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Behaviour of Mobile Adhoc Network under OLSR and MPOLSR protocols with increasing number of nodes.

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Abstract

Mobile Ad hoc network is a concept in wireless communication with mobile nodes which means that user wanting to communicate with each other form a temporary without any form of centralized administration. Each node participate in the network, acts both as a host and a router and must therefore be willing to forward packet for other node. For this purpose, a routing protocol is needed. A verity of routing protocols for MANETs have been developed by network researchers and designers primarily to improve the performance of MANETs with respect to correct and efficient route establishment between a pair of stations for message delivery. Ad hoc networks consist of a collection of wireless mobile nodes which dynamically exchange data without reliance on any fixed base station or a wired backbone network. They are by definition self-organized. The frequent topological change makes multi-hop routing a crucial issue for these networks. In this dissertation work all evaluation has been done on different scenario of two different MANET routing protocols i.e. OLSR (Optimized Link State Routing) and MP-OLSR (Multipath Optimized Link State Routing) on different simulation time with respect to the three performance metrics: packet delivery ratio, throughput and average End-to-End delay. All simulation result implement at network simulator-2 (NS-2.29). By doing the simulation work the need of a routing protocol adapted to the new situation is shown.

Keywords: MANET, Wireless Medium, Routing Protocol, Performance Metric, NS-2

1. INTRODUCTION

A MANET [1] [2] is a collection of nodes where the nodes will self-configure and self-organize themselves forming a wireless medium without any requirement of stationary infrastructure like base station. In these networks each node will not only act as a host but also acts as a router. Due to the mobility of nodes, the topology of the network is dynamic that is, it changes most of the time. Some examples where the possible use of Ad-hoc networks are in military, in emergency situation like hurricanes, earth quakes, conferences etc. One of the main issue in Ad-hoc networks is to develop a routing protocol which must be capable of handling very large number of nodes with limited bandwidth and power availability. Also they should respond quickly to the hosts that broken or newly formed in various locations. Many protocols have been proposed to solve these problems in the ad-hoc networks.

MANET protocols are usually evaluated by means of simulation analysis: a network of nodes is modeled and then run for a set of scenarios in a specific simulation environment. The scenario of MANET is shown in figure 1.1. In each scenario, the set of events generated by the nodes are specified. The simulation environment may take into account the physical area in which nodes are located, the time duration of simulation, the physical characteristics of nodes, and a node mobility model [1], which defines the speed and direction of a node's movement over time and also simulation result the robustness of protocol. A various protocols have been studied and their performance comparisons are made by many researchers. These protocols can be classified according to the "routing strategy" that they follow to find a path "route" to the destination. MANET having distinct types of routing protocol which working process of different protocols may give different result on the different types of scenario.

2. EXISTING SYSTEM

In existing system, examines two routing protocols for mobile ad hoc networks– the Optimized link state routing protocol, the table- driven protocol and the Multipath Optimized link state routing protocol hybrid protocol and evaluates both protocols based on packet delivery fraction and average delay while varying number of sources and pause time in presence of UDP traffic having 30 nodes in the network. [2] In this scenario, all simulation result has done with 10 and 20 source of nodes. All simulation has done in Network Simulator 2. In existing system having number of simulator parameters used that is node movement model is shadowing mobility model, speed of node is 0.25 m/s, bandwidth of the channel is 2Mb/s and transmission range of the network is 250m.It also describes the number of properties of routing protocol and one of the properties Quality of service explained in details. After simulation it analyze that both of the protocols deliver a greater percentage of the originated data packets when there is little node mobility, converging to 100% delivery ration when there is no node motion. The packet delivery of MPOLSR is almost independent of the number of sources. OLSR suffers from end to end delays. The difference between MOPLSR and OLSR packet delivery fraction is approximately equal for high mobility scenarios. They conclude that the MPOLSR protocol is the ideal choice for communication when the communication has to happen under the UDP protocol as the base. [4]

3. Protocol Specification

3.1 The Optimized Link State Routing (OLSR) Protocol

OLSR is the table driven, proactive routing protocol designed for mobile ad-hoc networks. It exchanges routing information periodically and has route immediately available when needed. The OLSR protocol achieves optimization by determining for each node of the network a minimal subset of neighbors, called Multi Point Relays (MPR) which is able to reach all 2-hop neighbors of the node. Generally two types of routing messages are used a HELLO message and a Topology Control (TC) message [10].

1. HELLO message is periodically broadcasted by each node and contains the sender's identity and three lists:

a. List of neighbors from which control traffic has been heard.

b. List of neighbors with which bi-directionality has already confirmed.

c. List of MPR set of originator node.

2. HELLO messages are exchanged locally by neighbor nodes and are not forwarded further to other nodes. HELLO message is used for neighbor sensing and also for selection of MPRs nodes.

TC messages are also emitted periodically by MPR nodes. TC message contains the list of the sender's MPR selector set. In OLSR, only MPR nodes are responsible for forwarding TC messages. Upon receiving TC messages from all of the MPR nodes, each node can learn the partial network topology and can build a route to every node in the network. This message is used for route calculation. [7]

The OLSR operation can be summarized as follows:

Neighbor sensing: To achieve that each node broadcasts to its 1-hop neighbors HELLO messages periodically.

MPR selection: There are two types of sets

a. MPR set this set of selected neighbor nodes for each node from its 1-hop neighbors. When a node sends a routing message, only the nodes that are in its MPR set forward this message.

b. MPR selector set. Each node also maintains information about the set of neighbors that selected it as MPR which is called MPR selector set.

Topology Diffusion: Nodes that were selected as MPR must send TC messages to construct routing table. TC messages are flooded in the network and only MPRs are allowed to forward TC messages. Each node in OLSR protocol has two tasks:

Correctly generate the routing protocol control traffic

Correctly relay the routing protocol control traffic on behalf of other nodes.

3.2 Multipath Optimized Link State Routing (MP-OLSR)

The Multipath Optimized Link State Routing (MP-OLSR) can be regarded as a hybrid multipath routing protocol. It sends out HELLO messages and TC messages periodically to be aware of the network topology, just like OLSR. The difference is that MP-OLSR does not always keep a routing table to all the possible destinations. It only calculates the routes when there are data packets need to be sent out. The core functioning of MP-OLSR has two main parts: topology sensing and route computation. [3] The topology sensing makes the nodes get to the topology information of the network, which includes link sensing, neighbor detection and topology discovery. This part gets benefit from MPRs as well as OLSR. By sending the routing control messages proactively, the node could be aware of the topology of the network: its neighbors, 2-hop neighbors and other links. The routing computation uses the Multipath Dijkstra Algorithm to populate the multiple paths based on the information get from the topology sensing. The source route (the hops from the source to the destination) will be saved in the header of the data packets. The medium hops just read the packet head and forward the packet to the next hop. The topology sensing and route computation make it possible to find multiple paths from source to destination. In the specification of the algorithm, the paths will be available and loop-free. However, in practice, the situation will be much more complicated due to the change of the topology and the instability of the wireless medium. So route recovery and loop detection are also proposed as auxiliary functionalities to improve the performance of the protocol. The route recovery can effectively reduce the packet loss, and the loop detection can be used to avoid potential loops in the network.

3.2.1 Topology Sensing

To get the topology information of the network, the nodes use the topology sensing which includes link sensing, neighbor detection and topology discovery, just like OLSR. Link sensing populates the local link information base (Link Set). It is exclusively concerned with OLSR interface addresses and the ability to exchange packets between such OLSR interfaces. Neighbor detection populates the neighborhood information base (Neighbor Set and 2-hop Neighbor Set) and concerns itself with nodes and their main addresses. Both link sensing and neighbor detection is based on the periodic exchange of HELLO messages. Topology Discovery generates the information base which concerns the nodes which are more than two hops away (Topology Set). It is based on the flooding of the TC messages (optimized by selecting the MPR set). Through topology sensing, each node in the network can get sufficient information of the topology to enable routing. The link state protocol tries to keep the link information of the whole network as mentioned above. By default, the path quality is measured by the number of hops. For the purpose of making the thesis self-contained, this part summarized the Topology Sensing functionality.

3.2.2 Link Sensing and Neighbor Detection

The link sensing and neighbor detection are based on the transmission of HELLO messages. Based on the received messages, the procedures called link sensing and neighbor detection are performed to build the link set and 2-hop set. On receiving a packet, the node examines the packet header and each of the message headers. If the message type is known to the node, the message is processed locally according to the specification for that message type. The message is also independently evaluated for forwarding. If parsing fails at any point the relevant entity (packet or message) must be silently discarded. [4]

3.2.3 Topology Discovery

Link Sensing and Neighbor Detection make the node be aware of its 1-Hop neighbors and 2-Hop neighbors by sending HELLO messages. To get the topology information located more than 2 hops away, Topology Discovery is needed. It is based on the broadcast of TC messages. A node with one or more OLSRv2 interfaces and with a non-empty neighbor set must generate TC messages. A node with an empty neighbor set should also generate "empty" TC messages for a period "hold" time after it last generated a non- empty TC message. Complete TC messages are generated and transmitted periodically on all OLSRv2 interfaces, with a default interval between two consecutive TC transmissions. In addition to the periodic broadcasting, it can be generated in response to a change of contents. Only MPR can forward the TC messages to the next hop. When receiving a TC message, it is processed according to its type. The node first checks the message is from itself or unavailable. If so, the message must be discarded. Otherwise, the node will populate the related information base set (Advertising Remote Node Set, Topology Set, etc.) based on the received message. [6] The procedure is based on the broadcasting and processing of TC messages, the topology information that more than two hops always can be saved in the Topology Set.

3.2.4 Route Computation

In OLSR, routes are determined by nodes each time they receive a new topology control messages (TC or HELLO). The routes to all the possible destinations are saved in the routing table. For MP-OLSR, an on demand scheme is used to avoid the heavy computation of multiple routes for every possible destination. In this section, the hypotheses will be first introduced and followed with the algorithm that we proposed for multipath computation.

3.2.5 Route Recovery

By using the scheme of the Topology Sensing, we can obtain the topology information of the network with the exchange of HELLO and TC messages. All this information is saved in the topology information base of the local node: link set, neighbor set or topology set. Ideally, the topology information base can be consistent with the real topology of the network. However, in reality, it is hard to achieve, mainly because of the mobility of the ad hoc network. Firstly, for the HELLO and TC messages, there are certain intervals during each message generation (2s for HELLO and 5s for TC by default) [8]. During this period, the topology might change because of the movement of the nodes. Secondly, when the control messages (especially the TC messages) are being transmitted in the network, delay or collision might happen. This will result in the control message being outdated or even lost. Both of the two reasons mentioned above will result in the inconsistency between the real network topology and the node's topology information base. This means that when a node is computing the multiple paths based on the information base, it might use links that do not exist anymore, and cause the route failure. Furthermore, even if the topology information is correct when the route is being constructed at the source node, the topology might change while the packets are being forwarded in the network. And because of the source routing scheme MP-OLSR uses, the source route cannot be adapted to this kind of changes. For the OLSR, the problem is less serious because it uses hop-by-hop routing. Unlike the source routing, whose routes are decided completely at the source, the nodes in OLSR just forward the packets to the next hop. So there is more chance for a node in OLSR to forward a packet to the next available link.

3.2.6 Loop Detection

It is important to mention the LLN (Link Layer Notification) before coming to the problem of the loops of the protocol. LLN is an extended functionality defined in [8], and implemented in different OLSR or MPOLSR simulations and implementations. If link layer information describing connectivity to neighbor nodes is available [9] (i.e. loss of connectivity though absence of a link layer acknowledgement), this information can be used in addition to the information from the HELLO-message to maintain the neighbor information base and the MPR selector of the information bases in node A and B. One transient loop is formed between A and B set.

4. Scenario of Simulation Setup

All extensive simulations were conducted using NS-2.29. The simulated network consisted of 50,100,150 and 200 nodes randomly scattered in 1400x1400m area at the starting time of the simulation. All simulation parameter are described in below table 1:

Simulation Parameter 4.2

S.No	Parameters	Value
1	Source Type	MAC
2	Number of Nodes	50,100,150 and 200
3	Simulation Time	50, 100 and 150 sec
4	Pause Time	5 ms
5	Environment Size	1400x1400
6	Transmission Range	250 m
7	Traffic Size	CBR (Constant Bit Rate)
8	Packet Size	512 Bytes
9	Packet Rate	5 packets/sec
10	Maximum Speed	20 m/s
11	Routing Protocols	OLSR & MPOLSR
12	Simulator Used	NS-2.29

In this scenario, I have taken two hybrid routing protocols, namely OLSR and MPOLSR. For all simulation result evaluate at different simulation time like 50, 100 and 150 sec. at maximum speed of the nodes is 20 m/s and pause time is constant set to 5ms and the number of nodes is varying as 50, 100,150 and 200. Transmission range of the network for delivery the packets from one node to another is 250 m.

5. Results and Discussions

5.1 SCENARIO 1

In this scenario, the performance of protocol compare with respect to their packet delivery ratio measurement, and the number of nodes connected in a network as varying with simulation time to varying the number of connections, through which the comparison graphs of OLSR and MPOLSR obtained. All observation graphs are shown as below:

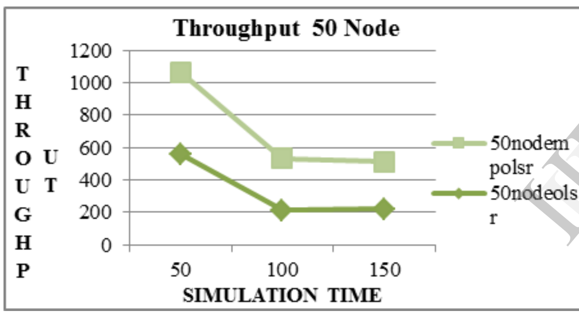

Figure 5.1 Comparison Graph between Throughput vs Simulation time at 50 nodes

The figure 5.1 shows that simulation result for 50 nodes throughput of MPOLSR and OLSR maintain this ratio with average difference from minimum to maximum simulation time. OLSR decreases initially at minimum time to maximum time of simulation as compare to MPOLSR of this scenario.

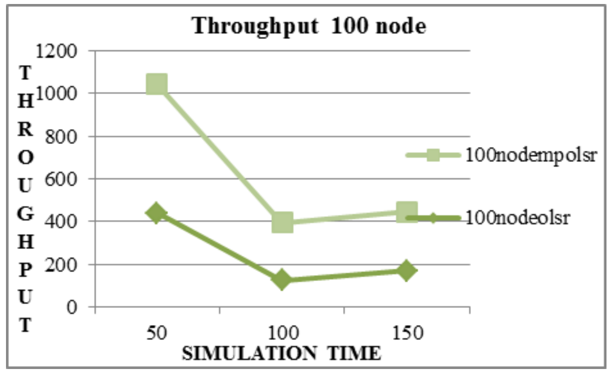

Figure 5.2 Comparison Graph between Throughput vs Simulation time at 100 nodes

The figure 5.2 shows that simulation result for 100 nodes throughput of OLSR decreases from initially to end of the maximum time of simulation and MPOLSR gives higher result as compare to OLSR shows the good performance in comparison to both of them .

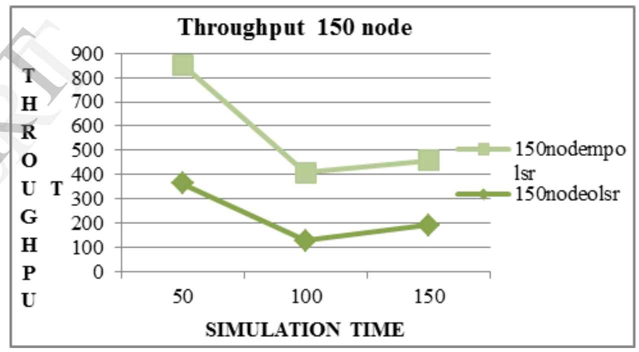

Figure 5.3 Comparison Graph between Throughput vs Simulation time at 150 nodes

The figure 5.3 shows that simulation result for 150 nodes throughput of initial MPOLSR is greater as compare to OLSR. After min simulation time suddenly throughput decreases from initially to average time of simulation and MPOLSR gives higher result as compare to OLSR from average time to maximum time shows the good performance in comparison to both routing protocol.

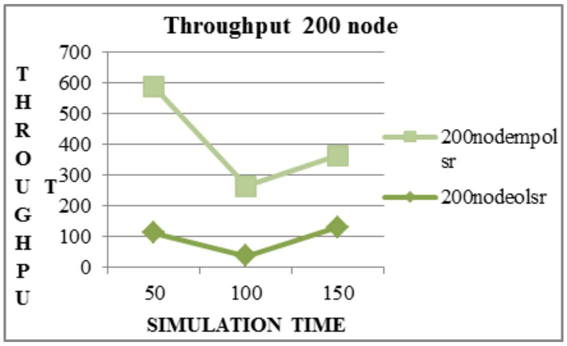

Figure 5.4 Comparison Graph between Throughput vs Simulation time at 200 nodes

Finally the figure 5.4 shows that simulation result for 200 nodes throughput of initial simulation time to maximum comparison of MPOLSR and OLSR. In both protocol throughput of MPOLSR is must be greater as compare to OLSR protocol in minimum to maximum simulation time then we can said the throughput performance of MPOLSR is better as compare to OLSR.

5.2 SCENARIO 2

In this scenario, the performance of protocol compare with respect to their packet delivery ratio measurement, and the number of nodes connected in a network as varying with simulation time to varying the number of connections, through which the comparison graphs of OLSR and MPOLSR obtained. All observation graphs are shown as below:

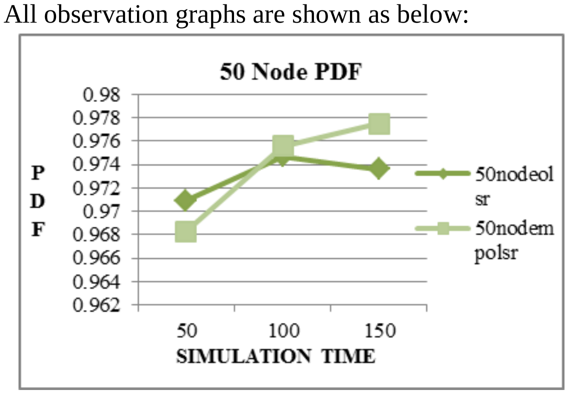

Figure 5.5 Comparison Graph between Packet Delivery Ratio vs Simulation time at 50 nodes

The figure 5.5 shows that simulation result for 50 nodes packet delivery ratio of OLSR is greater in initial simulation time as compare to MPOLSR but it is found in average simulation time MPOLSR is greater with minor difference with respect to OLSR and finally in maximum simulation time MPOLSR is much greater as compare to OLSR in this scenario.

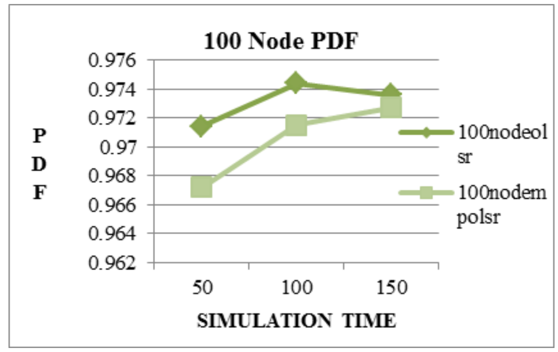

Figure 5.6 Comparison Graph between Packet Delivery Ratio vs Simulation time at 100 nodes

The figure 5.6 shows that simulation result for 100 nodes packet delivery ratio of OLSR is greater in minimum to maximum simulation time as compare to MPOLSR in minimum simulation time the difference more but the difference between OLSR and MPOLSR is minor in maximum simulation time.

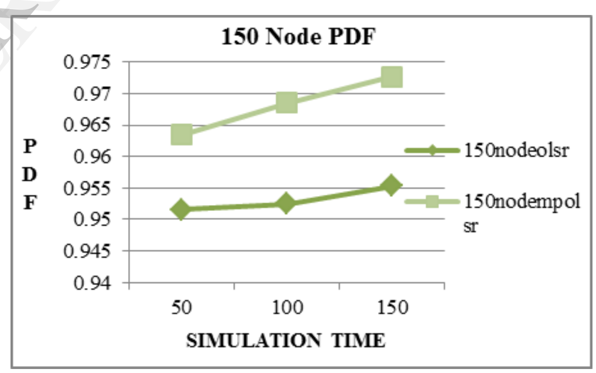

Figure 5.7 Comparison Graph between Packet Delivery Ratio vs Simulation time at 150 nodes

The figure 5.7 shows that simulation result for 150 nodes packet delivery ratio of OLSR decreases from initially to end of the maximum time of simulation and MPOLSR gives higher result as compare to OLSR so we can say the MPOLSR gives a good performance in this scenario.

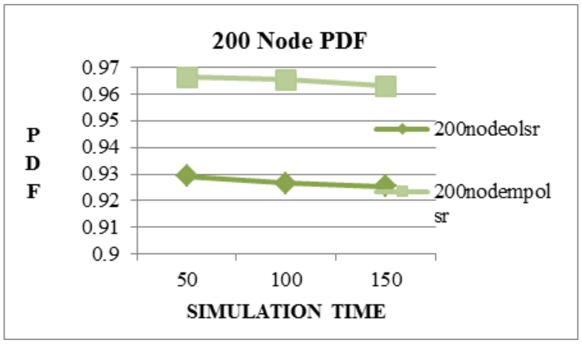

Figure 5.8 Comparison Graph between Packet Delivery Ratio vs Simulation time at 200 nodes

The figure 5.8 shows that simulation result for 200 nodes packet delivery ratio of OLSR is very lower from initially to end of the maximum time of simulation and MPOLSR gives higher result as compare to OLSR in mention simulation time so we can say the MPOLSR gives a good performance in this scenario. The main points is to be noted that's All 50,100,150 and 200 node the value of packet delivery ratio 50 and 100 node OLSR gives the better performance in terms of PDF but when we can vary the no of node 150 and 200 node in network MPOLSR is gives the higher performance as compared to OLSR.

5.3 SCENARIO 3

In mentioned scenario, the performance of protocol compares between average End-to-End delay and simulation time along with presence of traffic nodes 50, 100, 150 and 200 with varying number of simulation time i.e. 50, 100 & 150 sec in the network. The comparison graphs between OLSR and MPOLSR protocol shown in below.

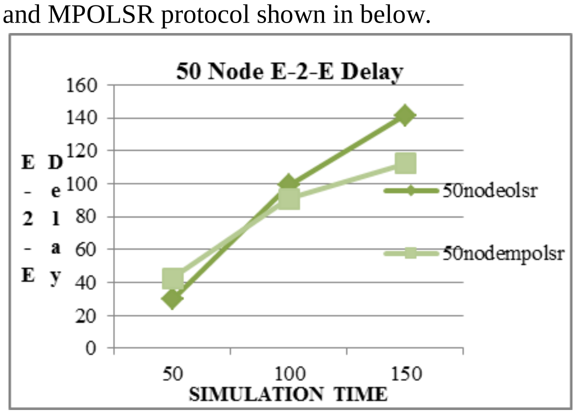

Figure 5.9 Comparison Graph between End-to-End Delay vs Simulation time at 50 nodes

The figure 5.9 shows that simulation result for 50 nodes end-2 end delay of MPOLSR is greater in initial simulation time as compare to OLSR but it is found in average simulation time OLSR is greater with minor difference with respect to MPOLSR and finally in maximum simulation time OLSR is much greater as compare to OLSR in this scenario. The figure 5.10 shows that simulation result for 100 nodes end-2 end delay of MPOLSR is greater in minimum to maximum simulation time as compare to OLSR in mention simulation time. In this scenario MPOLSR gives more delay in all mention simulation parameter as compare to OLSR.

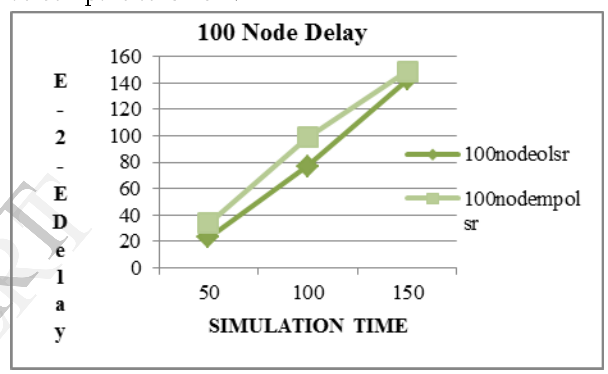

Figure 5.10 Comparison Graph between End-to-End Delay vs Simulation time at 100 nodes

The figure 5.11 shows that simulation result for 150 nodes end-2-end delay of MPOLSR decreases from initially to end of the maximum time of simulation and OLSR gives higher result as compare to MPOLSR so we can say in 150 node OLSR gives a greater delay performance in this scenario.

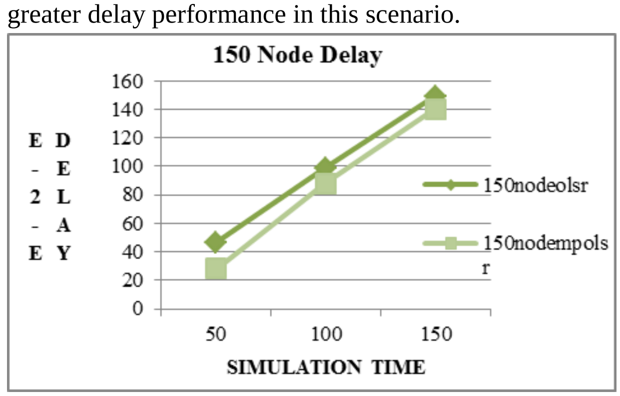

Figure 5.11 Comparison Graph between End-to-End Delay vs Simulation time at 150 nodes

The figure 5.2 shows that simulation result for 200 nodes end-2-end delay of MPOLSR is very lower from initially to end of the maximum time of simulation and OLSR gives higher delay results as compare to MPOLSR in mention simulation time so we can say the MPOLSR gives a good performance by lesser delay in this scenario.The main points is to be noted that's All 50,100,150 and 200 node the value of packet delivery ratio 50 and 100 node OLSR gives the better performance in terms of end-2-end delay but when we can vary the no of node 150 and 200 node in network MPOLSR is gives the higher performance as compared to OLSR.

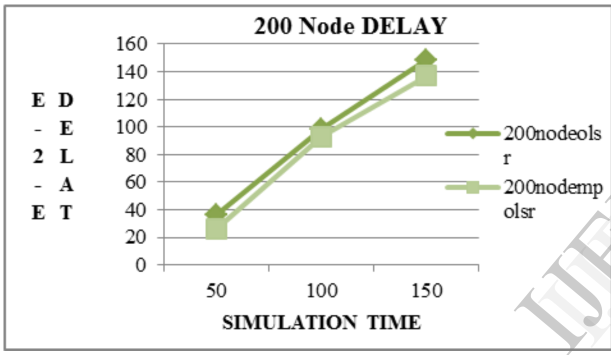

Figure 5.12 Comparison Graph between End-to-End Delay vs Simulation time at 200 nodes

6. Conclusion

In this paper, I have compared the two popular routing protocols in the presence of different scenario in network. The performance of OLSR, and MPOLSR routing protocols is analyzed with simulation using NS-2.29 simulator scenario available at 50, 100,150 and 200 nodes and the simulation time has varied from 50sec, 100sec and 150 sec on the basis of three parameters Average End-to-End delay, throughput, and packet delivery. In this research, we conclude that the MPOLSR performs better in case of, throughput but average End-to-End delay and packet delivery ratio at higher number of nodes just like 150 and 200 nodes in network. In small no. of node just like 50 an d100 OLSR perform better than MPOLSR when the simulation time increases. MPOLSR performs better than OLSR for higher node mobility, in case of end-to-end delay but it generates average result in PDR and throughput in large network. The simulation study can be extended to any future MANET routing protocols to facilitate comparison of the new protocol to the existing ones investigated in this study.

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