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Performance Analysis of AODV, DSR & OLSR Protocols in MANET

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Abstract

A mobile ad hoc network (MANET) consists of wireless mobile nodes. The communication between these nodes happens without any centralized control. MANET is a self-organized and self-configurable network where the mobile nodes move arbitrarily anywhere in a network. The mobile nodes has a feature like routers which can forward and receive the packets with other nodes. Routing is a critical issue in MANET and hence the focus of this paper is on performance analysis of routing protocols. I compared the three routing protocols i.e. AODV, DSR and OLSR. Simulation tool will over here is QualNet Simulator – Network Simulator Software. The performance of these routing protocols is analysed by three metrics: Average end-to end delay, energy consumption and throughput based on node density. All the three routing protocols are compared and explained with results using QualNet simulator tool. The comparative analysis is carried out of all the three protocols which concludeswhich routing protocol is the best one for mobile ad hoc networks considering multiple parameters impacting the network.

Keywords: *MANET, DSR, AODV,OLSR, PMP, RMP.*

I. INTRODUCTION

MANET stands for Mobile Ad hoc Network. It is a decentralized autonomous wireless network which consists of free nodes. MANET are also known as mobilemesh network which is a self-configurable wireless network. A MANET consists of router, mobile nodes anda multiple hosts with wireless communication devices. The wireless communication devices are transmitters, receivers and smart antennas. These antennas can be of any kind and a nodes can be mobile nodes or fixed.The nodes in a network are free to move arbitrarily in any direction. These nodes can be a mobile phone, laptop, personal computer, personal digital assistance, etc. These nodes can be located in cars, airplanes, ships or with people having small electronic devices [15]. Nodes in a network can connect with each other forming arbitrary topologies and randomly. Nodes has functionality of router which can communicate to each other and also forward packets to neighbor nodes. The self-configuration ability of the nodes makes them more suitable for urgently required network connection type applications. For example: In the areas where disasters happens and there is no communication infrastructure setup to recover the things. It means MANET is the quick remedy for any disaster situation. It has the ability to have a quick communication infrastructure.

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MANET is a spontaneous network. It helps to deal with wireless devices in which some of the devices are part of the network only for the duration of a communication session

Till date a lot of research work has been done on the performance evaluation of routing protocols using NS2 network simulator. Different methods and simulation are used in MANETs which gives different results for each routing protocol performance. This paper is to evaluate the performance of Proactive MANET protocols (PMP)and Reactive MANET Protocols (RMP) using QualNet Simulator tool.

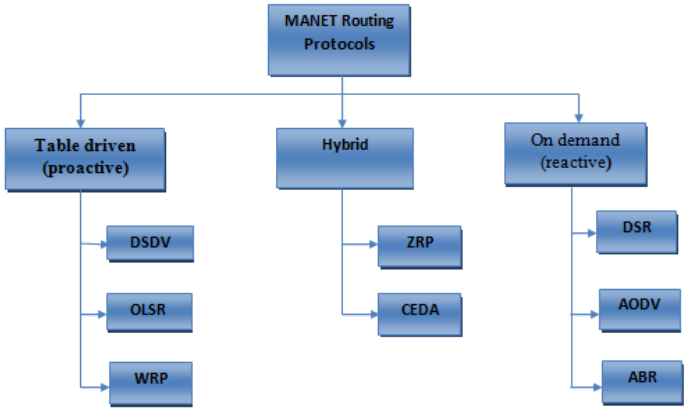

Fig.1: Classification of MANET routing protocols

Routing protocols in mobile ad hoc network means that the mobile nodes will search for a route or path to connect to each other and share the data packets between them. Routing protocols for MANET must be capable of maintaining routes and adaptive despite of network topology changes. To make sure the proper functioning and management of the large MANETslots of routing protocol have been developed so far. The routing protocols are differentiated into three categories as reactive, proactive and hybrid routing protocols.

Proactive routing protocol detects the whole network layout pro-actively. A routing table has to be maintained at every node in a network from which a route can be determined with less delay towards destination node. The protocols also provideslow latency and good reliability on the current network topology for deciding a route. In reactive routing protocols the communication betwwen source and destination nodes happen only when the source node requests to communicate with the other node. Reactive MANET Protocols are mostly suited for nodes in a network with very high mobility or rare transmision of between the nodes. The hybrid routing protocols are composed of both proactive and reactive routing protocols in a MANETs [3] [6].

In this paper, section II presents a overview of DSR, AODV and OLSR protocols, section III proposes performance analysis of these three protocolswith simulations and result analysis. The section IV concludes the overall work.

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II. LITERATURE SURVEY

The Dynamic Source Routing protocol (DSR) is a reactive routing protocol designed specifically for multi-hop wireless ad hoc networks of mobile nodes and also called on-demand routing protocol. It is a source routing protocol. DSR has the ability to make the network self-organizing and self-configuring without and administration and infrastructure. DSR compose of two basic mechanisms for its operation i.e. route discovery and route maintenance.Route discovery has two message route request (RREQ) and route reply (RREP). When a node wants to send a data to a specific destination, it broadcast the RREQ packet towards destination in the network. The neighbor nodes receive this RREQ packet in the broadcast range and add its own routing address list and rebroadcasttill it reaches to a required destination. DSR protocol uses a route cache to store the routes for each node in the network and maintains it for further communication. In route maintenanceroute error (RERR) message is sent to inform sender, that there is problem in the transmission. The disadvantage of DSR protocol is that, it creates RREP storm by replying for each RREQ message received by destination. This increases routing overhead of the protocol and degrades the performance [4] [5].

AODV Protocol:

The Ad hoc On Demand Distance Vector (AODV) routing protocol is a routing algorithm designed for mobile ad hoc networks. AODV routing protocolsupports both unicast and multicast routing. It find routes between nodes only as desired by source nodes as it supports on demand algorithm. The desired source to destination routes are maintained as long as it is needed by the source nodes. Also, AODV forms a trees which can connect a multicast group members in a network. These formed trees consists of the group members and the nodes needed to connect the members. To ensure the freshness of routes AODV uses sequence numbers. It is loop- self-starting, free and scalable to large numbers of mobile nodes. To discover the path towards destination the AODV protocol uses route request (RREQ) messages which passes through all over the network in order to search a paths required by a source node. If an inter-mediate node receives a RREQ message then it replies with a RREP message to a source node only if it has a route to the destination node having corresponding destination sequence number is greater or equal to the one contained in the RREQ. The RREQ message contains the most recent sequence number for the destination node of which the source node is aware. A node receiving the route request message (RREQ) may send a route reply (RREP) messageif it is a route to the destination or if it is a destination with corresponding sequence number greater than or equal to that contained in the RREQ message. The destination node unicast the RREP if it's a destination or else it rebroadcast the RREQ message.

The nodes in a network keeps track of the RREQ's source node IP address and the broadcast ID. If any node receives a RREQ with same broadcast ID then it discards that RREQ which they have already processedand do not forward it to further nodes in a network. As the RREP propagates back to the source nodes set up forward pointers to the destination. The source node begin to transfer data packets to the destination as soon as it receives a RREP from destination node.The source node can update it routing path if it receives a RREP containing a greater sequence number or contains the same sequence number with a smaller hop count and begin using the better route for further communication. It keeps it path active and maintained till the communication between them happens. A route remains active as long as there are data packets periodically transferring from the source

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node to the destination node along that path. The routing path will be deleted from the routing tables of the source node as soon as it stops sending the data packets to the destination. If a link break occurs while the route is active, the node upstream of the break propagates a route error (RERR) message to the source node to inform it of the now unreachable destination(s).

Optimized Link State Routing (OLSR):

OLSR is a proactive routing protocol where we can say the routes are fixed and always available whenever necessary. It is also called as optimized version of a pure link state protocol. If any topological changes occurs then the network gets flooded with new topological information to all available hosts in the network. To reduce the possible overhead in the network protocol multipoint relays (MPR) are used. OLSR uses two kinds of the control messages namely hello and topology control. Hello messages are used for finding the information about the link status and the host's neighbors. For broadcasting information the topology control messages are used about its own advertised neighbors, which includes at least the multipoint relays (MPR) selector list.

QualNet Simulator:

Simulator used for the comparative analysis is QualNet 5.0. It is suitable for comparing and designing new protocols and evaluation of traffic.

Parameters Considered for Simulation:

There are many factors that affect communication in real time applications. Some of the parameters considered for simulation are listed below.

1 .Node Density: It specifies the number of nodes present in given area.

2. Pause Time: It is the time for which a mobile node takes a pause. Due to such pauses link breakage may occur which may lead to packet drop.

3. Speed of mobile nodes: Since speed of mobile nodes is a very important factor in communication, we have to analyze the performance of network for different speeds to find effect on packet dropping rate, average end to end delay etc.

4. Packet Rate: It is the number of packets sent per second. Increase in packet rate leads to increase in packet dropping rate, so we have to analyze different protocols which can suite our application.

5.Simulation Area: It is the area over which nodes are placed during simulation. It is measured in square meters; variation in simulation area affects QoS parameters.

6. Simulation Time: It is defined as the time duration for which simulation is carried out.

Metrics used for performance analysis of different routing protocol:

Qualities of service (QoS) parameters are analyzed for different routing protocols. QoS parameters are compared for parameters mentioned in section. These QoS parameters are defined as follows.

1. Throughput: The total amount of data a receiver receives from sender divided by time it takes for receiver to get last packet. Ratio of total data received to required propagation time. The value of throughput should be as high as possible for better performance.

2. Average End-to-End Delay: It is the average source-to-destination data packet delay including propagation and queuing delay.

3. Packet Delivery Ratio (PDR): Ratio of number of packets successfully received by destination nodes to number of packets sent by source nodes.PDF describes information about packet loss rate.

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A high value of PDF indicates that most of the packets are being delivered to the higher layers and is a positive sign of the protocol performance.

4. Energy Consumed: It is energy required to transmit all data packets to destination node. To achieve better energy efficiency, energy consumed should be as low as possible.

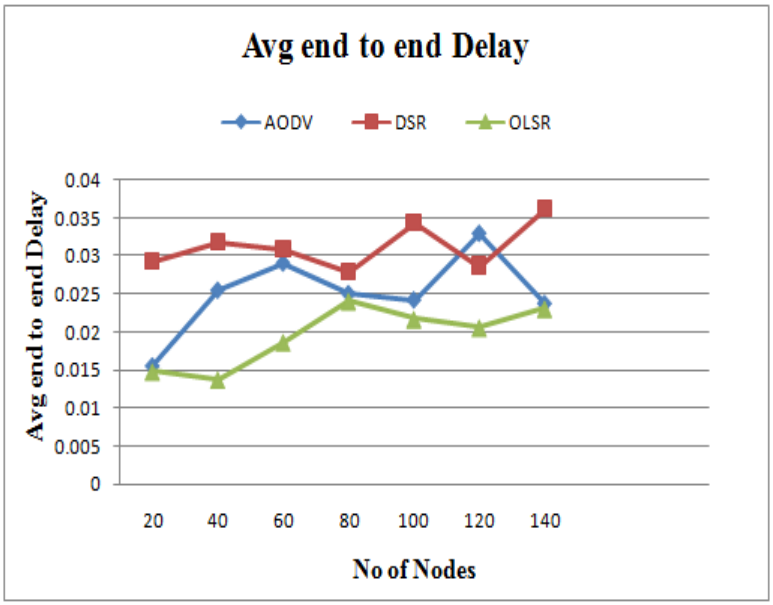
IV. PERFORMANCE ANALYSIS

The performance of the routing protocols OLSR, AODV and DSR are compared using Qualnet 5.0. Network Simulator with the metrics like average jitter, throughput, end-to-end delay and packets delivery ratio.

Parameters	Set II
Number of nodes	20-140
Field size (m)	1500x1500
CBR Link	1
Simulation duration (sec)	120
Pause time (sec)	30
Speed (m/sec)	10
Data packet rate (packets/sec)	1
Protocol	DSR, AODV, OLSR

Simulation I: Node Variation

The below are the results which were achieved after running the simulation on QualNet simulator for 120 seconds for nodes varying from 20 to 140 nodes.



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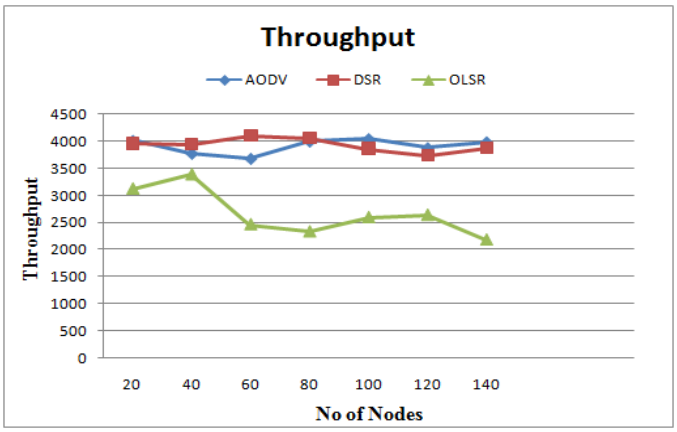
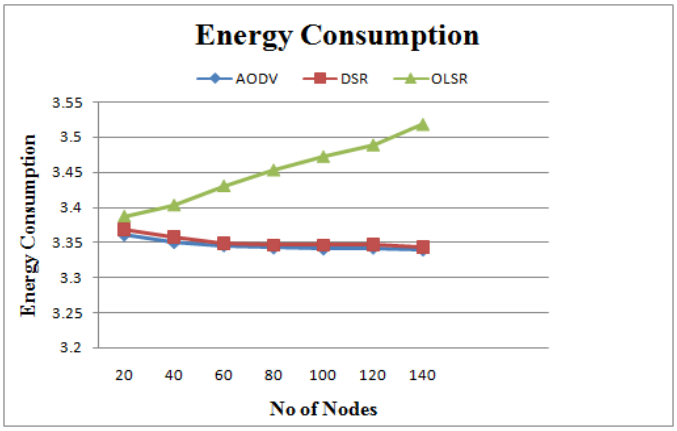
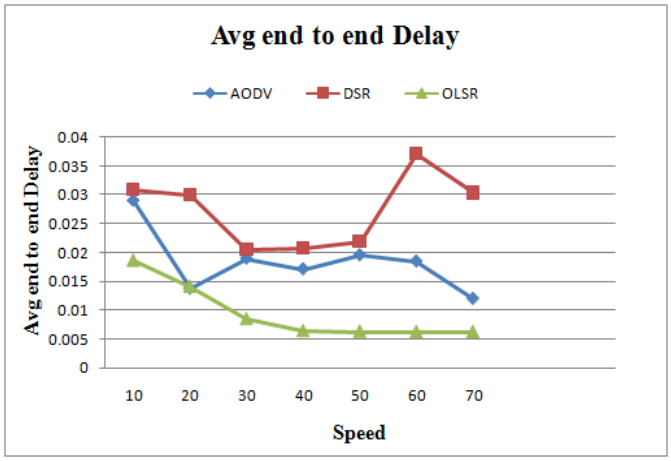




Results:

- DSR performance is good for 60 nodes.
- Throughput and Avg. Jitter is better than AODV
- Also energy consumption is low comparative to OLSR protocol
- Delay of DSR is high.

Simulation II: Speed Variation



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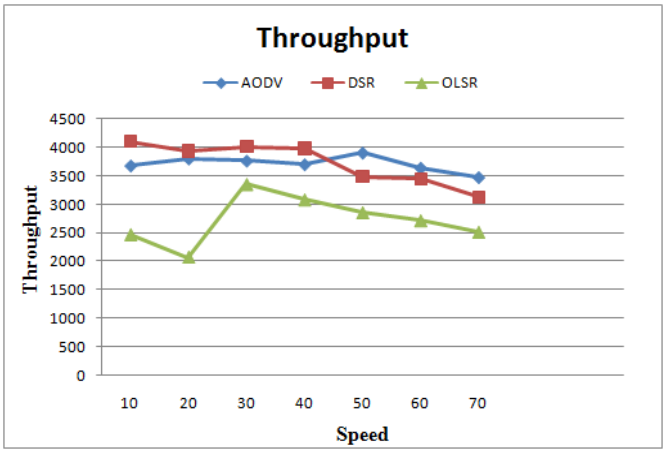

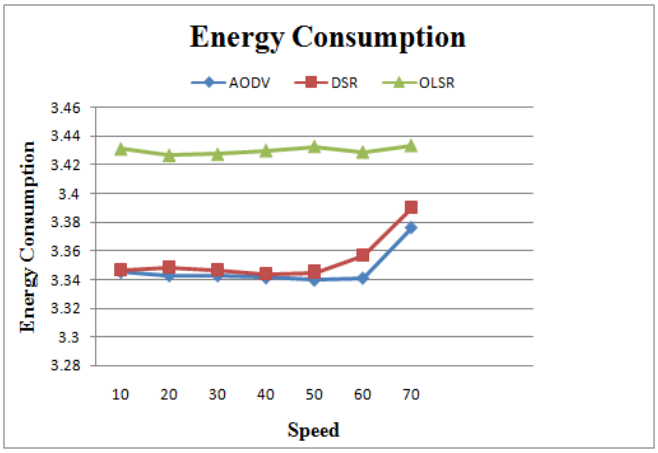

Results:

- DSR gives good result for 10, 30, 40 mobility speed.
- Overall PDR and Throughput is high.
- But Jitter and Delay are also high.
- Energy consumption is almost same to AODV but lower than OLSR.

V. CONCLUSION

The Dynamic Source Routing protocol provides comparatively good performance for routing in multi-hop wireless ad hoc networks. As shown in our detailed simulation studies, DSR has very low routing overhead and is able to correctly deliver almost all originated data packets, even with continuous, rapid motion of all nodes in the network.

• Node variation: Good for 60 nodes for 1 CBR link.

• Average jitter increases for 2 CBR links.

• Simulation Time: For 100 sec it performs well.

• Mobility Speed: Performs better for 10, 30, 40 m/sec speed.

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• Packet Rate: Performs well for 4 packets /sec.

• Area variation: For 1000*1000 m2 area DSR performs well.

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