



Performance Analysis of Star, Dymo and ZRP Routing Protocols of MANET

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Abstract - Mobile Ad-Hoc Network (MANET) is a collection of wireless mobile hosts forming a temporary network without the aid of any stand-alone infrastructure or centralized administration. Most of the proposed MANET protocols do not address security issues. In MANETs routing algorithm is necessary to find specific routes between source and destination. The primary goal of any ad-hoc network routing protocol is to meet the challenges of the dynamically changing topology and establish an efficient route between any two nodes with minimum routing overhead and bandwidth consumption. Several protocols are introduced for improving the routing mechanism to find route between any source and destination host across the network. This paper gives the complete study of three routing protocols of MANET- STAR, DYMO and ZRP. Also the performance of these three routing protocols is compared on the basis of certain parameters. The tool used to compare the performance is NS-2 i.e. network simulator 2.

Keywords- MANET, STAR, DYMO and ZRP.

I Introduction

MANET(mobile ad-hoc networks) is a collection of wireless nodes that can exchange information dynamically among them without pre-existing fixed infrastructure. In mobile ad-hoc network nodes can directly communicate with each other within their radio ranges, whereas nodes that cannot directly communicate with each other make use of intermediate nodes. The nodes in mobile ad-hoc network can act as both routers and host. Manet are said to be self-organized and self-configurable in nature.

(A) Advantages of manet -

- 1.Mobility**- With the emergence of public wireless network, users can access internet even outside their working environment.[2]
- 2.Convenience**- The wireless nature of such networks allows users to access network resources from nearly any convenient location within their primary networking environment. [2]
- 3.Expandibility**- Ad-hoc networks can serve suddenly increased number of clients without affecting the existing equipment.[2]
- 4.Rapid set-up time**- Ad hoc network requires the installation of radio NICs in the user devices.[2]

(B) Applications of manet-

- 1.Disaster relief**- Infrastructure typically breaks down in disaster areas. Emergency teams can rely on infrastructure that they can set themselves.[3]
- 2.Military battlefield**- Ad hoc network allow military to take advantage of commonplace network topology to maintain an information network between the soldiers, vehicles etc.[3]
- 3.Effectiveness**- Services provided by existing infrastructure might be too expensive for certain application. Registration procedure might take too long, and communication overheads might be too high with existing networks. Application-tailored ad-hoc networks can offer a better solution.[3]

(C) Types of Routing Protocols

Proactive Routing Protocol

Each node maintains routing information to every other node in the network. The routing information is usually kept in a number of different tables. These tables are periodically updated and/or if the network topology changes.

Reactive (on demand) routing protocols

On demand protocols use two different operations:-Route discovery and Route maintenance. In this routing information is acquired on-demand. This is the route discovery operation. Route maintenance is the process of responding to change in topology that happen after a route has initially been created.

Hybrid routing protocols

Hybrid routing protocols are a new generation of protocol, which are both are Proactive and Reactive in nature. Most hybrid protocols proposed to date are zone based, which means that the network is partitioned or seen as a number of zones by each node.

II STAR(Source Tree Adaptive Routing)

STAR is a proactive or table-driven routing protocol. STAR protocol is based on link state algorithm. The routers in star communicates to its neighbors the parameters of its source routing tree which consists of each links that the router needs to reach every known destination in the ad-hoc network or internet. To conserve transmission bandwidth and energy a router communicates changes only when the router detects new destination or when there is a possibility of looping. The STAR routing protocol can be run either by using an optimum routing approach(ORA) or by using a least overhead routing approach(LORA)[4]. The first approach tries to fulfill a requirement to provide optimal paths between nodes in accordance with a defined metric and its performance characteristics will depend on the frequency of routing table updates. On the other hand LORA in accordance with its name strives to keep the overhead of routing messages to a minimum while sacrificing the optimality requirement of ORA. STAR scale well in large networks since it has significantly reduced the bandwidth consumption for the routing updates while at the same time reducing latency by using predetermined routes.

III Dynamic MANET On-demand (DYMO)

DYMO is a type of reactive routing protocol. It is referred as an enhanced version of AODV. The working of DYMO protocol is split into:- route discovery and route maintenance.

(A)Route Discovery

When a source needs to send a data packet, it sends an RREQ (route request) to discover a route to that particular destination. After issuing an RREQ, the origin DYMO router waits for a route to be discovered. If a route is not obtained within RREQ waiting time, it again tries to discover a route by sending another RREQ.

In order to reduce congestion in a network, repeated attempts at route discovery for a particular node should utilize an exponential backoff[5] . Data packets awaiting a route should be buffered by the source's DYMO router. This buffer should have a fixed limited size and older data packets should be discarded first. If a route discovery has been attempted maximum times without receiving a route to the target node, all data packets intended for the corresponding target node are dropped from the buffer and a Destination Unreachable ICMP message is delivered to the source.

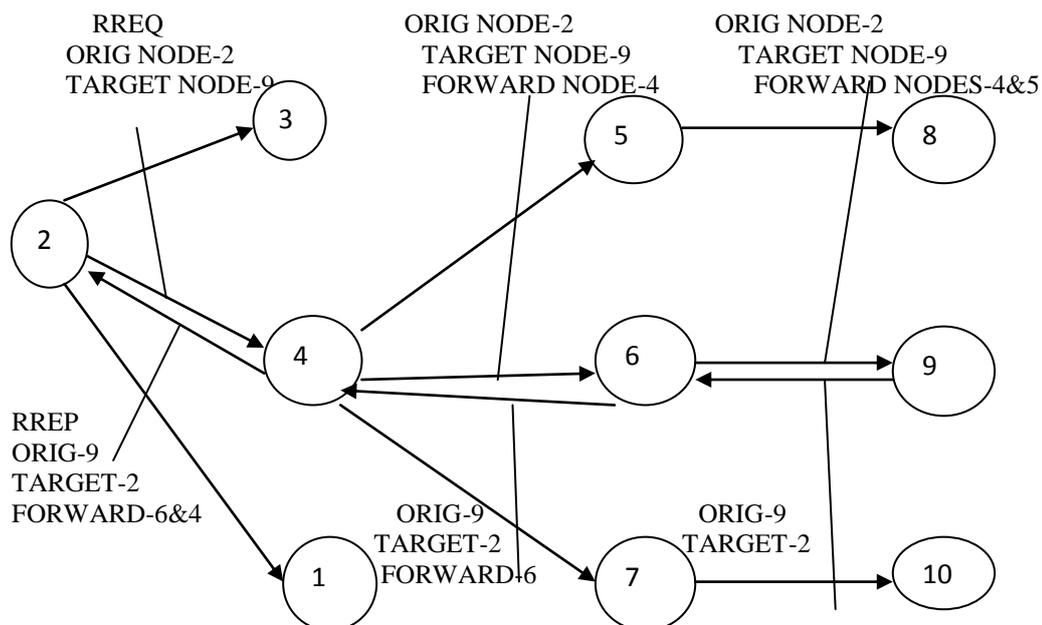


Fig 1- example of route discovery

(B)Route Maintenance

When a data packet is received for forwarding and a route for the particular destination route is found unknown, broken or missing , then the source is notified by sending aRERR (route error) message. On receiving the RERR message, the source deletes that particular route. In future, if it receives a packet which has to be forwarded to the same destination, then it has to again perform the route discovery process [6] .

IV Zone Routing Protocol (ZRP)

(A) Intrazone Routing Protocol (IARP)

This protocol is used by a node to communicate with the interior nodes of its zone. The node continuously needs to update the routing information in order to determine the peripheral nodes as well as maintain a map of which nodes can be reached locally. The IARP allows for local route optimization through the removal of redundant routes and the shortening of routes if a route with fewer hops has been detected, as well as bypassing link failures through multiple (local) hops, thus leveraging global propagation. As mentioned earlier, it is possible that a node A can broadcast messages to a node B [7].

Due to its pro-active nature, local route discovery is very efficient and routes to local destinations are immediately available. In order to not over utilize the available bandwidth resources, the IARP – as the name suggests – is restricted to routing within the zone, which is why it is referred to as a “limited scope pro-active routing protocol”. Global route discovery, communication with nodes in a different zone, is done by guiding the route queries to the peripheral nodes instead of flooding all local nodes.

Example – considering the figure below. Suppose node S wish to send the packet to E then it uses the mechanism of IARP. Since both the source and destination lies within the same zone the packets are forwarded easily.

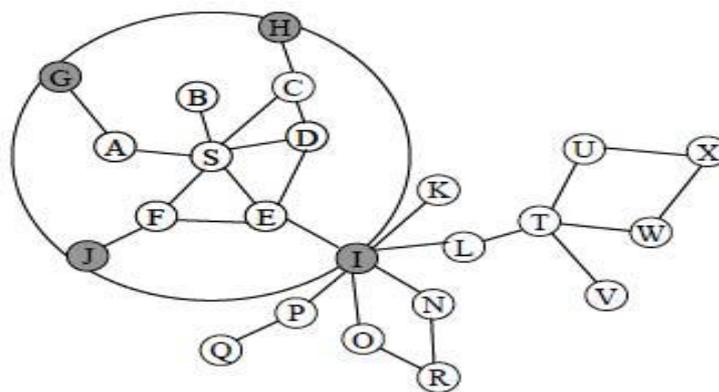


Fig2- Routing node for S

(B) Interzone Routing Protocol (IERP)

For routes which do not belong to the local zone, route discovery is performed reactively. The source node sends a route request to its border nodes, containing its own address, the destination address and a unique sequence number. Border nodes are nodes which are exactly the maximum number of hops to the defined local zone away from the source. The border nodes check their local zone for the destination. If the requested node is not a member of this local zone, the node adds its own address to the route request packet and forwards the packet to its border nodes. If the destination is a member of the local zone of the node, it sends a route reply on the reverse path back to the source. The source node uses the path saved in the route reply packet to send data packets to the destination [8]. Example – consider the figure above. The node S has a packet to send to node X. the zone radius is $r=2$. The node S makes use of the routing table which is provided by IARP to check whether the destination node i.e X is within its zone. Since it is not found a route request is issued by IERP. Now this request is broadcasted to the peripheral nodes (gray in figure). Now node I checks its zone to see if the destination X lies within its zone or not. Since X lies within its zone the send the packet to the destination.

V Methodology

The tool used to compare the performance of these three routing protocols is NS-2 (network simulator 2). NS (version 2) is an object-oriented, discrete event driven network simulator developed at UC Berkeley written in C++ and OTcl (Tcl script language with Object-oriented extensions). NS-2 is a discrete event simulator developed for networking research [9]. It provides support for wired and wireless networking with multicast capability and networks. It provides substantial support for simulation of Transmission Control Protocol (TCP) and User Datagram Protocol (UDP) routing. It is specifically targeted at networking research. NS can easily be installed on machines. The simulator is written in C++ and a script language Object Transcript control language (OTcl). The scene script defines the network components such as nodes, links, protocols and traffic requirements. The simulator uses this script and output the trace at different selective layers. This output is used to calculate delays, throughput, power consumption, packet delivery and other performance measures. NS-2 includes a tool for viewing the simulation results, called NAM. NAM is a Tcl/TK based animation tool for viewing network simulation traces and real world packet trace data. The first step to use NAM is to produce the trace file. The trace file should contain topology information, e.g., nodes, links, as well as packet traces. Usually, the trace file is generated by NS. During an ns simulation, user can produce topology configurations, layout information, and packet traces using tracing events in ns. When the trace file is generated, it is ready to be animated by NaM. Upon Startup,

NAM will read the trace file, create topology, pop up a window, do layout if necessary, and then pause at the time of the first packet in the trace file. Through its user interface, NAM provides control over many aspects of animation.

Parameters used-

The throughput is measured in terms of the following parameters:-

- Number of packets transmitted (npkts)
- Number of packets lost (nlost)
- Time the last packet transmitted (lastPktTime)
- Number of expected transmission rate (expected)
- Bit rate (bitra)
- Bit rate with delay (bitrate)
- Packet delay (packet_delay)
- Packet loss rate (packet_lossrate)

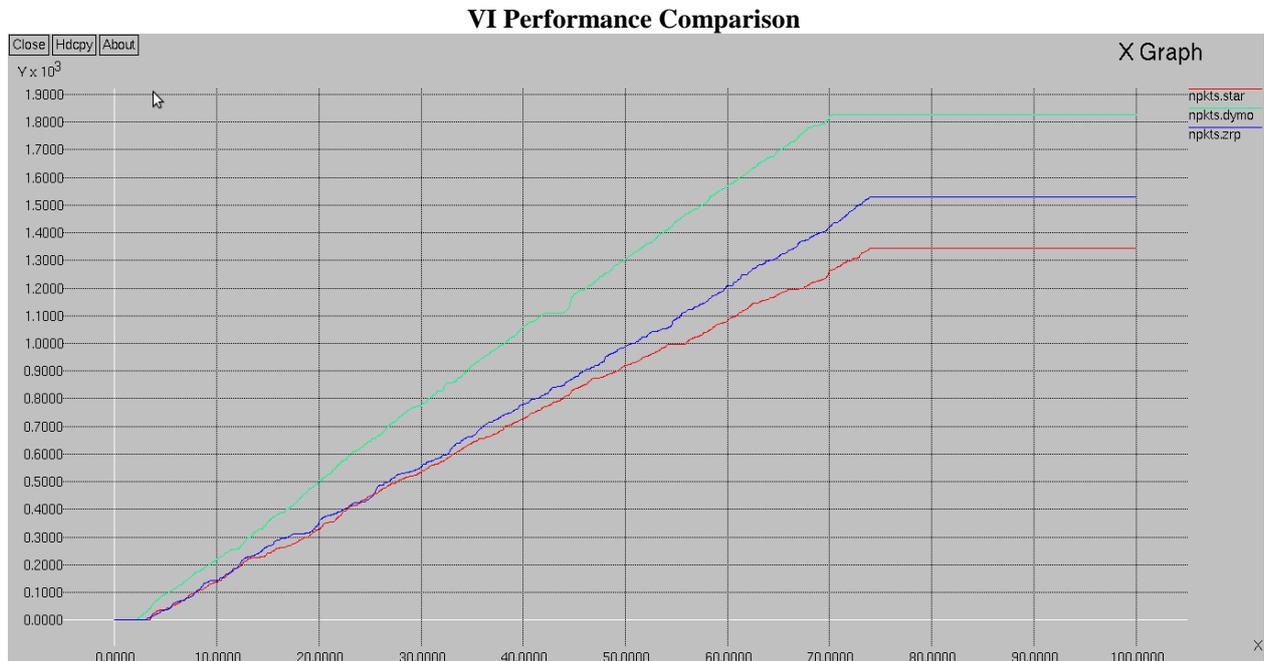


Fig 3

Figure3 is showing the analysis of the protocols on the basis of number of packets transmitted. Here x axis represents the simulation time and y axis represents the packets transmitted. The results shows that the throughput in terms of packet transmission of dymo is higher, it means it provides the better throughput among three whereas star is providing the least throughput in case of star.

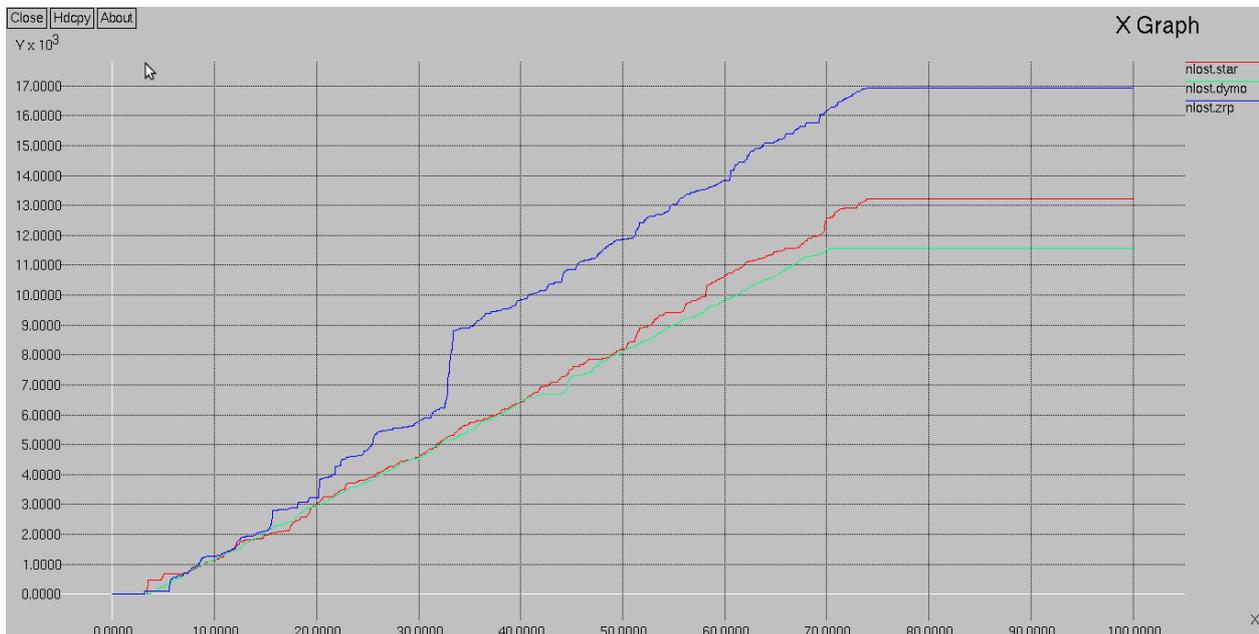


Fig 4

Figure4 is showing the analysis of the protocols on the basis of packet lost. Here x axis represents the simulation time and y axis represents the packets. The results show that the packet loss in case of zrp is higher, whereas time of packet loss in dymo is least. It means dymo is providing the better throughput.

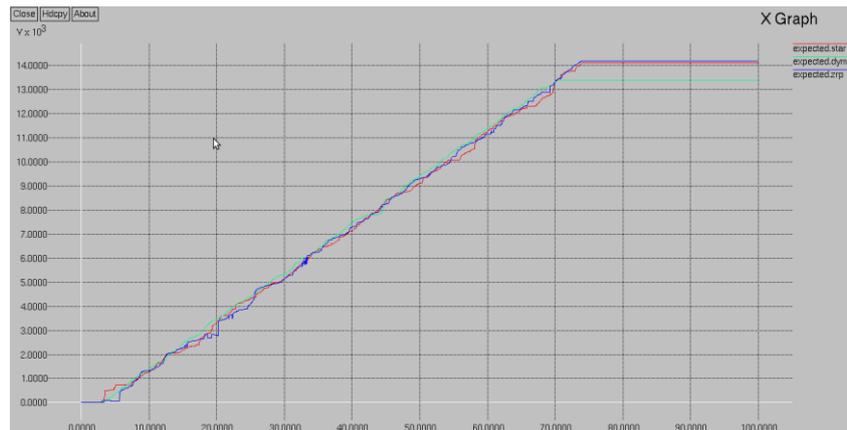


Fig 5

Figure 5 is showing the analysis of the protocols on the basis of number of expected transmission rate. Here x axis represents the simulation time and y axis represents the number of expected transmission rate. The results shows that the expected rate of zrp is higher, whereas expected rate of dymo is least.



Fig 6

Figure6 is showing the analysis of the protocols on the basis of time of last packet transmitted. Here x axis represents the simulation time and y axis represents the time. The results shows that the time of packet transmission of zrp is higher whereas time of last packet transmission of dymo is least.



Fig 7

Figure7 is showing the analysis of the protocols on the basis of number of bytes transmitted. Here x axis represents the simulation time and y axis represents the number of bytes transmitted. The results shows that the throughput in terms of byte transmission of dymo is higher, it means it provides the better throughput among three whereas star is providing the least throughput in case of star.

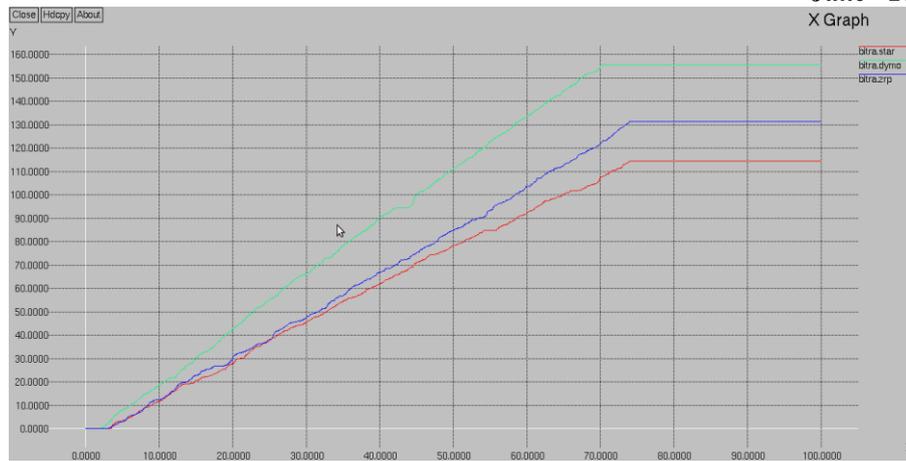


Fig 8

Figure 8 is showing the analysis of the protocols on the basis of bit rate. Here x axis represents the simulation time and y axis represents the transmission rate. The results shows that the bit transfer rate of dymo is higher, it means it provides the better throughput among three whereas star is providing the least bit transmission rate, so that the throughput will be low in case of star.



Fig 9

Figure 9 is showing the analysis of the protocols on the basis of bit rate with delay. Here x axis represents the simulation time and y axis represents the transmission rate. The results shows that the bit transfer rate of dymo is higher, it means it provides the better throughput among three whereas star is providing the least bit transmission rate, so that the throughput will be low in case of star.

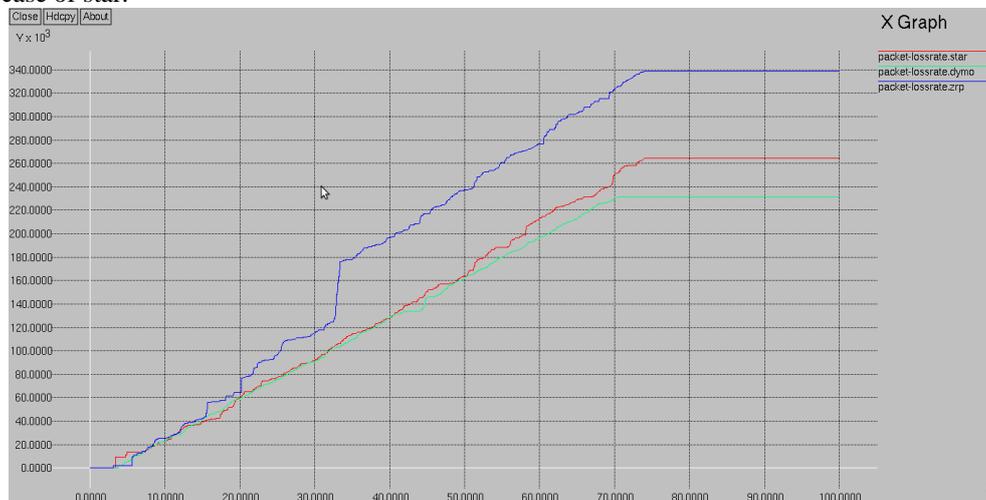


Fig 10

Figure 10 is showing the analysis of the protocols on the basis of packet lost rate. Here x axis represents the simulation time and y axis represents the packet loss rate. The results shows that the packet loss rate in case of zrp is higher, whereas time of packet loss rate in dymo is least. It means dymo is providing the better throughput.

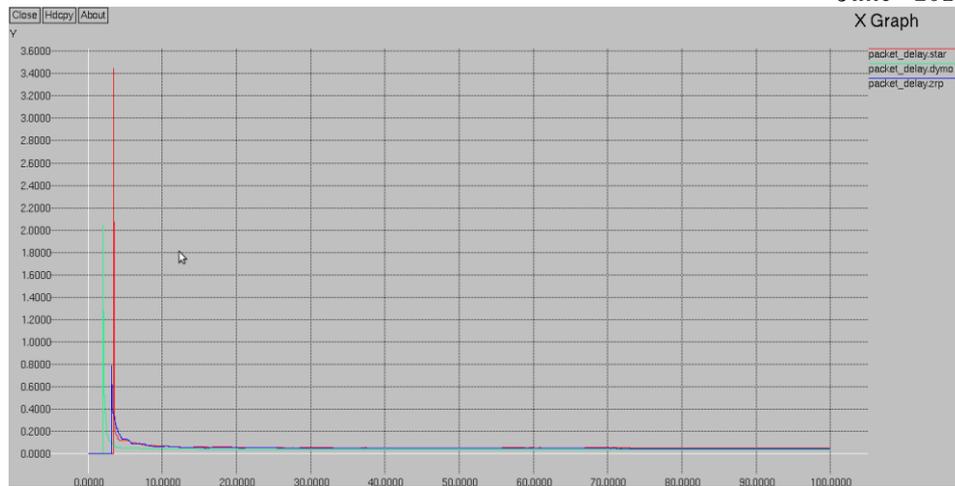


Fig 11

Figure 11 is showing the analysis of the protocols on the basis of packet delay. Here x axis represents the simulation time and y axis represents the packets delay. The results shows that the packet delay in case of star is higher, whereas dymo is providing the least packet delay. It means the dymo is more effective among these three protocols.

VII Conclusion

The paper presents a thorough study of the three routing protocols of manet-STAR, DYMO and ZRP. Further the performance of the protocols has been compared using various parameters under consideration using NS-2.

VIII Future Work

In future the performance of other routing protocols of manet can be compared taking into account some new parameters and in different simulation environment.

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