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JWSN 2015, 2, 1-0010

Journal of Wireless Sensor Networks

ISSN: 2001-6417

www.wsn-journal.com

Article

Analysis and Comparison of Routing protocols in MANET using Simulation

Anjum Nazir, Celestine Iwendi and Murtaza Siddiqi

1. Research Analyst, Geeks Hub, anjum@geeks-hub.com (Mr. Anjum Nazir)
2. Director, WSN Consults Ltd, Celestine.iwendi@ieee.org (Dr. Celestine Iwendi)
3. SzabistLarkana, C. S Department, murtazasiddiqi@lrk.szabist.edu.pk (Mr. Murtaza Siddiqi)

Correspondence: celestine.iwendi@ieee.org (Dr. Celestine Iwendi)

Received: 29 May 2015/ Accepted: 03 July 2015/Published: 27 July 2015

Abstract: In this paper a comparative analysis among Proactive, Reactive and Hybrid routing protocolis presented using simulation. As we are 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.

Key Words: MANET; Routing Protocol analysis;routing protocol simulation

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.

Simulation details: This analysis is for Mobile Adhoc Network (MANET) to analyze its behavior using while using NS-2 Simulator on routing protocols
On demand/ reactive:

1. Dynamic Source Routing (DSR),
2. Ad hoc On-demand Distance Vector (AODV)

Table driven/Proactive:

1. Optimized Link State Routing Protocol (OLSR)
2. Destination Sequence Distance Vector (DSDV)

Hybrid:

1. ZRP (Zone Routing Protocol)

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 / Receiving Rate and Normalized Routing Load.As these are the most important factors which can highlight the main difference among these routing protocols and under what scenario which protocol will be suited best as shown in Table 1.0. 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.

Table 1.0

Parameter	**Value**
Simulator	NS2 Version 2.35
Protocols Studied	AODV, DSR
	DSDV, OLSR
	ZRP
Simulation Time	300 sec
Simulation Area	500m x 500m
Traffic Parameters	
Traffic Type	CBR
Packet Size	512 bytes
Packet Rate / Source	10 PPS
Mac	802.11
No. of Nodes	20, 40, 60
No. of Sources	16, 32, 48
Mobility Parameters	
Node Movement	Random Way Point
Speed Type	Uniform
Minimum Speed	1 m/s
Maximum Speed	10 m/s
Pause Type	Uniform
Pause Time	5 seconds

Analysis:

Packet Drop Rate Analysis

Figure1.0: Packet Drop Rate behaviour for 20 nodes for 300 seconds

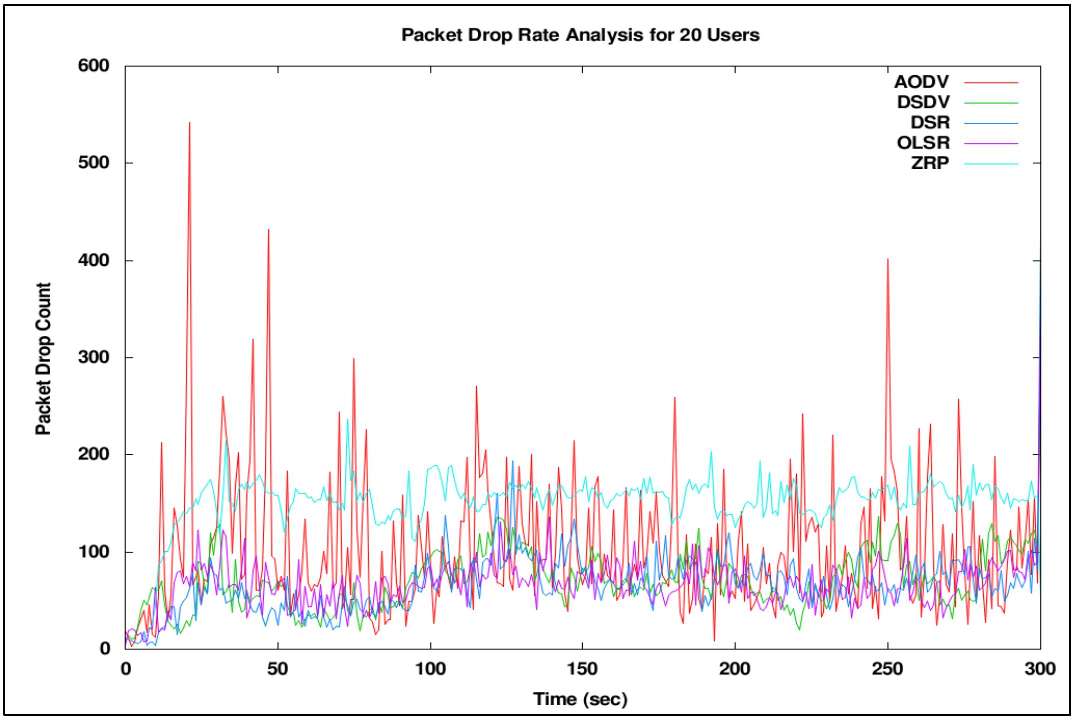


Figure 1.2: Packet Drop Rate behaviour for 40 nodes for 300 seconds

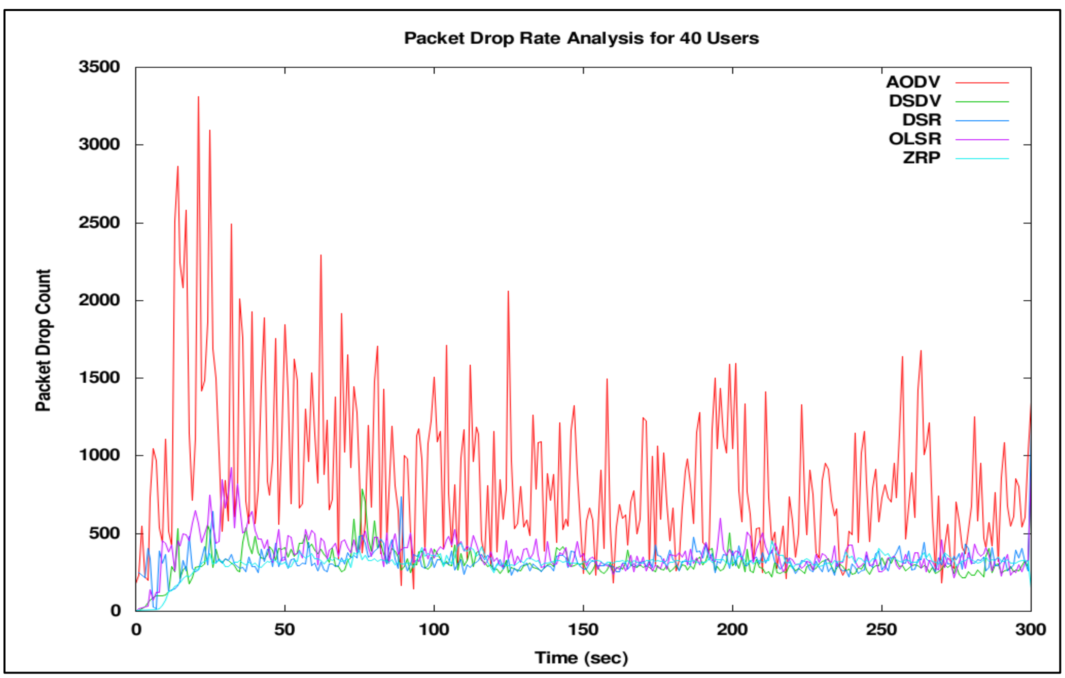
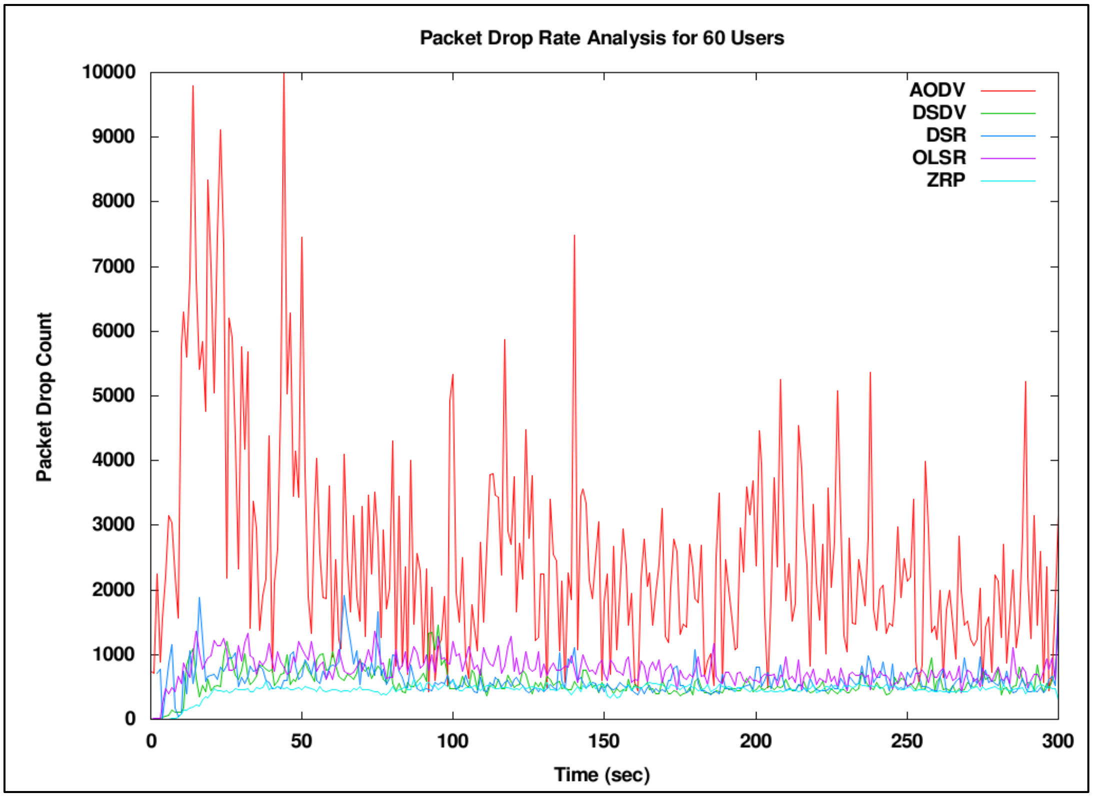


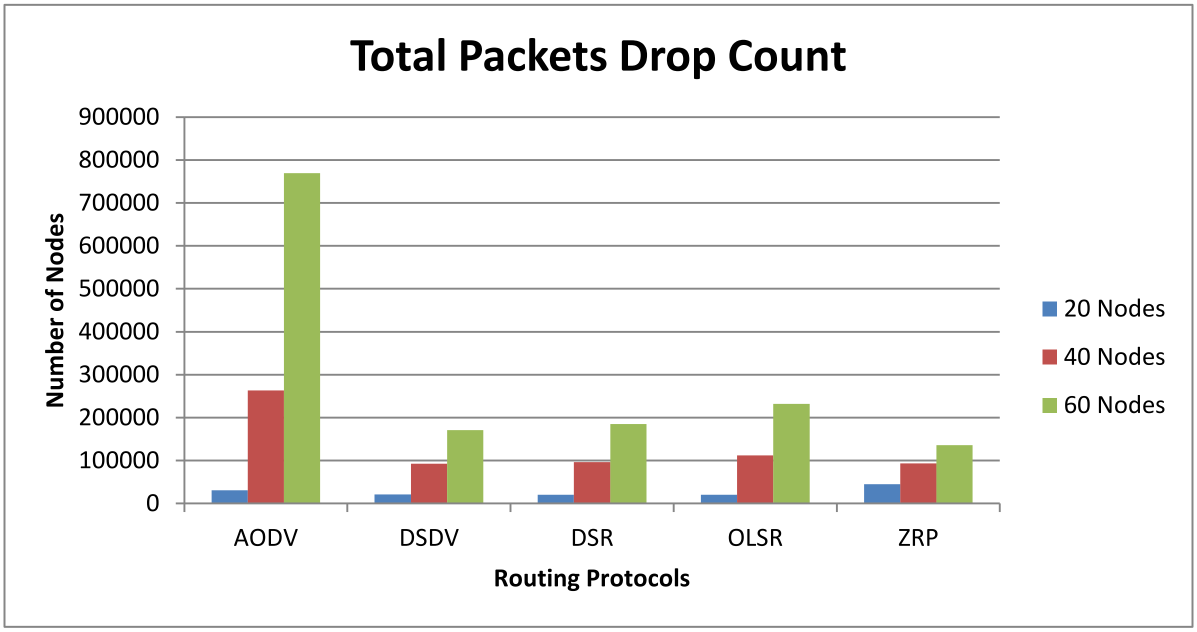
Figure 1.3: Packet Drop Rate behaviour for 60 nodes for 300 seconds



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

Table 2.0: **Total Packets Drop Count**

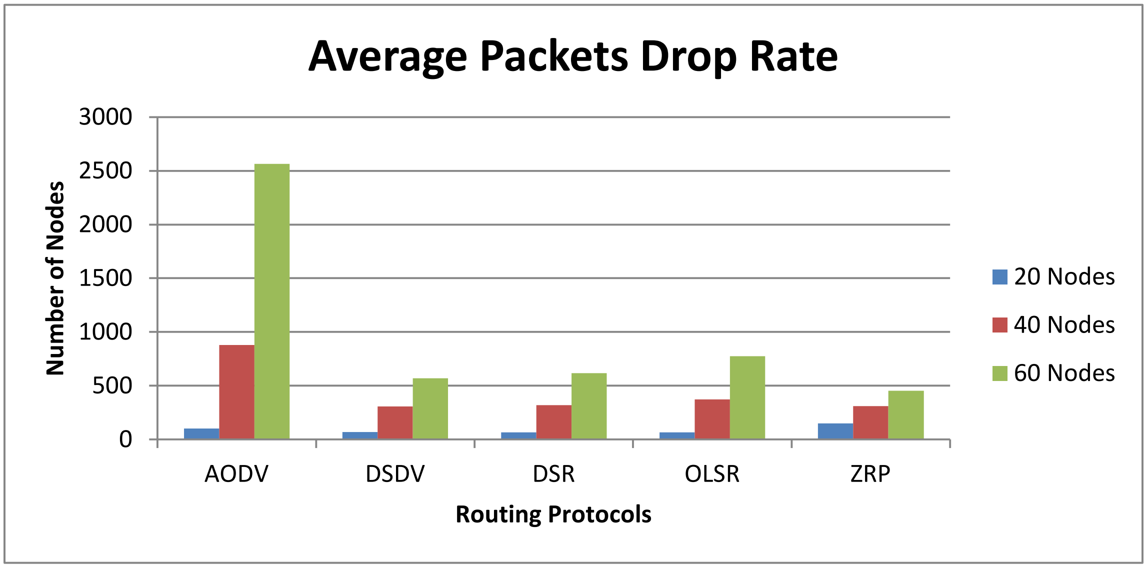
Figure 2.0: Total Packets Drop Count for 20, 40 and 60 nodes



Average Packets Drop Rate			
	Number of Nodes		
Routing Protocols	20	40	60
AODV	102.65	878.69	2564.93
DSDV	70.61667	308.0867	568.4767
DSR	66.88667	320.5433	617.2233
OLSR	67.30333	373.89	774.4433
ZRP	150.4667	311.75	452.1433

Table 2.1: **Average Packets Drop Rate**

Figure 2.1: Average Packets Drop Rate for 20, 40 and 60 nodes



Throughput

Figure 3.0: Throughput analysis for 20 nodes

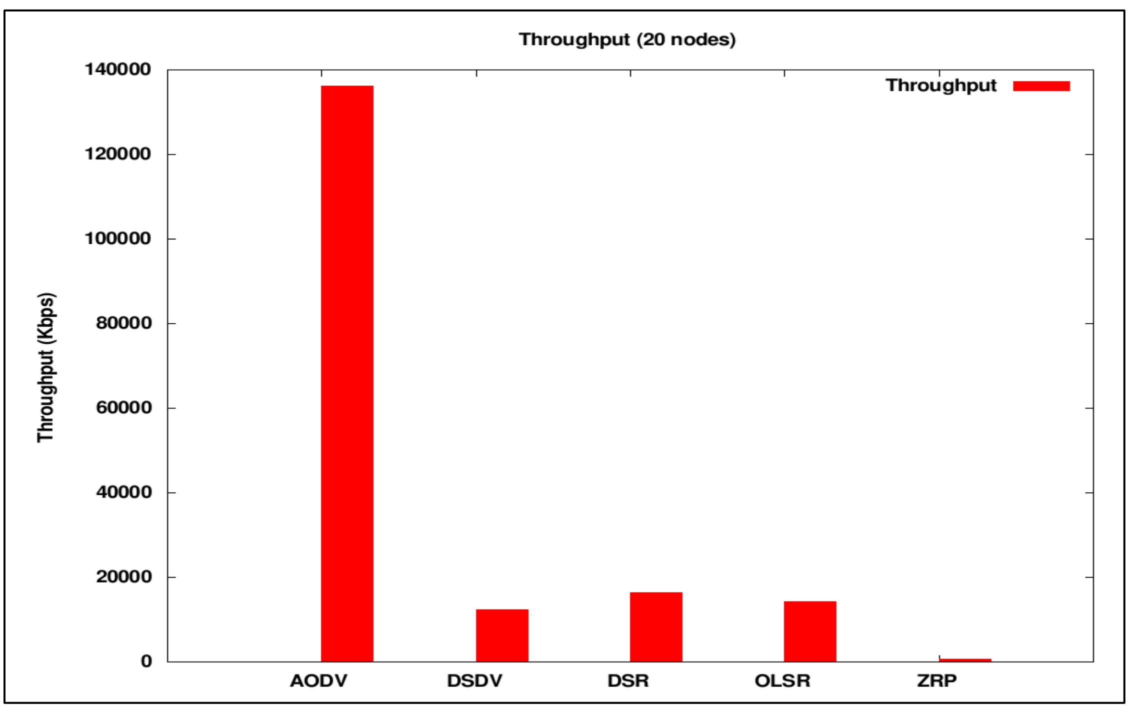


Figure 3.1: Throughput analysis for 40 nodes

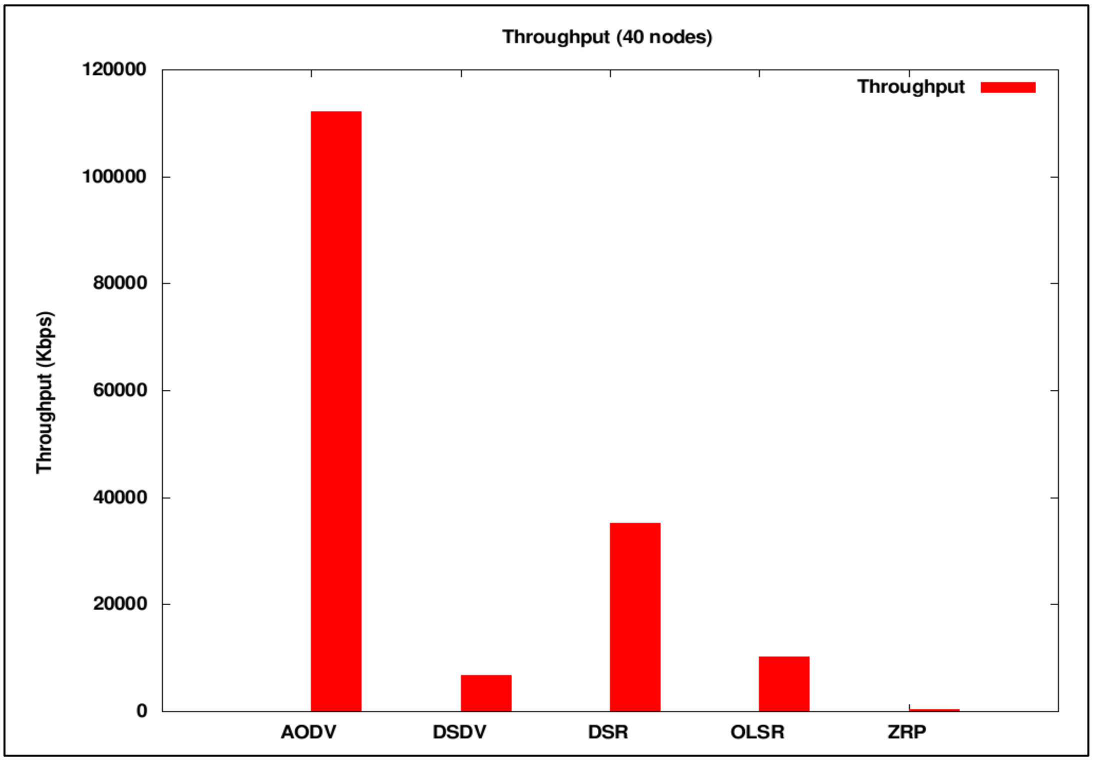
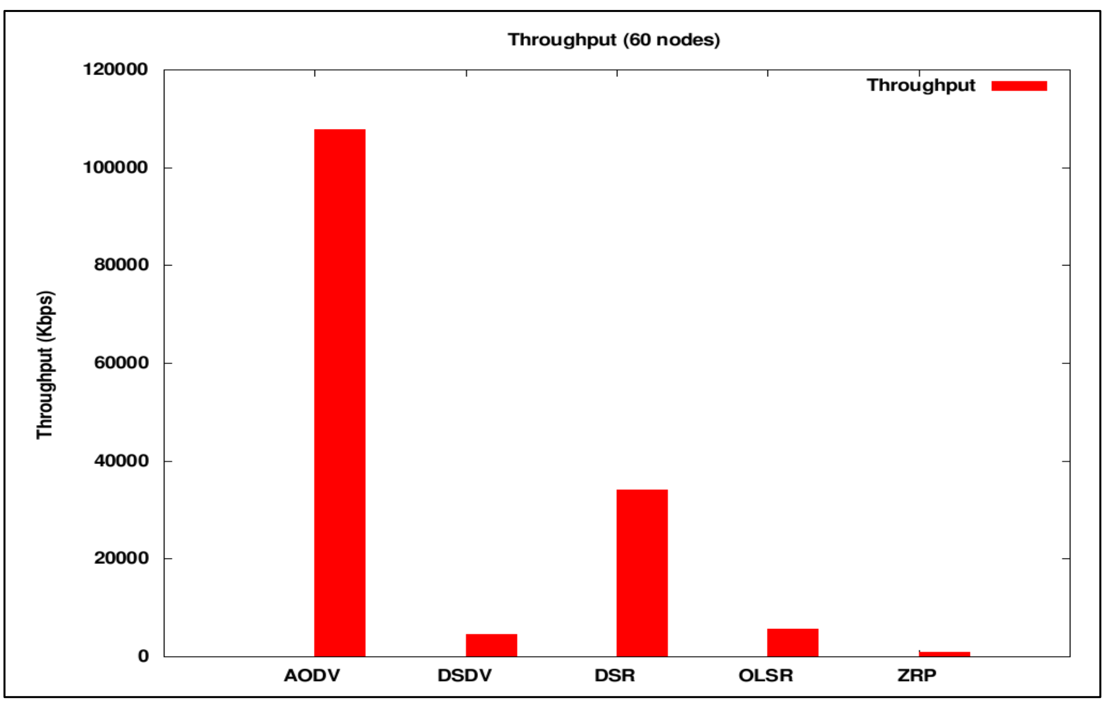


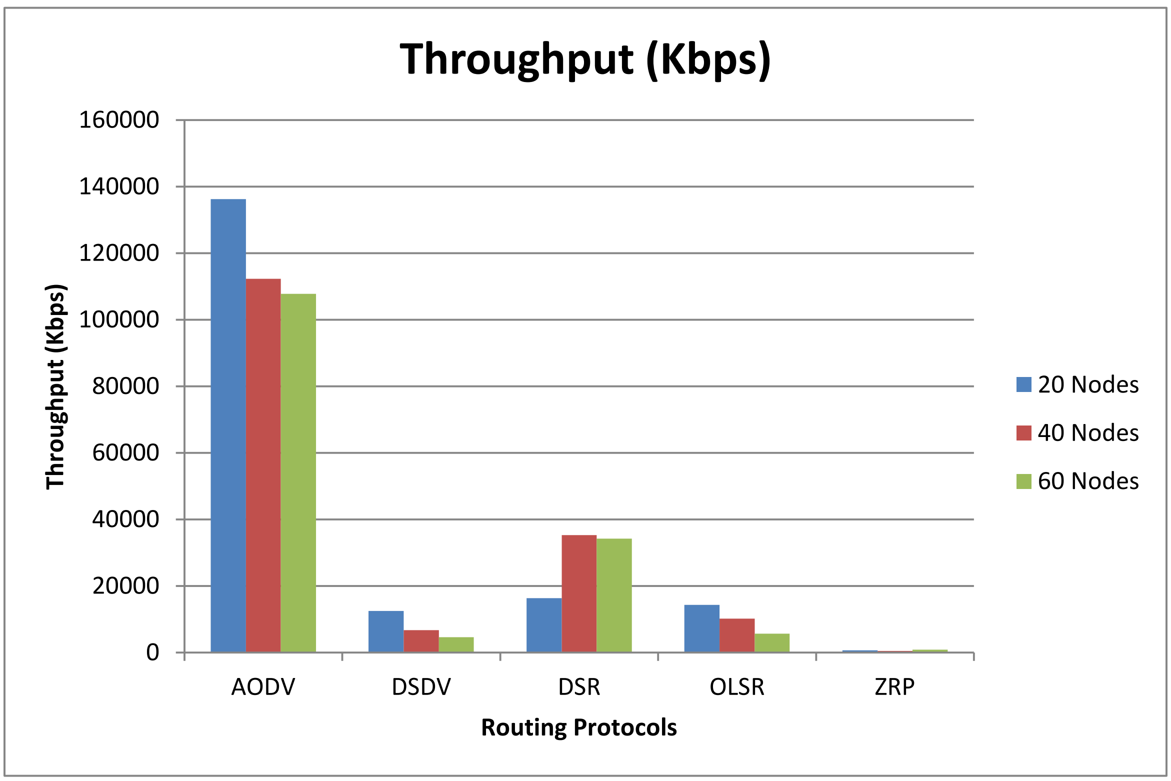
Figure 3.2: Throughput analysis for 60 nodes



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

Table 2.2: **Throughput (Kbps)**

Figure 4.0: Throughput comparison for 20, 40 and 60 nodes

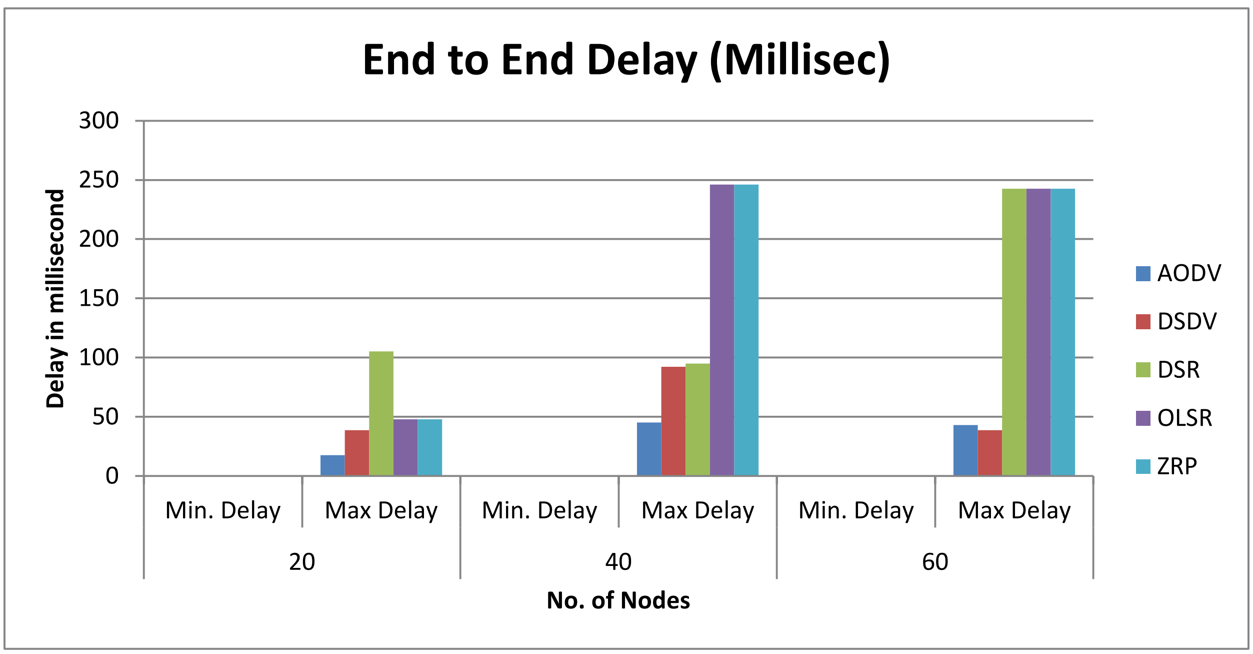


End to End Delay

End to End Delay (msec)						
Routing Protocols	**Number of Nodes**					
	20		**40**		**60**	
	Min. Delay	**Max Delay**	**Min. Delay**	**Max Delay**	**Min. Delay**	**Max Delay**
AODV	0.005467571	17.667242	0.005498198	45.018971	0.005497101	42.924596
DSDV	0.005460466	38.69645	0.005483689	92.106234	0.005496545	38.69645
DSR	0.005452819	105.29017	0.005448028	94.794575	0.005496601	242.4625
OLSR	0.00544787	47.856507	0.005448028	245.99055	0.005458219	242.4625
ZRP	0.00544787	47.856507	0.005448028	245.99055	0.005458219	242.4625

Table 2.3: **End to End Delay (msec)**

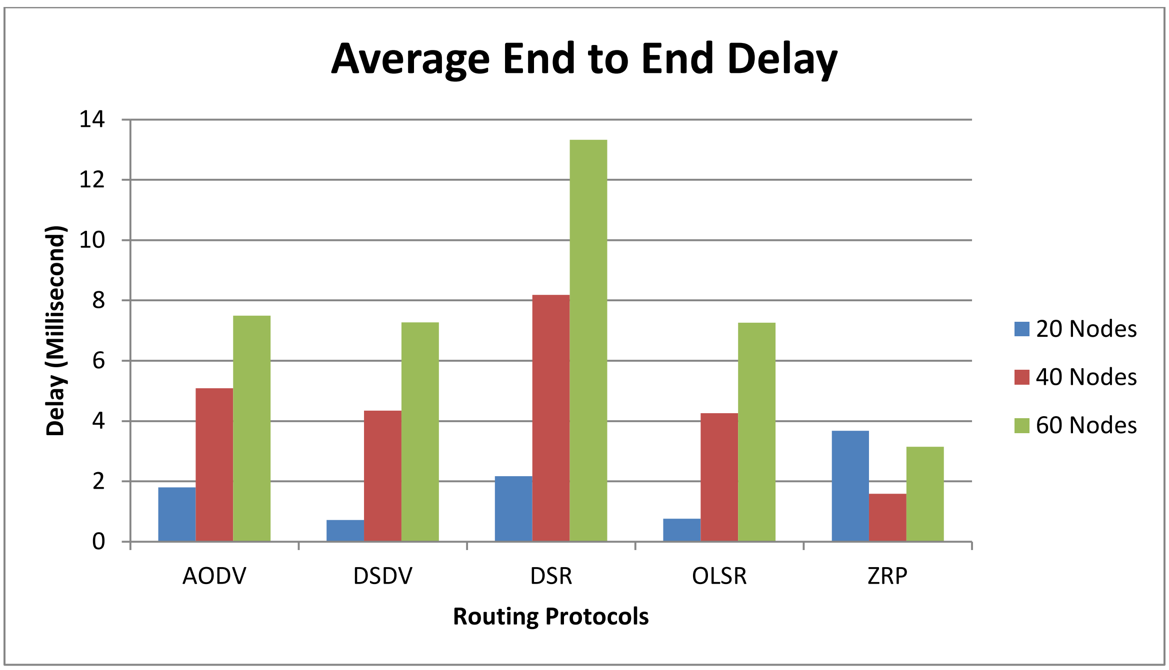
Figure 5.0: End to end minimum and maximum delay for 20, 40 and 60 nodes comparison



Average End to End Delay (Millisec)			
	Number of Nodes		
Routing Protocols	20	40	60
AODV	1.797867	5.084719	7.494557
DSDV	0.715957	4.350629	7.273283
DSR	2.16701	8.184668	13.32457
OLSR	0.761475	4.263738	7.262849
ZRP	3.675804	1.590896	3.151393

Table 2.4: **Average End to End Delay (millisecond)**

Figure 6.0: Average end to end delay for 20, 40 and 60 nodes



Packet Receiving / Delivery Rate

Packet delivery or receiving rate describes the summation of total number of packets received by each node over time.

Figure 7.0: Packet receiving / delivery rate analysis for 20 nodes

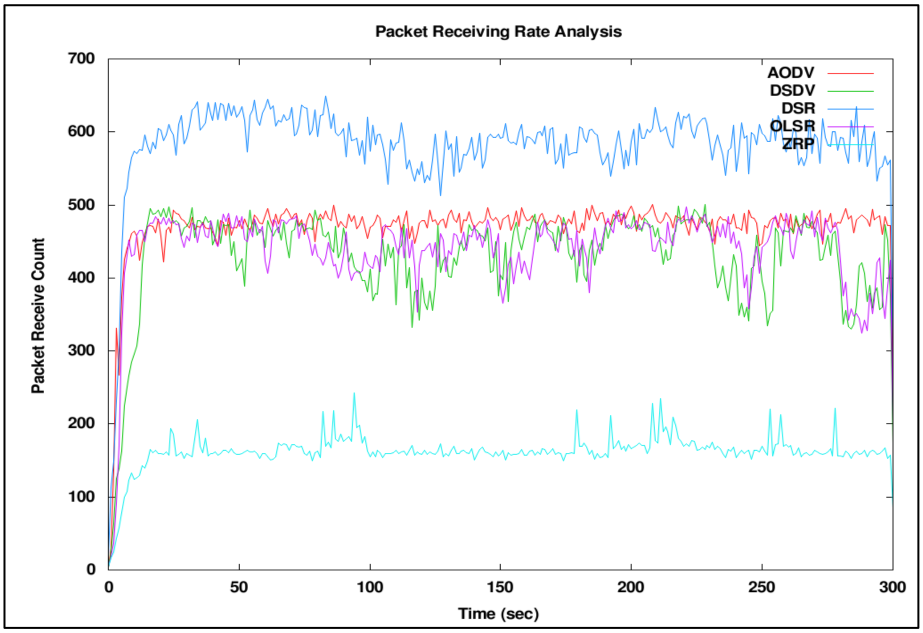


Figure 7.1: Packet receiving / delivery rate analysis for 40 nodes

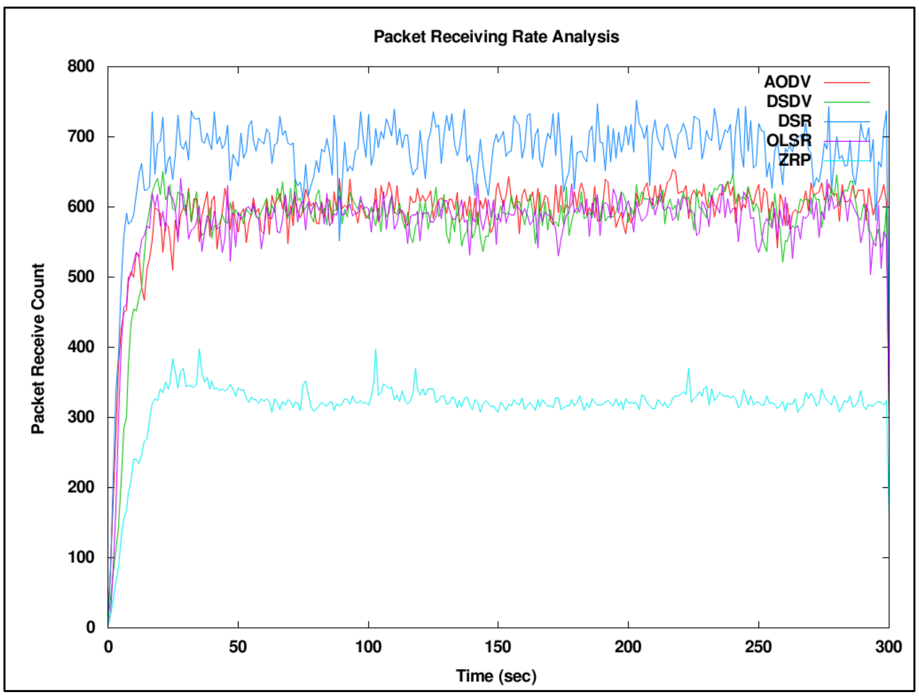
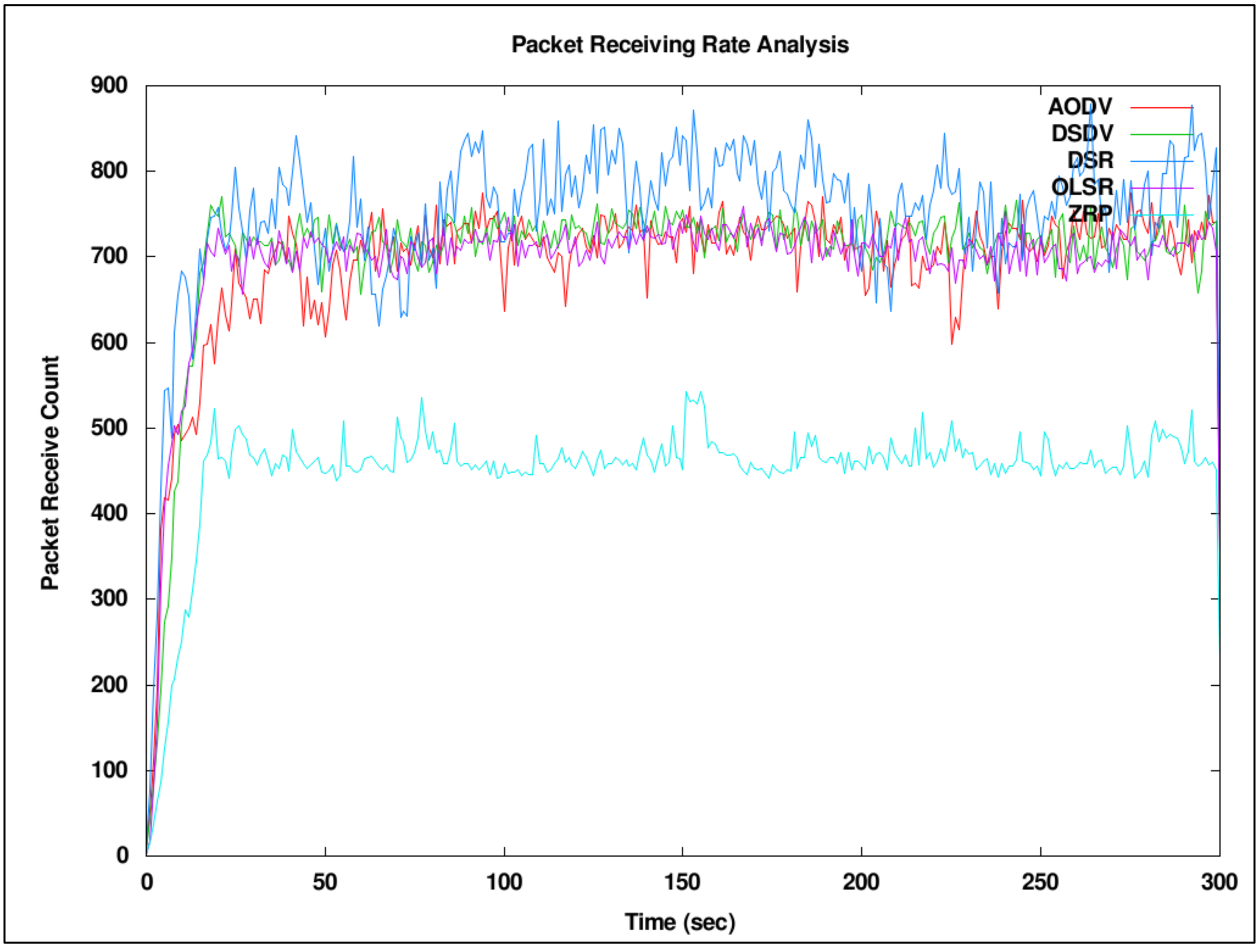


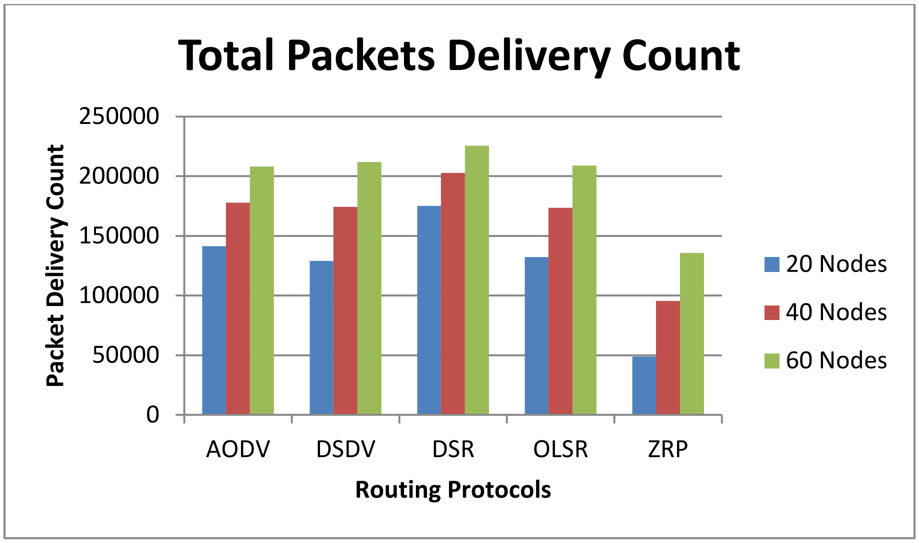
Figure 7.2: Packet receiving / delivery rate analysis for 60 nodes



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

Table 2.4: **Total Packets Delivery / Receiving Rate**

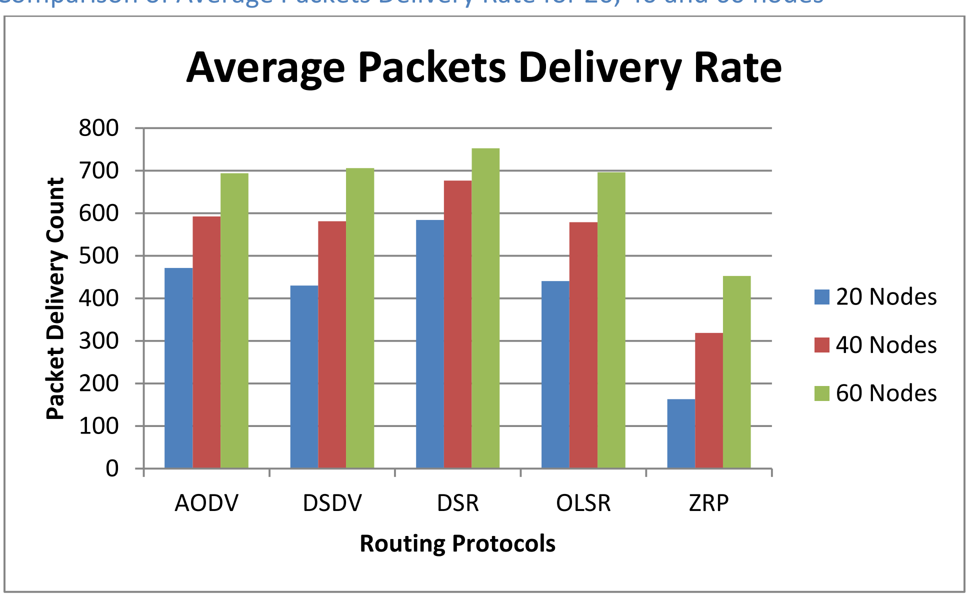
Figure 7.3: Comparison of total packets delivery count for 20, 40 and 60 nodes



Average Packets Delivery / Receiving Rate			
	Number of Nodes		
Routing Protocols	20	40	60
AODV	471.2467	592.3767	693.83
DSDV	430.0767	581.06	705.7633
DSR	584.0733	676.1267	752.15
OLSR	440.4133	578.4933	696.0567
ZRP	162.67	318.2	452.0033

Table 2.5: **Average Packets Delivery / Receiving**

Figure 7.4: Comparison of Average Packets Delivery Rate for 20, 40 and 60 nodes



Routing Load Analysis

Routing load determines the number of routing messages / packets exchange during the course of simulation.

Figure 8.0: Routing Load Analysis for 20 nodes for 300 seconds

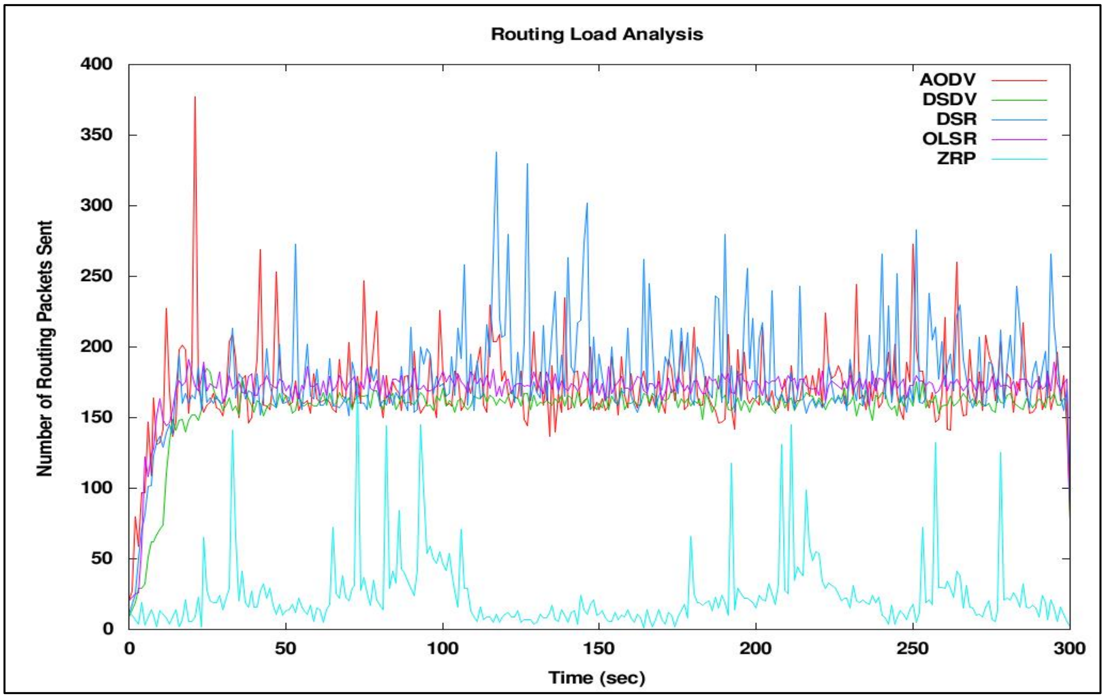


Figure 8.1: Routing Load analysis for 40 nodes for 300 seconds

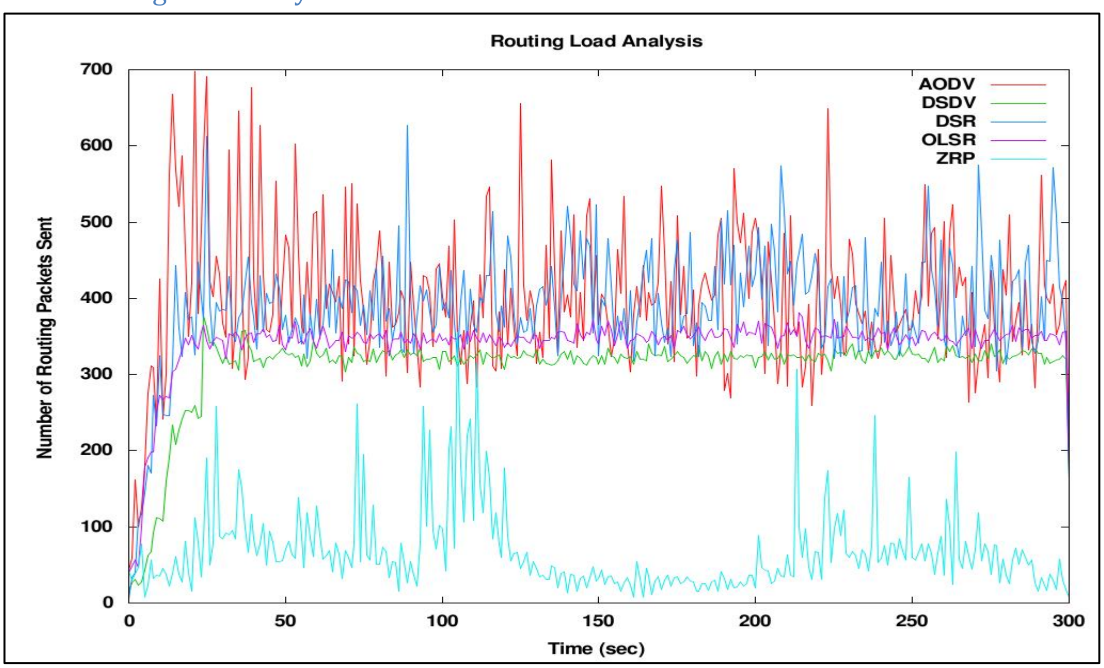
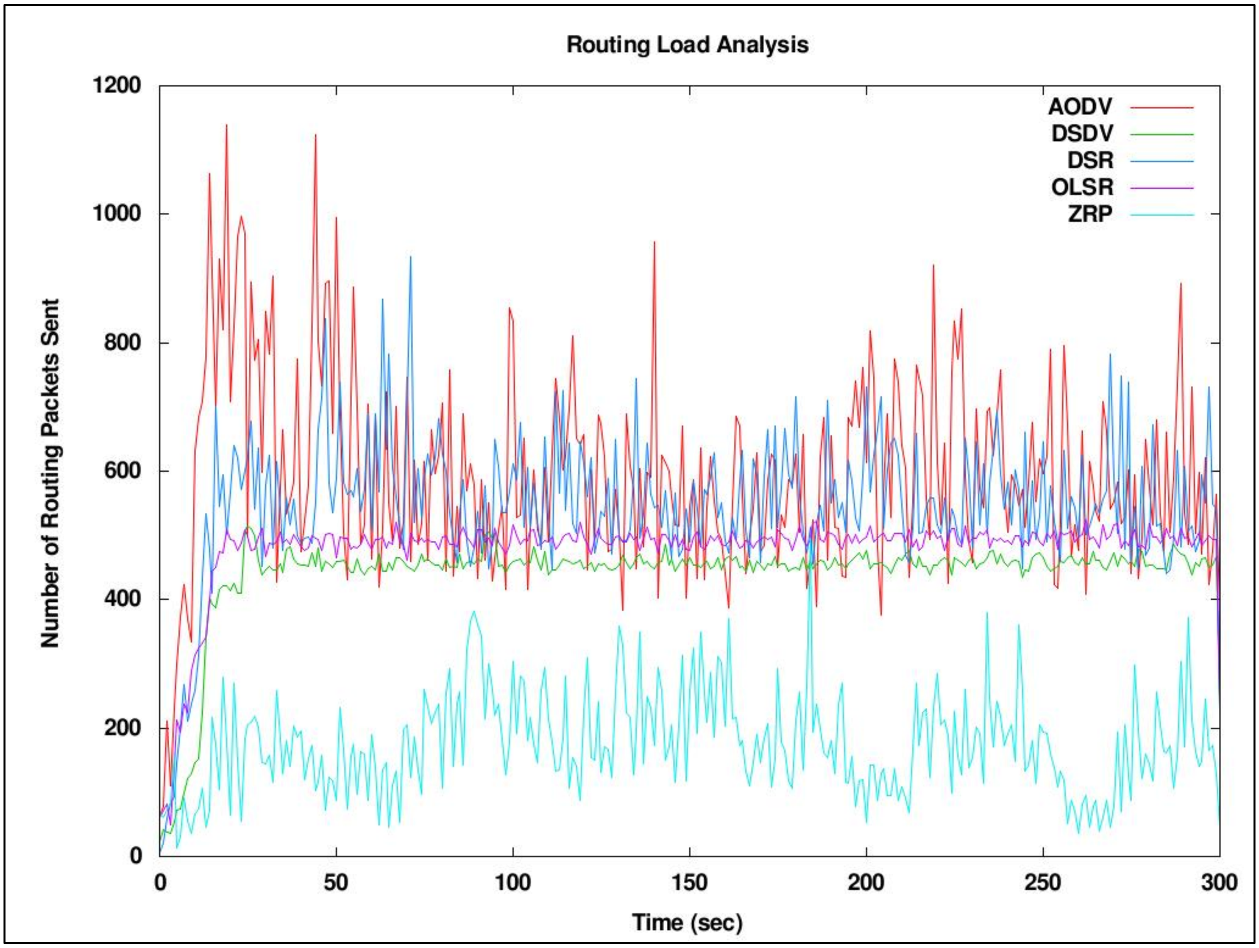


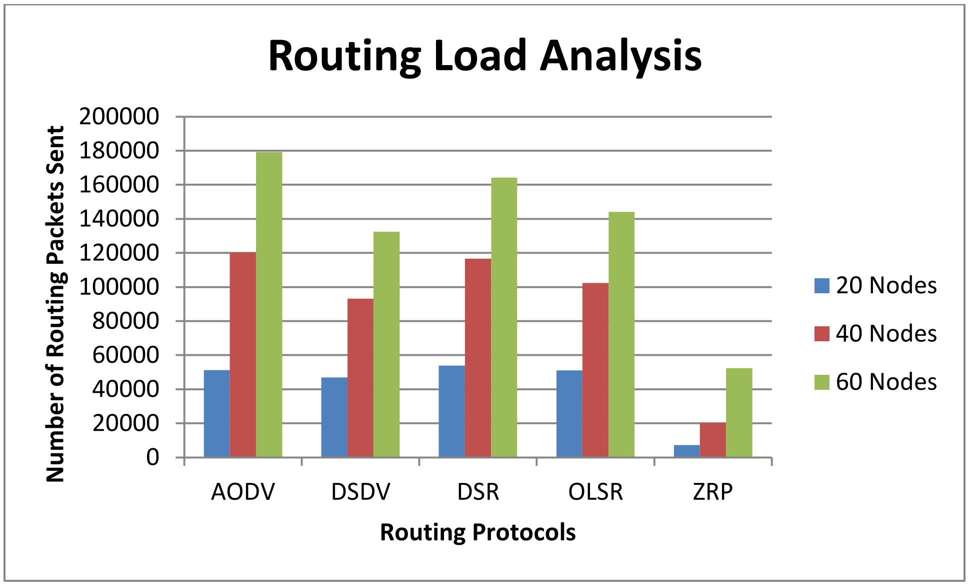
Figure 8.2: Routing Load Analysis for 60 nodes for 300 seconds



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

Table 2.5: **Routing Load Analysis Rate**

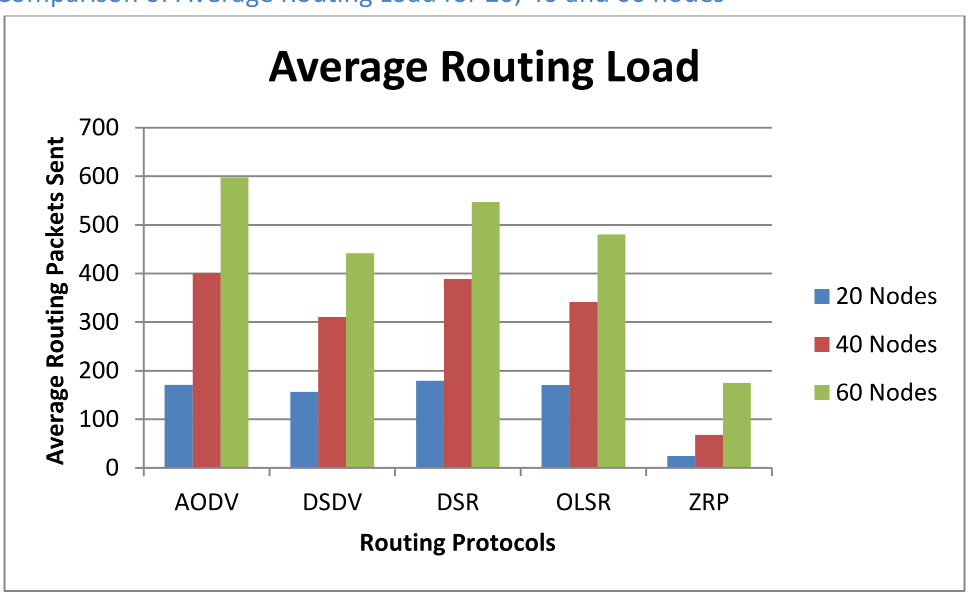
Figure 8.3: Comparison of Routing load for 20, 40 and 60 nodes



Average Routing Load Analysis			
	Number of Nodes		
Routing Protocols	20	40	60
AODV	170.84	400.75	597.24
DSDV	156.4633	310.28	441.2067
DSR	179.3	388.8767	547.2367
OLSR	170.19	341.18	480.2133
ZRP	23.98333	67.13667	174.5833

Table 2.6: **Average Routing Load Analysis**

Figure 8.4: Comparison of Average Routing Load for 20, 40 and 60 nodes



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 Reactive (AODV, DSR), Proactive (OLSR, DSDV) and Hybrid (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 we 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 end to end delay was decreased during the course of simulation. We identified steady increase in average end to end delay for all routing protocols while increasing 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.

Conflict of Interest

The authors declare no conflict of interest.

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