International Journal of Innovative Technology and Exploring Engineering (IJITEE)
ISSN: 2278-3075 (Online), Volume-8 Issue-5, March 2019

Routing Protocols Comparison and Analysis in MANET using Simulation

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Abstract*: *In this paper a comparative analysis among Proactive, Reactive and Hybrid routing protocol is presented using simulation. As we well aware that a MANET is self-configuring network and most of the real world scenario involving MANET requires individual nodes to route data. Keeping in view MANET is infrastructure less and at times nodes are free to move in different direction, making routing protocol a vital component for network operational effectiveness and efficiency.

Index Terms*: *MANET; Routing Protocol Analysis; Routing Protocol Simulation

I. INTRODUCTION

In the last few years use of wireless communication have grown rapidly. Regardless it's industrial or commercial facilitation. In general we can categorize wireless technology into three types- ad-hoc network, infrastructure based network and hybrid network. A mobile ad-hoc network (MANET) can be defined as a type of ad hoc network with infrastructure-less[1] and nodes that can either be static or mobile. Most of the practical implementation of MANETS involves mobility, which makes it important for the nodes to also perform routing for networks optimal performance. MANET devices might need to stream a voice, data and video between random pairs of nodes using wireless communication with very limited bandwidth. We must also not forget that in some applications power of nodes also plays a vital role, as these nodes can be at remote location and with limited power. This might give a brief idea of how important it is for routing protocols to be efficient and effective. At the moment there are number of methods which are used in order to offer robust MANET proficiency.

II.PR PROPOSED MANET ROUTING PROTOCOLS

Routing protocols for MANETs can mainly be classified into the three categories illustrated in Figure 1.

A.Dynamic Source Routing (DSR)

DSR routing protocol developed for control of bandwidth utilization by the packets using an approach called table driven. It discards the renovate message of the periodic table. A route cache contains total routes are maintained by each host. Source Routing is used here to represents the complete information.

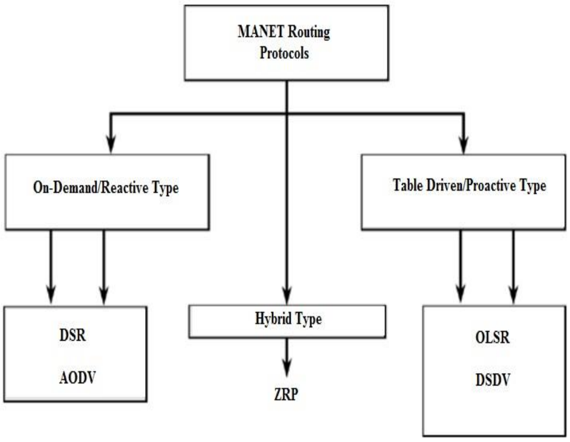

Figure 1: MANET Routing Protocols Proposed

B. Ad Hoc On-Demand Distance Vector (AODV)

At the nodes AODV maintains Routing tables that show good performance than DSR, so that data packets do not have to contain routes. The hop information is stored by Source nodes and intermediate nodes in AODV belong to each packet flow. Up to date path to the destination is determined by AODV, supports symmetrical links.

C.Zone Routing Protocol (ZRP)

Drawbacks such as higher latency in routes identification and high number of messages required as control messages reactive and proactive protocols are overcome by ZRP which decreases latency and control messages.

D.Optimized Link State Routing Protocol (OLSR*)*

OLSR is Internet routing protocol of type proactive, utilizes hello messages along with topology Control messages (TC Messages) to identify, propagate state of the path matters on MANET. Information of Topology is used by individual nodes.

E. Destination-Sequenced Distance-Vector Routing (DSDV)

A table driven routing, Destination Sequenced Distance Vector Routing (DSDV) is used for routing loop problems solution. Routing table contains a sequence number corresponding to each entry generated by the destination.

Manuscript published on 30 March 2019.
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II. SIMULATION ANALYSIS PARAMETERS

Simulation analysis is for Mobile Ad hoc Network (MANET) protocols is performed to analyze its behavior using Network Simulator-2 on DSR,AODV,OLSR,DSDV and ZRP routing protocols.

We will be using a constant bit rate – user datagram protocol (CBR (UDP)) based traffic speaking sources, and then we will compare their results with each other. Through this simulation we have analyzed and compared Packet Drop Rate, Throughput, End to End Delay, Packet Delivery or Receiving Rate and Normalized Routing Load. As these are the most important factors which can highlight the main difference among routing protocols and under what scenario which protocol will be suited best as shown in Table 1.

To perform our analysis we have created different scenarios to route data using the above mentioned protocols, as we are aware that most of the ad-hoc network topologies are based on either static nodes or moving nodes.

Parameter	*Value*
Type of Simulator	Network Simulator-2 of version 2.35
Protocols Considered here	DSR,AODV, DSDV,OLSR,ZRP
Simulation Time in sec	300
Simulation Area(in Meters)	500x500
Type of Traffic	Constant Bit Rate type
Packet Size	0.512KB
Rate of Packet Transmission	10 Packets per Sec
Node Movement	Random
Pause Time in sec	5
Maximum and Minimum Speeds	1m/s and 10m/s

Table 1: Parameters used in simulation

III. SIMULATION RESULTS FOR DIFFERENT ANALYSIS TYPES

Different Analyses are presented for the proposed protocols here for comparison purpose. They are Packet Drop Rate Analysis, Throughput Analysis, End-to-End Delay Analysis, Packet Delivery Analysis and Routing Load Analysis. Simulation is carried out by considering 20, 40 and 60 nodes for all analyses.

A.Packet Drop Rate Analysis

Other name used for this analysis is Packet loss rate and is the number of packets dropped in reaching the receiver among total transmitted packets. The following figures 2, 3 and 4 for different nodes shows the Drop rate analysis of packets transmitted.

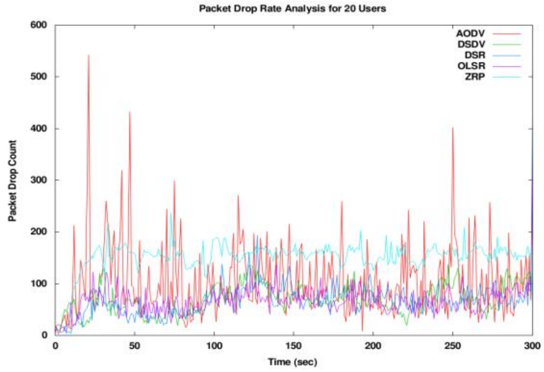

Figure 2: Packet Drop Rate behaviour for 20 nodes for 300 seconds

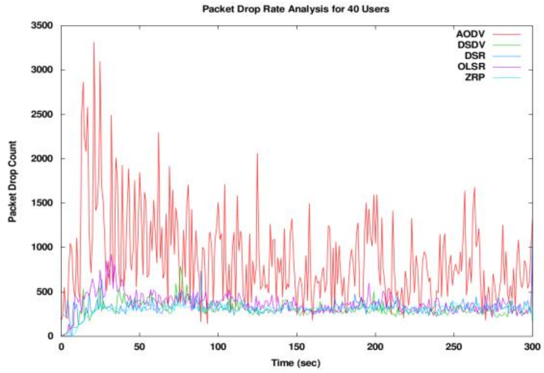

Figure 3: Packet Drop Rate behaviour for 40 nodes for 300 seconds

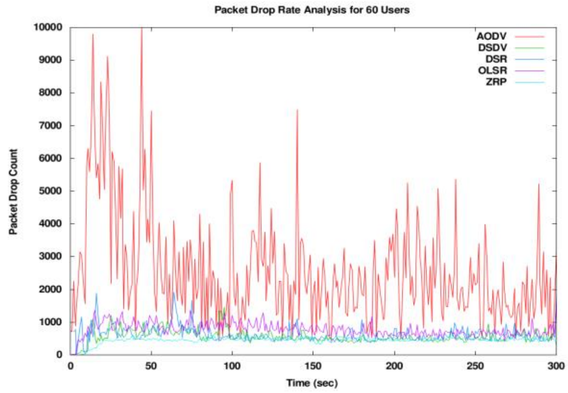

Figure 4: Packet Drop Rate behaviour for 60 nodes for 300 seconds

The packet drop rate count is listed in below table 2.

Total Packets Drop Count			
	Number of Nodes		
Proposed Protocols	20	40	60
DSR	20066	96163	185167
AODV	30795	263607	769479
DSDV	21185	92426	170543
OLSR	20191	112167	232333
ZRP	45140	93525	135643

Table 2: Total Packets Drop Count for 20, 40 and 60 nodes

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The Bar Graph corresponding to the Packet drop count is shown in below figure 5.

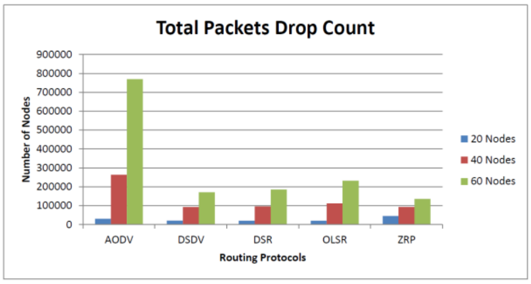

Figure 5: Bar Graph showing Packets Drop Count

B. Throughput Analysis

Throughput Analysis is the overall number of packets transmitted over the overall simulation time. This analysis is shown in the following figures 6, 7 and 8 for different nodes.

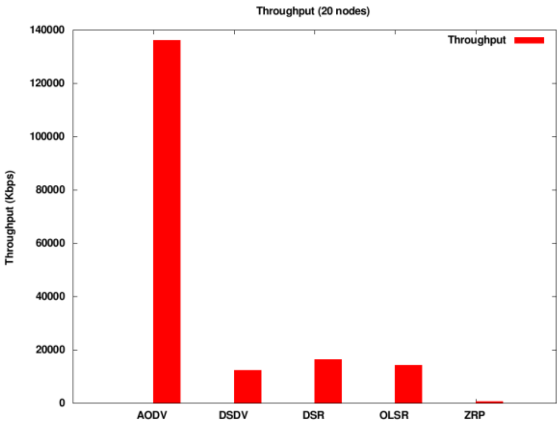

Figure 6: Throughput analysis for 20 nodes

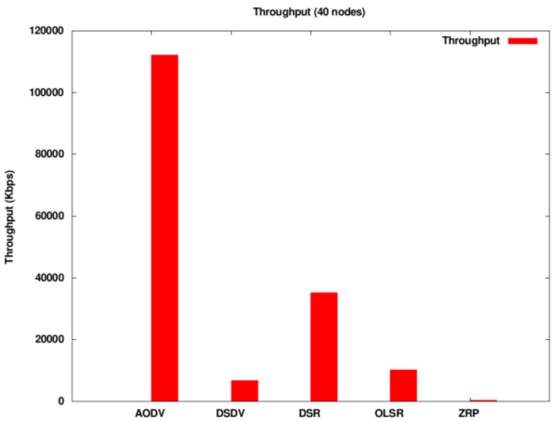

Figure 7: Throughput analysis for 40 nodes

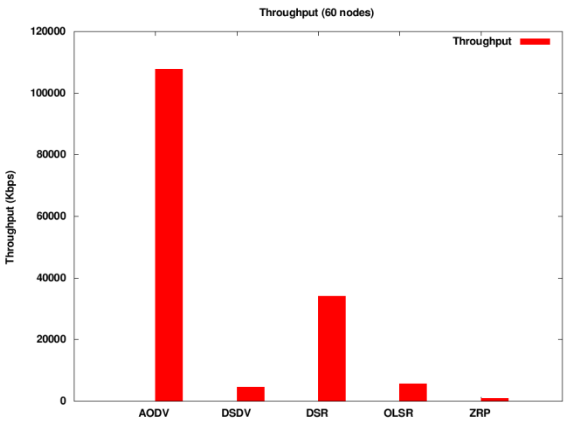

Figure 8: Throughput analysis for 60 nodes.

The following table 3 shows the Throughput corresponding to different nodes in Kbps.

Throughput Analysis			
	Number of Nodes		
Proposed Protocols	20	40	60
DSR	16340	35216.06	34157.47
AODV	136200.3	112247.8	107788.2
DSDV	12427.5	6720.656	4609.438
OLSR	14285.03	10182.81	5660.813
ZRP	641.0938	403.5938	838.8438

Table 3: Throughput comparison for 20, 40 and 60 nodes

The Bar Graph corresponding to the Throughput Analysis is shown in below figure 9.

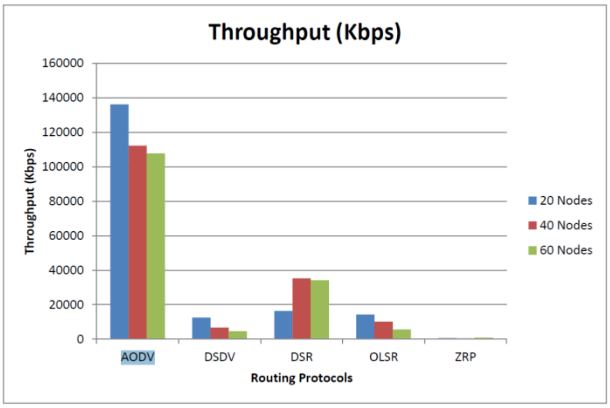

Figure 9: Bar Graph showing Throughput

C. Packet Receiving / Delivery Rate

Packet delivery or receiving rate describes the summation of total number of packets received by each node over time. The following figures 10, 11 and 12 shows this analysis.

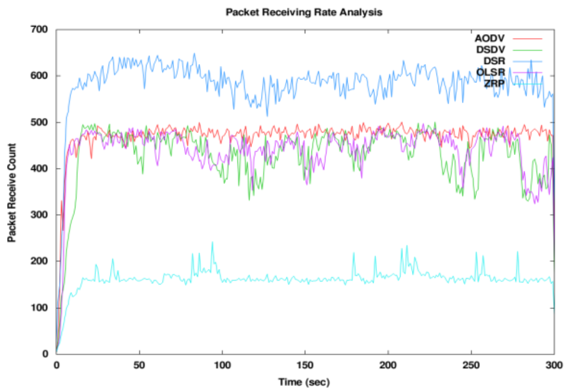

Figure 10: Packet receiving / delivery rate analysis for 20 nodes.

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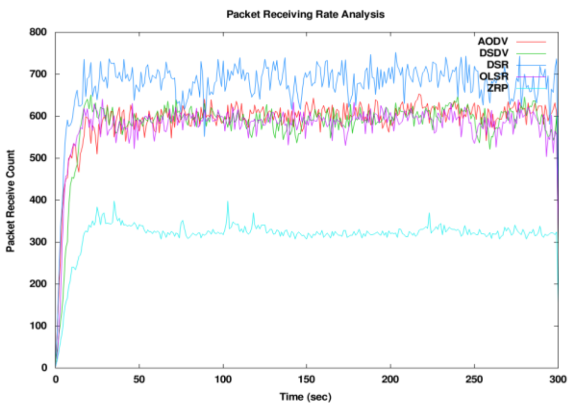

Figure 11: Packet receiving / delivery rate analysis for 40 nodes.

Figure 12: Packet receiving / delivery rate analysis for 60 nodes.

The following table 4 shows the list of packet delivery count for different nodes.

Total Packets Delivery Rate			
	Number of Nodes		
Proposed Protocols	20	40	60
DSR	175222	202838	225645
AODV	141374	177713	208149
DSDV	129023	174318	211729
OLSR	132124	173548	208817
ZRP	48801	95460	135601

Table 4: Comparison of total packets delivery count for 20, 40 and 60 nodes.

The following figure 13 is a Bar Graph shows the Packet delivery count for different nodes.

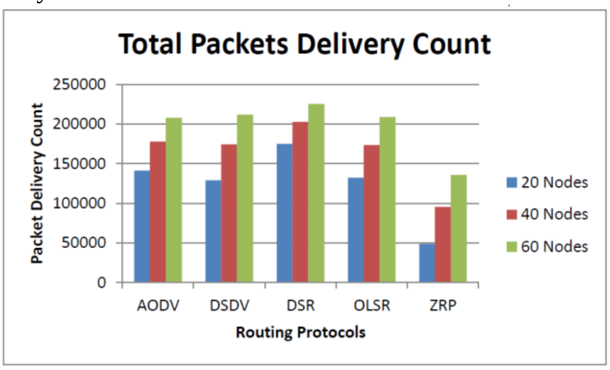

Figure 13: Bar Graph showing Packet Delivery Count.

D.Routing Load Analysis

Routing load determines the number of routing messages / packets exchange during the course of simulation. The following figures 14, 15 and 16 shows the Routing Load Analysis

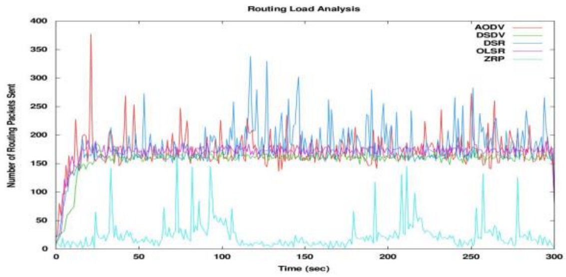

Figure 14: Routing Load Analysis for 20 nodes for 300 seconds

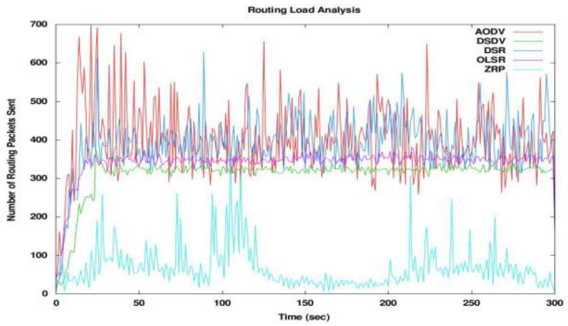

Figure 15: Routing Load analysis for 40 nodes for 300 seconds.

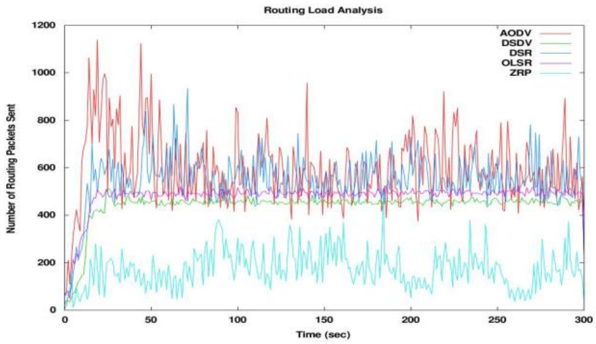

Figure 16: Routing Load Analysis for 60 nodes for 300 seconds.

The following table 5 shows Routing Load analysis for different nodes.

Routing Load Analysis			
	Number of Nodes		
Proposed Protocols	20	40	60
DSR	53790	116663	164171
AODV	51252	120225	179172
DSDV	46939	93084	132362
OLSR	51057	102354	144064
ZRP	7195	20141	52375

Table 5: Comparison of Routing load for 20, 40 and 60 nodes.

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The following figure 17 shows the Bar Graph corresponding to the Routing Load Analysis for different nodes.

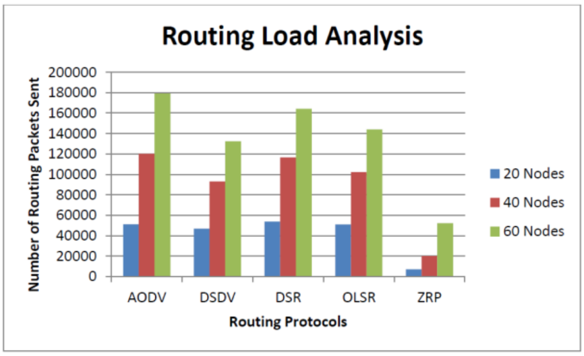

Figure 17: Bar Graph showing Routing Load Analysis.

E. End to End Delay (E2E Delay) Analysis

E2E Delay is the Time required to transmit a packet on the network from source to destination. The following table 6 shows the delays corresponding to different nodes.

The following figure 18 shows Bar Graph for end to end delays for different nodes.

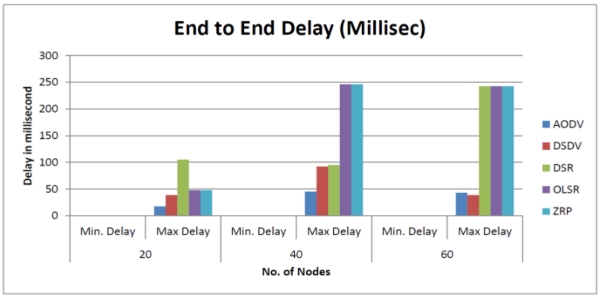

Figure 18: Bar Graph of End to End Delay

Throughput(ms)						
	Number of Nodes					
Proposed Protocols	20		40		60	
	Min.Delay	Max.Delay	Min.Delay	Max.Delay	Min.Delay	Max.Delay
DSR	0.0054528	105.29017	0.0054480	94.79457	0.0054966	242.4625
AODV	0.0054675	17.66724	0.0054981	45.01897	0.0054971	42.92459
DSDV	0.0054604	38.69645	0.0054830	92.10621	0.0054965	38.69645
OLSR	0.0054478	47.85650	0.0054480	245.9905	0.005458	242.4625
ZRP	0.0054478	47.85650	0.0054480	245.9905	0.005458	242.4625

Table 6: End to End minimum and maximum delay (ms) for 20, 40 and 60 nodes comparison

IV. CONCLUSION

We have presented a comparative analysis among Proactive, Reactive and Hybrid routing protocol. During simulation, we have established that MANET is self-configuring network and requires individual nodes to route data, this making routing protocol a vital component for network operational effectiveness and efficiency.

CBR (UDP) based traffic speaking sources were used and the results compared and simulation based study was performed using AODV, DSR, OLSR, DSDV and ZRP routing protocols using NS2 simulator. We identified that: By increasing the number of nodes the packet drop rate also increased, when we doubled the number of nodes we identified that packet drop rate increased exponentially, AODV has highest packet drop rate while ZRP has lowest packet drop rate. When we further increased the number of nodes to 60 i.e. 2.5 times of the initial scenario, we observed that packet drop rate decreased while increasing the number of nodes. ZRP has lowest packet drop rate and AODV has highest packet drop rate for all 3 scenarios.

As we can see that AODV has the highest throughput in all three scenarios. When we increased the number of nodes throughput was decreased, however ZRP throughput was increased relatively. We identified that the minimum delay for all five routing protocols was more or less same; we observed variation in maximum delay threshold while I increased the number of nodes. We found that when we doubled the number of nodes the end to end delay for OLSR and ZRP routing protocols increased more than five times, however for other routing protocols delay also doubled. When we increased number of nodes to 60 i.e. 2.5 times of the initial scenarios, no measure variation in delay was observed, however for the case of DSDV, we observed that delay was increased when doubling the number of nodes but when we further increased the number of nodes its E2E delay was decreased during the course of simulation. We identified steady increase in average end to end delay for all routing protocols while rising number of nodes.

We observed marginal improvement in packet delivery / receiving rate while increasing number of nodes.

With increased number of nodes, we found that ZRP has highest routing load during the simulation, while OLSR and DSDV routing load was less than that of AODV and DSR routing protocols.

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