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Performance Analysis of DSDV, I-DSDV, OLSR, ZRP Proactive Routing Protocol in Mobile Ad Hoc Networks in IPv6

Aman Kumar[1] and Rahul Hans[2]

[1]*Research Scholar CSE Department DAV University Jalandhar*
[2]*Assistant Professor CSE Department DAV University Jalandhar*
[1]*amank764@gmail.com*, [2]*rahulhans@gmail.com*

Abstract

Ad hoc network is a collection of wireless mobile nodes where wireless radio interface connects each device in MANET to move freely, independently and randomly. Routing protocols in mobile ad hoc network helps to communicate source node with destination node by sending and receiving packets. The communication between these mobile nodes is carried out without any centralized control. Thus it is necessary to analyze the behavior of different routing protocols under different environments. Many studies have been done on the performance evaluation of routing protocols of MANET, but most of these studies are based on IPv4. On the other hand Ipv6 is gaining popularity because it has some additional feature over Ipv4 as it supports multicasting, multi-homing, efficient routing. Ipv6 is more secure as compared to IPv4 and has large address space to support. In this paper performance of four proactive ad hoc routing protocols Optimized Link State Routing Protocol (OLSR) Destination-Sequenced Distance Vector (DSDV) Improvement Destination-Sequenced Distance Vector (I-DSDV) Zone routing protocol (ZRP) evaluated under Ipv6 environment on the basis of end to end delay, packet delivery fraction, routing overhead. The objective of this paper is to investigate how these routing protocols behave under IPv6 environment and identify which routing protocol perform better. Ns-2 is used as simulation tool.

Keywords**:** *Mobile Ad Hoc Network, Routing Protocols, Internet Protocol Version 6, DSDV, OLSR, I-DSDV, ZRP*

1. Introduction

A mobile Ad-hoc Network (MANET) is a collection of wireless nodes that cam dynamically be set up anywhere and anytime without using any pre0existing network infrastructure. A MANET consist mobile nodes, a router with multiple host and wireless communication devices. The wireless communication devices are transmitters, receivers and smart antennas. These antennas can be of any kind and nodes can be fixed or mobile [1]. The term node referred to as, antennas can be of any kind and nodes can be fixed or mobile. In mobile ad hoc network nodes move arbitrarily so topology in mobile ad hoc network may change frequently. Study of the routing protocols of mobile ad hoc network is an area of research since past two decades. The vision of mobile ad hoc networking is to support robust and efficient operation in mobile wireless network is to support robust and efficient operation in mobile wireless network by incorporating routing functionality into mobile nodes [4]. There is always a need in mobile ad hoc network to search a good path for the routing of data packets from source to destination. In mobile ad hoc network every mobile node acts as a host and as a or Due to the limited transmission range of wireless networks, multi-hops are needed to exchange data packets between sources to destination in network. The IPv6 Based MANETs technology has become increasingly important and has a great application prospect

And internet today has become the backbone of wire network which is deployed all

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around the world [14]. AT The same time, wireless communications and mobile computing are gaining more popularity in recent years. When a mobile nodes in the ad hoc network wants to exchange packet with internet, it must be assigned global IP address firstly and the discovery the available internet gateways to connect internet through them. Much wireless technology is based upon the principle of direct point-to-point communication. In most popular communication models such like Wireless Local Area Network (WLAN) and Group Standard for Mobile communications (GSM), mobile nodes use an approach, where communicate takes place to each other via some centralized access points [12].

2. Routing Protocols in Manet

On the basis of properties mobile ad hoc routing protocols are divided into two types:

- Reactive Routing Protocols (On Demand)
- Pro-active Routing Protocols (Table Driven)

2.1 Reactive Routing Protocols

Reactive Protocol has lower overhead since routes are determined on demand. It employs flooding concept. Reactive Protocol searches for the route in an on-demand manner and set the link in order to send out and accept the packet from a source node to destination node. Reactive routing protocol is a type of routing protocol in which route is established when it is needed by source node is established when it is needed by source node to send data packets to the destination node. In reactive routing protocol flooding technique is used for route discovery. The main advantage of this type of routing protocols is to save precious bandwidth of ad hoc network.

2.2. Pro-active Routing Protocols

Proactive is type of routing protocol in which each node maintains routing information of every other node in a network. These nodes record for the entire presented destination, number of hops record for the entire presented destination in routing table. The routing entry is tagged with a sequence number which is created by the destination node. To retain the stability each station broadcasts and modifies its routing table from time to time. How many hops are required to arrive that particular node and which stations are accessible is result of broadcasting of packets between nodes. The proactive protocols are appropriate for less number of nodes in networks, as they need to update node entries for each and every node in the routing table of every node.

2.2.1 OLSR (Optimized Link State Routing Protocol): OLSR is a proactive protocol. Its main functionality is to construct a routing table for each node in the MANET. The OLSR protocol is a variation of the pure LSR protocol and is designed specifically for MANETs [3]. The OLSR protocol achieves optimization over LSR through the use of MPR (Multi Point Relay) nodes [13]. The MPR nodes are selected and designated by neighboring nodes.OLSR is type of table-driven pro-active link state routing protocol developed for mobile ad hoc network [14]. OLSR exchange information with other nodes in the network [8]. In OLSR the concept multi point relay (MRP) is used to reduce control traffic overhead. In OLSR nodes elect MRP among themselves. MRP is transmitting the control messages on the behalf of other nodes in the network. Each node in a network has a list of MPR nodes. The OLSR is suited for large and dense network. MPR helps in providing the shortest path to destination. Different types of control messages are used in OLSR. Hello message are used to find link status information and host’s neighbor.

2.2.2 **DSDV (Destination-Sequenced Distance Vector):** DSDV is a table driven routing protocol that is an enhanced version of the distributed Bellman-Ford algorithm. In all table driven protocols each node maintains a table that contains the next hop to reach all destinations [2]. In DSDV, each route is tagged with a sequence number which is originated by the destination, indicating how old the route is to each node manages its own sequence number by assigning it two greater than the old one every time. Packets are transmitted between the stations of the network by using routing tables which are stored at each station of network. When a route update with a higher sequence number is received, the old route is replaced. In case of different routes with the same sequence number, the route with better metric is used. Updates are transmitted periodically or immediately when any significant topology change is detected. Packets are transmitted between the stations of the network by using routing tables which are stored at each station of the network. Each routing table at each of the stations, lists all available destinations and the number of hops to each.

2.2.3 **I-DSDV (Improvement Destination-Sequenced Distance Vector):** In DSDV the low packet delivery is due to the fact that, it uses stale routes in case of broken links. In DSDV the existence of stale route does not imply that there is no valid route to destination [9]. The packets can be forwarded thru other neighbors who may have route to the destination.

2.2.4 **ZRP (Zone routing protocol):** ZRP is designed to address the problems associated with proactive and reactive routing [7]. The ZRP takes advantages of a pro-active routing protocol. For communication over the local neighborhood, the reactive routing protocol. Excess bandwidth consumption because of flooding of updates packets and long delay in route discovery request are two main problems of proactive and reactive routing respectively. ZRP came with the concept of zone route maintenance is easier and reactive routing respectively [5][6]. ZRP came with the concept zones [16]. In limited zone route maintenance is easier and because of zone, numbers of outing updates are decreased. Nodes on the boundary of the routing zone are called peripheral nodes and play an important role in the reactive zone-based route discovery Nodes out of the zone can communicate via reactive routing for this purpose route request is not flooded to entire network only the border node is responsible to perform this task. ZRP combines the feature of both proactive and reactive routing algorithms [10, 11]. The architecture of ZRP consists of four elements: MAC-level function, Intra- Zone Routing Protocol (IARP), Intra-Zone Routing Protocol (IERP) and Broadcast Routing Protocol (BRP). The proactive routing is based within limited specified zones and beyond the zones reactive routing is used. MAC-level performs neighbor discovery and maintenance function [17].

3. Internet Protocol

Internet protocol is a primary communication protocol which is used to send data packets from source to destination node in network. Data is transmitted in the form of data gram. Fragmentation is a technique which is used to send large datagram in network in it large datagram is divided into small data packets that can easily be transmitted in the network, because every network link has limited size for messages transmission in a network which known as maximum transmission unit (MTU) [18]. Datagram is used to send large amount of data. Datagram structure is defined by internet protocol and data is which is encapsulated in these datagram is sent from source to destination. Internet Protocol is connection less protocol is no guarantee of delivery of data. Internet Protocol has two versions, namely, internet Protocol Version 4 and Internet Protocol Version 6. Internet Protocol Version 4 (IPv4) is a widely used protocol which was deployed by Internet Engineering Task Force (IETF) is early 1990. IPv4 has 32 bits address space and is able to provide 4,294,467,294 addresses. Some addresses are reserved for special purposes and are not available for public use. IPv4 is more prone to network attacks because no encryption and authentication is used. IPsec which is responsible for secure routing is optional in IPv4. IPv6 has 128 bits address space and is able to provide approximately 3.4× addresses. IPv6 and also it is more secure as compared to IPv4 because several encryption and authentication techniques like ESP are used. IPsec is mandatory in IPv6. IPv6 uses flow label mechanism so router easily recognize where to send information. IPv6 header size is 40 bytes and so it is simple and small in size as compared IPv4. IPv6 supports multicasting and multi-homing, efficient routing which is not supported by IPv4. On the basis of the above discussion we conclude that internet protocol version 6 is the future internet protocol and the future internet technology depends on IPv6, Therefore, it is necessary to evaluate the performance of these routing protocols under IPv6. This can help us if immediate shifting from IPv4 environment to IPv6 environment is required.

4. Simulation

The objective of this paper is the performance evaluation of four routing protocol for mobile ad hoc network by using an open source network simulation tool is called NS-2. Four routing protocols: DSDV, I-DSDV, OLSR and ZRP have been considered for performance evaluation in this work. The simulation environment has been conducted with the UBUNTU operating system, because NS-2 works with Ubuntu platform only. Whole simulation study is divided into two part one is create the node i.e. NS-2 output it called NAM (Network Animator) file, which shows the nodes movement and communication occurs between various nodes in various condition or to allow the users to visually appreciate the movement as well as the interactions of the mobile node and another one is graphical analysis of trace file (.tr). Trace file contain the traces of event that can be further processed to understand the performance of the network.

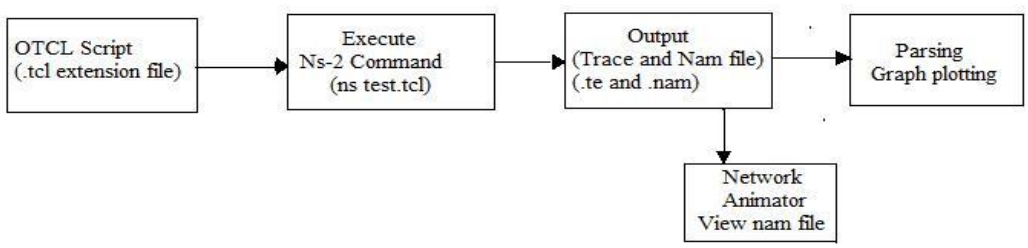

Figure 1

5. Performance Metrics

5.1 End-To-End Delay: End-To-End delay is the average time that takes by a data packet to reach its destination. This metric is calculated by subtracting time that first data take to traverse the network from time at which first data packet arrived to destination. This is a time the generate data packet by sender and it received by receiver at destination in application layer and it is measured in seconds. All delays in network is cause by node mobility, packet, retransmission and due to weak signal strength between nodes connection tearing and its making is also be included.

5.2 Packet Delivery Fraction: Packet delivery Fraction is defined as the ratio of data packets received by the destinations to those generated by the sources. Mathematically, it can be defined as: PDR= S1÷ S2 Where, S1 is the sum of data packets received by the each destination and S2 is the sum of data packets generated by the each source. Graphs show the fraction of data packets that are successfully delivered during simulations time versus the number of nodes. Performance of the DSDV is reducing regularly while the PDF is increasing in the case of OLSR and ZRP. OLSR is better among the three protocols.

5.3 Routing Overhead: Traditionally the routing schemes for ad hoc networks are classified into proactive and reactive protocols. Proactive protocol likes DSDV, I-DSDV, ZRP and OLSR maintain routing information about the available paths in the network even if these paths are not currently used. The drawback of such paths is that it may occupy a significant part of the available bandwidth Reactive routing protocol like DSR, TORAand AODV maintain only the routes that are currently available.

6. Simulations and Performance Analysis

This simulation is conducted in three different scenarios. In the first scenario the comparison of the four routing protocol is compared in End to End delay in IPv4 and IPv6. The number of nodes is set to 10, 20, 30 nodes. In the Second scenario the comparison of the four routing protocol is compared in Packet Delivery Fraction in IPv4 and IPv6. The number of nodes is set to 10, 20, 30 nodes. In the third scenario the comparison of the four routing protocol is compared in Routing Overhead IPv4 and IPv6. The number of nodes is set to 10, 20, 30 nodes.

6.1 End to End in Ipv4 and Ipv6 Internet Protocol

- Various number of nodes which are 10, 20, 30 nodes
- Packet size is set to 1200 Bytes
- Area Size is set to 1000×1000
- Node Speed is fixed to 10m/s
- Random way point mobility model is used

6.1.1 End to End delay in IPv4 Internet Protocol

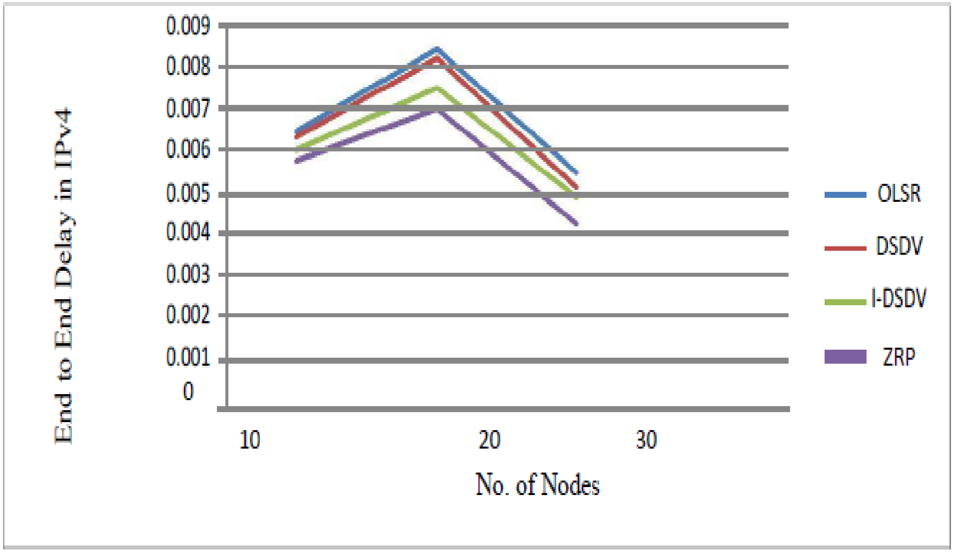

Figure 2.

Table 2. Resultant Values

No. of Nodes	Protocol	IP Version	End to End Delay
10	OLSR	IPv6	0.00555
10	DSDV	IPv6	0.0052
10	I-DSDV	IPv6	0.0049
10	ZRP	IPv6	0.00583
20	OLSR	IPv6	0.00852
20	DSDV	IPv6	0.0083
20	I-DSDV	IPv6	0.0076
20	ZRP	IPv6	0.0071
30	OLSR	IPv6	0.00555
30	DSDV	IPv6	0.0052
30	I-DSDV	IPv6	0.00495
30	ZRP	IPv6	0.0043

6.1.2 End to End delay in IPv6 Internet Protocol

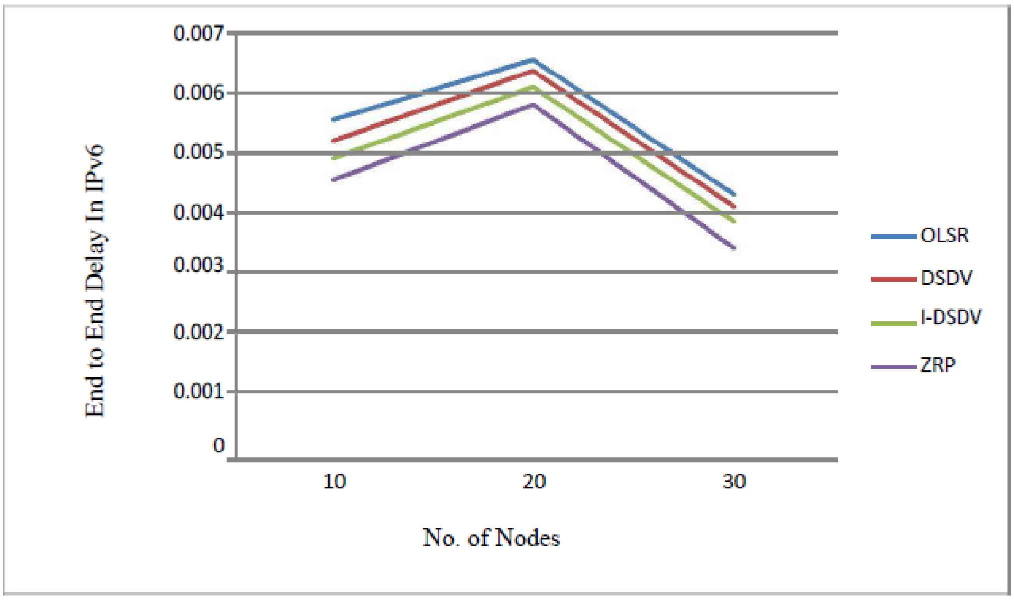

Figure 3

Table 3. Resultant Values

No. of Nodes	Protocol	IP Version	End to End Delay
10	OLSR	IPv6	0.00555
10	DSDV	IPv6	0.0052
10	I-DSDV	IPv6	0.0049
10	ZRP	IPv6	0.00583
20	OLSR	IPv6	0.00852
20	DSDV	IPv6	0.0083

20	I-DSDV	IPv6	0.0076
20	ZRP	IPv6	0.0071
30	OLSR	IPv6	0.00555
30	DSDV	IPv6	0.0052
30	I-DSDV	IPv6	0.00495
30	ZRP	IPv6	0.0043

End to End is the average rate of successful data packets received at destination**.** Figure 2, 3 shows End to End of DSDV, I-DSDV & OLSR with variation in speed. It has observed that the performance Of OLSR is better than DSDV & ZRP with IPV4 whereas the performance of OLSR is better than DSDV, I-DSDV & ZRP with IPV6. OLSR end to end delay corresponds to high efficiency than DSDV, I-DSDV, &ZRP.

6.2. Packet Delivery Fraction in Ipv4 and Ipv6 Internet Protocol

- Various number of nodes which are 10, 20, 30 nodes
- Packet size is set to 1200 Bytes
- Area Size is set to 1000×1000
- Node Speed is fixed to 10m/s
- Random way point mobility model is used

6.2.1. Packet Delivery Fraction in Ipv4 Internet Protocol

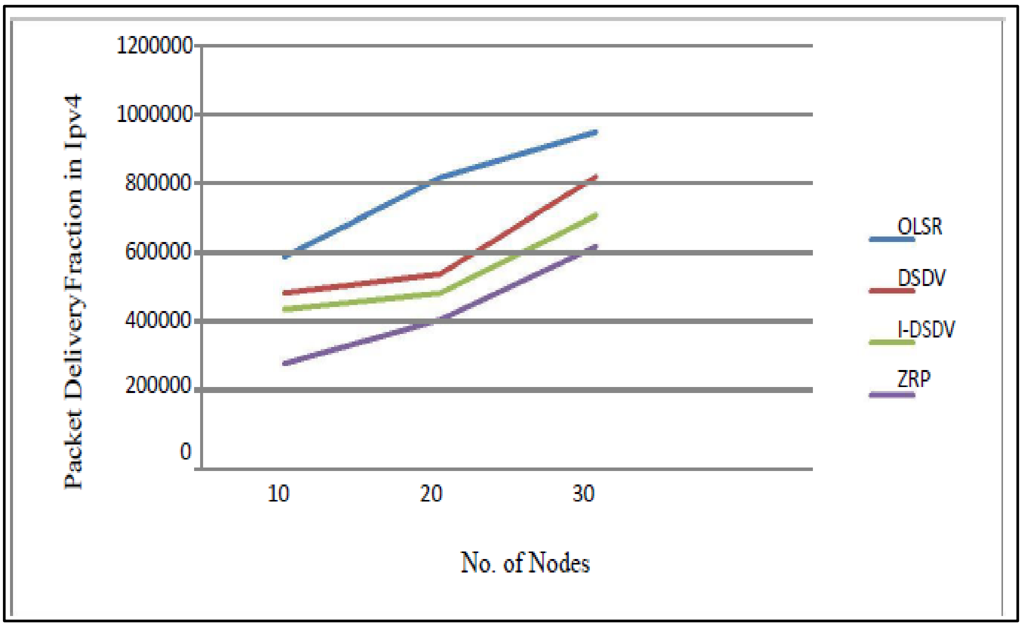

Figure 4

Table 3. Resultant Values

No. of Nodes	Protocol	IP Version	Packet Delivery Fraction
10	OLSR	IPv4	605212
10	DSDV	IPV4	502365
10	I-DSDV	IPv4	455126
10	ZRP	IPV4	302365
20	OLSR	IPv4	825642
20	DSDV	IPV4	556987
20	I-DSDV	IPv4	502365
20	ZRP	IPV4	425684
30	OLSR	IPv4	956894
30	DSDV	IPV4	828954
30	I-DSDV	IPv4	721668
30	ZRP	IPV4	634876

6.2.2. Packet Delivery Fraction in Ipv6 Internet Protocol

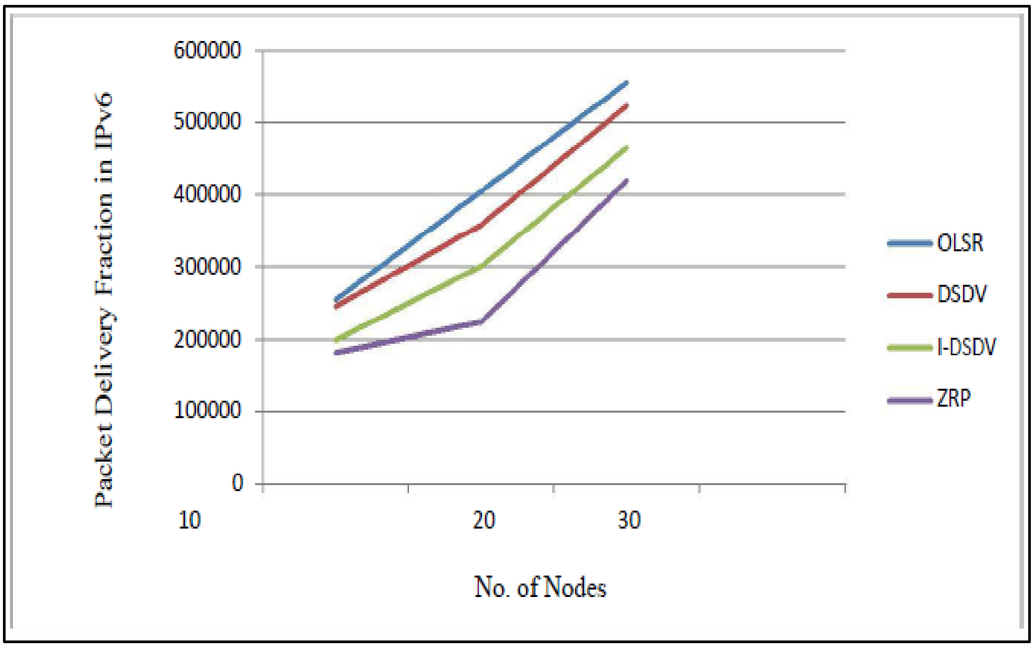

Figure 5

Table 4. Resultant Values

No. of Nodes	Protocol	IP Version	Packet Delivery Fraction
10	OLSR	IPv6	255654
10	DSDV	IPV6	245568
10	I-DSDV	IPv6	200025
10	ZRP	IPV6	182256
20	OLSR	IPv6	405894

20	DSDV	IPV6	358598
20	I-DSDV	IPv6	302356
20	ZRP	IPV6	225698
30	OLSR	IPv6	555562
30	DSDV	IPV6	524815
30	I-DSDV	IPv6	465236
30	ZRP	IPV6	420123

OLSR have better packet delivery fraction than DSDV, I-DSDV & ZRP WITH IPv4 and IPv6. OLSR have better average packet received and broadcast packet received than DSDV, I-DSDV & ZRP WITH IPv4 and IPv6.

6.3 Routing Overhead in Ipv4 and Ipv6 Internet Protocol

- Various number of nodes which are 10, 20, 30 nodes
- Packet size is set to 1200 Bytes
- Area Size is set to 1000×1000
- Node Speed is fixed to 10m/s
- Random way point mobility model is used

6.3.1 Routing Overhead in IPv4 internet Protocol

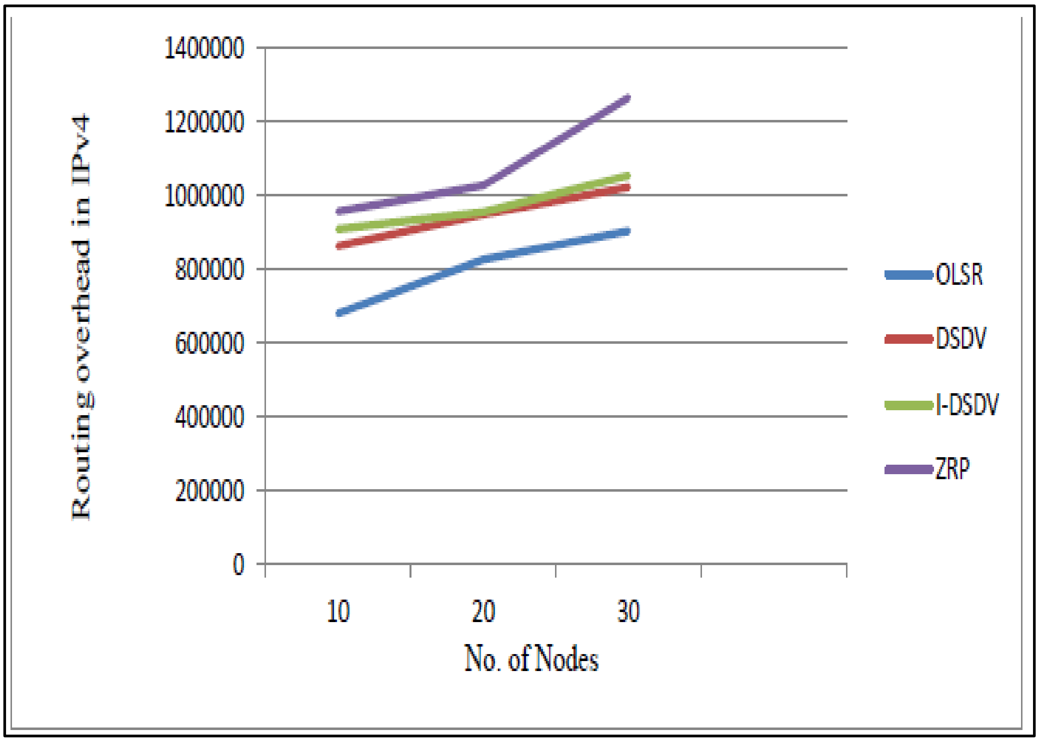

Figure 6

Table 5. Resultant Values

No. of Nodes	Protocol	IP Version	Routing Overhead
10	OLSR	IPv4	679856
10	DSDV	IPV4	863355
10	I-DSDV	IPv4	907936
10	ZRP	IPV4	956598
20	OLSR	IPv4	826598
20	DSDV	IPV4	948975
20	I-DSDV	IPv4	955865
20	ZRP	IPV4	1023985
30	OLSR	IPv4	903698
30	DSDV	IPV4	1022365
30	I-DSDV	IPv4	1053659
30	ZRP	IPV4	1265985

6.3.2. Routing Overhead in IPv6 Internet Protocol

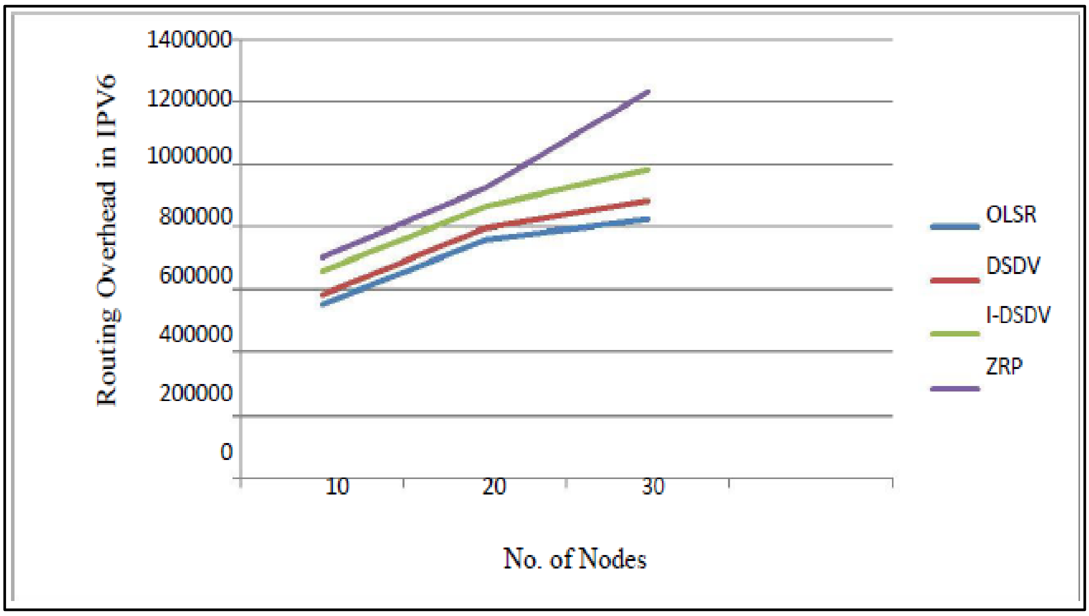

Figure 7

Table 6. Resultant Values

No. of Nodes	Protocol	IP Version	Routing Overhead
10	OLSR	IPv6	552365
10	DSDV	IPV6	582365
10	I-DSDV	IPv6	658965
10	ZRP	IPV6	702569
20	OLSR	IPv6	758954

20	DSDV	IPV6	796589
20	I-DSDV	IPv6	865489
20	ZRP	IPV6	925648
30	OLSR	IPv6	825648
30	DSDV	IPV6	885698
30	I-DSDV	IPv6	985698
30	ZRP	IPV6	1236598

The performance of ZRP is far superior compared to the DSDV, I-DSDV & OLSR in IPv4 & IPv6. Regular DSDV, I-DSDV & OLSR is almost close to each other for varying number of speed. But OLSR is slightly better the regular DSDV and I-DSDV when the number is high.

7. Conclusions

In this research we tested four routing protocols of mobile ad hoc network DSDV, I-DSDV, OLSR and ZRP under IPv6 environment. On the basis of observation, it has been observed that OLSR performs better in terms of end to end delay and packet delivery fraction, whereas ZRP shows good result in terms of routing overhead. Thus we conclude that OLSR and ZRP perform better as compared to DSDV and I-DSDV. However, it is not necessary that OLSR and ZRP always perform better the result may vary by varying network.

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Authors

Aman Kumar, Research Scholar, CSE Department DAV University Jalandhar Punjab. Completed B.Tech from RBIENT Hoshiarpur, PTU Jalandhar. Having projects on java and .Net. Many papers published in international journals.

Rahul Hans, he is working as assistant professor in the Department of computer Science and Engineering at DAV University, Jalandhar Punjab (INDIA). He has done his M.Tech in Computer Science and Engineering from Guru Nanak Dev University, Amritsar (INDIA). His research areas include Networking, Operating systems, Distributed computing, Mobile agents. He has various research publications in various international conferences and journal and also presented several papers in various national and international conferences.

