7: Throughput In RPGM Model

XII. Performance Evolution of Protocols with Throughput in RPGM Model

In RPGM Model every protocols has maximum throughput but as the No. of Node increase the throughput decrease. In Short we can say AODV is best in case of PRGM Model and TORA is worst protocols.

CMM MODEL				
	NUMBER OF NODE			
PROTOCOL	25	50	75	100
AODV	75.91	76.91	66.05	61.63
DSDV	58.92	64.69	59.53	40.52
TORA	46.4	50.61	35.16	31.21
OLSR	75.95	76.22	42.98	31.43
DSR	59.43	65.99	60.84	46.43

Table 8: Throughput in CMM Model

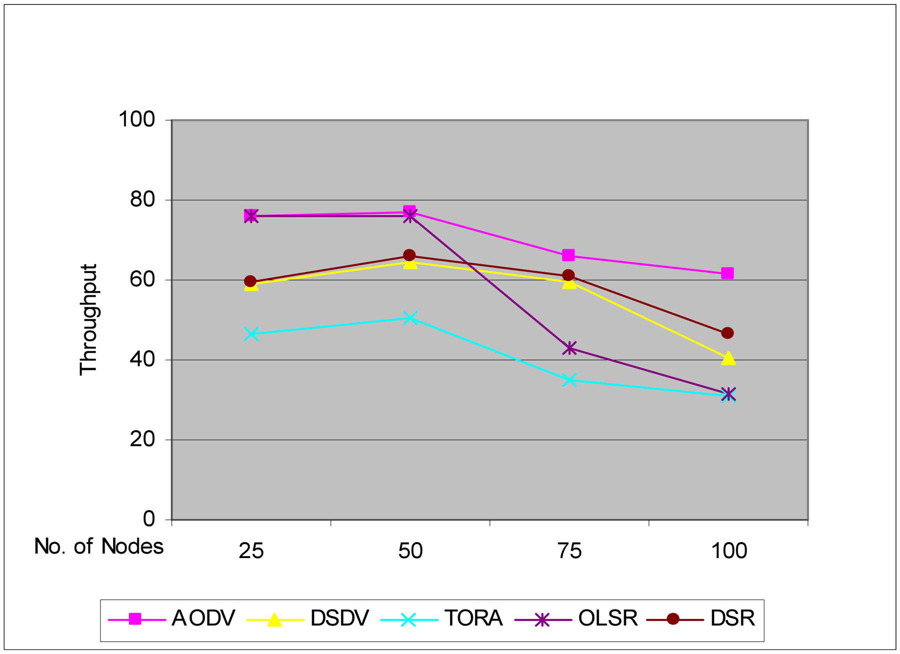

Figure 8: Throughput in CMM Model

XIII.Performance Evolution of Protocols with Throughput in CMM Model

In case of CMM model the AODV and OLSR protocols has maximum throughput when the number of node is less but as the No. of node the only AODV gives better performance than the others protocols but TORA has worst performance.

RWP MODEL				
PROTOCOLS	NUMBER OF NODE			
	25	50	75	100
AODV	75.16	68.04	57.69	51.95
DSDV	52.84	51.24	34.83	8.82
TORA	41.41	19.01	12.17	4.62
OLSR	76.03	24.01	22.34	6.25
DSR	54.97	33.78	14.51	10.91

Table 9: Throughput in RWP Model

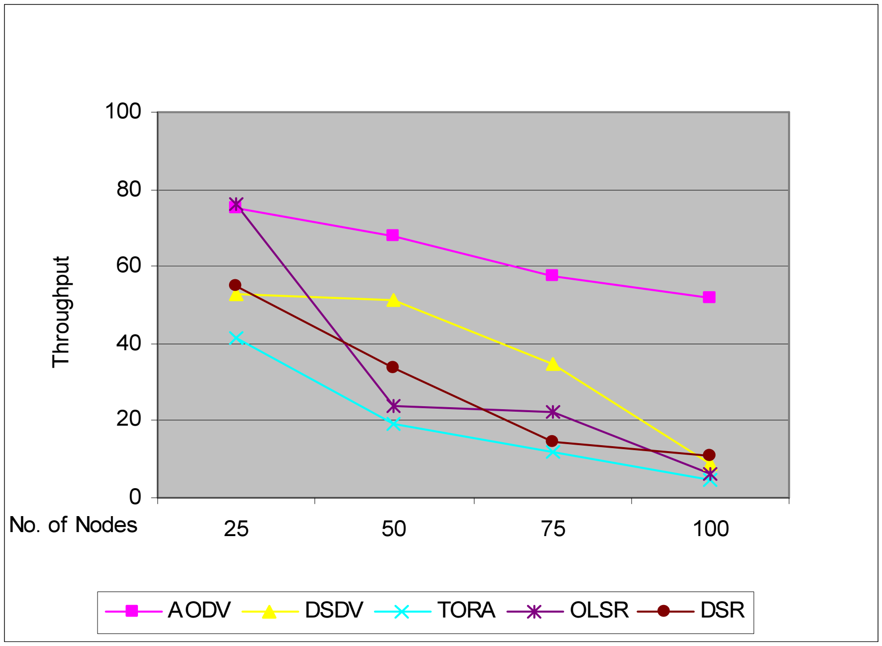

Figure 9: Throughput in RWP Model

XIV. PERFORMANCE EVOLUTION OF PROTOCOLS WITH PDR THROUGHPUT IN RWP MODEL

In case of RWP Model AODV protocol has better performance than the others protocols but as the number of nodes it performance decreases. But TORA gives worst throughput even the No. of node is 25 or 100.

RPGM MODEL				
	NUMBER OF NODE			
PROTOCOL	25	50	75	100
AODV	0.21	0.32	1.91	1.86
DSDV	0.43	1.06	4.82	3.84
TORA	0.64	0.47	1.94	2.76
OLSR	0.36	0.57	2.28	1.98
DSR	0.58	0.84	2.16	1.97

Table 10: Average End To End Delay In RPGM Model

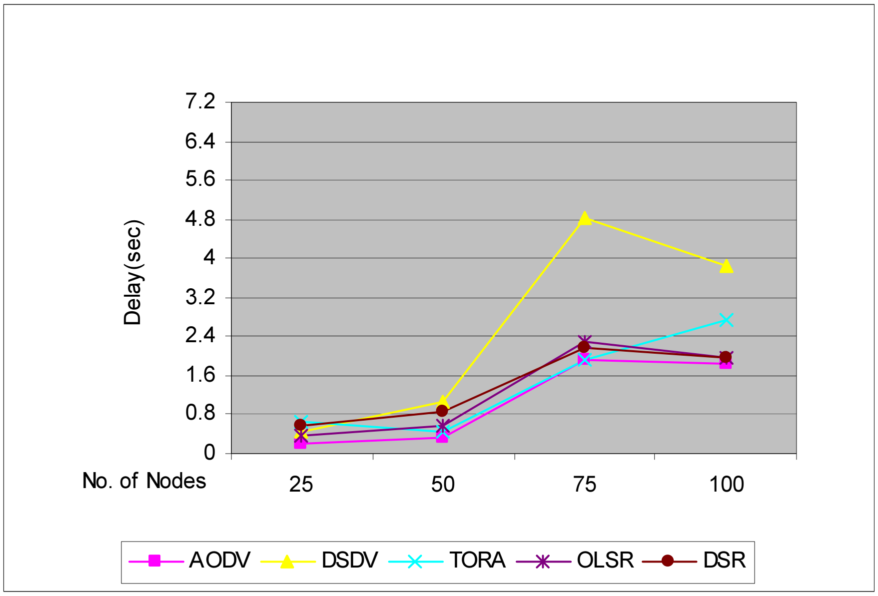

Figure 10: Average End To End Delay In RPGM Model

XV. PERFORMANCE EVOLUTION OF PROTOCOLS WITH PDR AVERAGE END TO END DELAY IN RPGM MODEL

In case of RPGM Model the as the No. of node is less every protocols has minimum delay but as the No. of node increase the AODV protocol has minimum delay but DSDV protocols has the maximum delay. TORA has a sharp delay as the No. of node increased.

CMM MODEL				
PROTOCOL	NUMBER OF NODE			
	25	50	75	100
AODV	0.14	0.22	0.85	0.85
DSDV	0.22	0.53	3.12	7.23
TORA	0.17	0.34	1.32	2.8
OLSR	0.16	0.28	1.45	1.75
DSR	0.13	0.21	1.56	0.97

Table 11: Average End To End Delay Average End To End Delay In CMM Model

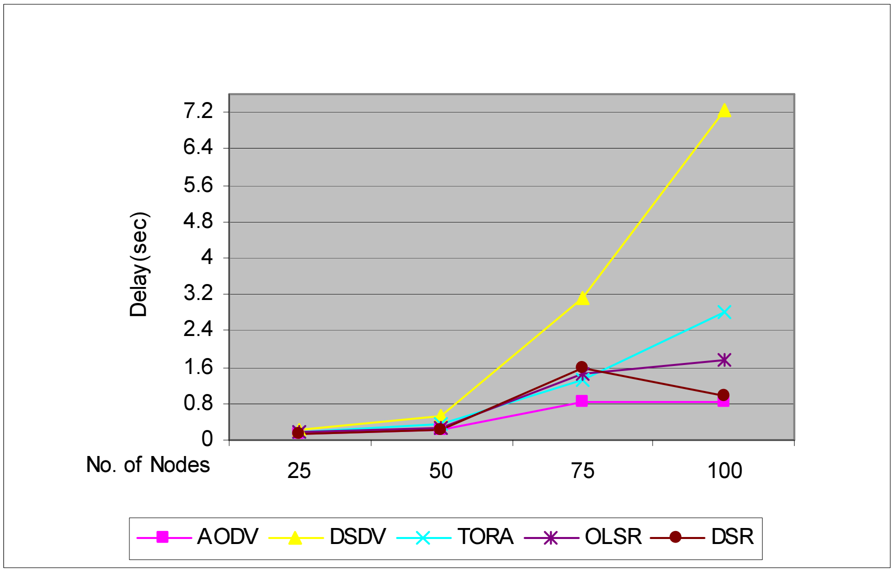

Figure 11: Average End To End Delay In CMM Model

XVI. PERFORMANCE EVOLUTION OF PROTOCOLS WITH PDR AVERAGE END TO END DELAY IN CMM MODEL

Like RPGM Model every protocols has minimum delay but when the number of node increase AODV has minimum delay. But DSDV has a sharp delay ratio as the number of nodes increased.

RWP MODEL				
PROTOCOLS	NUMBER OF NODE			
	25	50	75	100
AODV	0.21	1.37	2.08	2.27
DSDV	0.23	2.49	3.95	6.49
TORA	0.58	2.44	2.78	3.04
OLSR	0.59	2.46	3.43	5.83
DSR	0.37	1.57	2.28	2.57

Table 12: Average End To End Delay In RWP Model

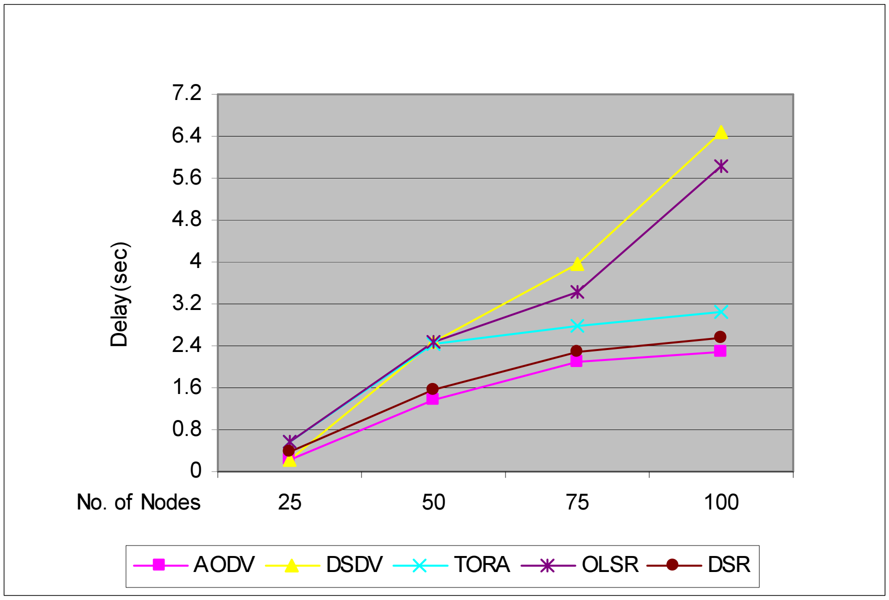

Figure 12: Average End To End Delay In RWP Model

XVII. Performance Evolution of Protocols with PDR Average End To End Delay in RWP Model

Like RPGM and CMM model in every protocol has minimum delay .But as the number of node increased the delay is also increased. Like other models AODV has minimum delay in RWP Model. And DSDV has maximum delay which gives worst performance in all models.

XVIII. CONCLUSION

After study and analyzing the behavior of Five MANETs routing protocols i.e. AODV, DSDV, DSR, OLSR, TORA under the three mobility models (RPGM,CMM,RWP) And then compare the performance of protocols using NS-2 simulator in the area of 700 x 700 m2 which clearly indicate the significant impact on node mobility pattern has on routing performance, these routing protocols were compared in the manner of Packet delivery ratio (PDR), Average End to End delay (delay), Normalized routing load(NRL) and Throughput when subjected to change in numbers of nodes. Our simulation results show that Reactive protocols is much better than proactive in the manners of packet delivery (PDR), A End-to-End delay(Delay), Normalized routing load(NRD) and throughput . In this paper we look increase the number of nodes has impact on all protocols under these mobility models i.e the degradation varies for different protocols and mobility models. In this research our results is made into how well AODV, DSDV, DSR, OLSR and TORA work to different network conditions in MANET. The delay of OLSR is less and in the DSR is worst. Throughput is high in case of AODV. In DSR delay is greater than the AODV and OLSR. In the terms of packet dropper the DSDV perform better and consistently well with increase number of nodes while the AODV is worst. On the other hand DSR perform better when the numbers of nodes are less but it will fails when the numbers of nodes increase but DSR showed high end to end delay due to formation of temporary loops within the network . TORA is very poor and not reliable for the MANETs. In future, we can evaluate the performance of these five routing protocols under three mobility models by varying it to the speed, pause time.

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