Abstract—Ad hoc network is a collection of wireless mobile nodes where wireless radio interface connects each device in a 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. Many authors have compared various routing protocols such as AODV, DSR, DSDV, TORA, DYMO, OLSR etc in the past [1], [5], [7] and [11]. In this paper, we have analyzed the behavior of three routing protocols AODV (Ad hoc on demand distance vector), DYMO Dynamic MANET On demand), and OLSR (Optimized link state routing) in the network protocol IPV4 & IPV6 and compared the performance of these protocols using Qualnet5.0.2 simulator. The performance metrics are Throughput, Average Jitter, Packet Delivery Ratio & Total Packets Received. To test competence and effectiveness of all three protocols under IPV4 & IPV6, Changing the speed and mobility. Finally results are scrutinized from different scenarios to provide qualitative assessment of the applicability of the protocols.

Index Term—MANETs, AODV, DYMO, OLSR, IPV4, IPV6 & Qualnet5.0.2 simulator.

I. INTRODUCTION

A mobile ad hoc network (MANET) is a self-configuring network of mobile devices connected by wireless links. In other words, a MANET is a collection of communication nodes that wish to communicate with each other, but has no fixed infrastructure and no predetermined topology of wireless links. Each node in a MANET is free to move independently in any direction, and will therefore change its links to other devices frequently. Individual nodes are responsible for dynamically discovering other nodes that they can directly communicate with. Due to the limitation of signal transmission range in each node, not all nodes can directly communicate with each other. Each node must forward traffic unrelated to its own use, and therefore be a router. The primary challenge in building a MANET is equipping each device to continuously maintain the information required to properly route traffic. Therefore, nodes are required to relay packets on behalf of other nodes in order to deliver data across the network. A significant feature of ad hoc networks is that changes in connectivity and link characteristics are introduced due to node mobility and power control practices.

II. MANET ROUTING PROTOCOLS

Both the protocols i.e. AODV and DYMO are reactive or On-Demand protocols which find route to destination when there is traffic between the nodes or when it is demanded. Following section describe two On Demand protocols.

A. Ad-hoc On Demand Distance Vector Protocol

The Ad hoc On Demand Distance Vector (AODV) [10] is a routing protocol designed for ad hoc mobile networks. AODV is capable of both unicast and multicast routing. It builds and maintains routes between nodes only as desired by source nodes. AODV consists of a routing table which contains the sequence number and next hop information. The protocol consists of two processes: route discovery and route maintenance. In route discovery process a source node broadcasts a route request (RREQ) packet across the network. RREQ packet contains the source node's IP address, current sequence number, broadcast ID and the most recent sequence number for the destination of which the source node is aware. A destination node after receiving the RREQ may send a route reply (RREP) back to the source node. The source node receives the RREP, and begins to forward data packets to the destination. A route is considered active as long as there are data packets periodically raveling from the source to the destination along that path. Once the source stops sending data packets, the links will time out and eventually be deleted from the intermediate node routing tables. In route maintenance process if a link breaks occurs while the route is active;
the node upstream of the breaking link propagates a route error (RERR) message to the source node to inform it of the now unreachable destinations. After receiving the RERR, if the source node still desires the route, it can reinitiate route discovery.

B. Dynamic MANET On-demand (DYMO)

The DYMO [13] routing protocol enables reactive multihop unicast routing between participating nodes. The working of DYMO is similar to AODV with slight modification. The protocol also consists of route discovery and route maintenance process. During route discovery, the source node initiates dissemination of a Route Request (RREQ) throughout the network to find a route to the destination. During this hop by-hop dissemination process, each intermediate node records a route to the source. When the destination receives the RREQ, it responds with a Route Reply (RREP) sent hop-by-hop toward the source. Each intermediate node that receives the RREP creates a route to the target, and then the RREP is unicast hop-by-hop toward the source. When the source node receives the RREP, routes have been established between the source and destination.

Route maintenance consists of two operations. In order to preserve routes in use, node extends route life times upon successfully forwarding a packet. In order to react to changes in the network topology, DYMO routers monitor links over which traffic is flowing. When a data packet is received and a route for the destination is not known or the route is broken, then the DYMO source router is notified. A Route Error (RERR) is sent toward the source to indicate the current route to a particular destination is invalid or missing. When the source receives the RERR, it deletes the route. If the source node later receives a packet for forwarding to the same destination, it will need to perform route discovery again for that destination.

C. Optimized Link State Routing protocol (OLSR)

The OLSR [12] is based on link state algorithm and it is proactive in nature. OLSR is an optimization over a pure link state protocol as it squeezes the size of information send in the messages, and reduces the number of retransmissions. It provides optimal routes in terms of number of hops. For this purpose, the protocol uses multipoint relaying technique to efficiently flood its control messages [12]. Unlike DSDV and AODV, OLSR reduces the size of control packet by declaring only a subset of links with its neighbors who are its multipoint relay selectors and only the multipoint relays of a node retransmit its broadcast messages. Hence, the protocol does not generate extra control traffic in response to link failures and node join/leave events. OLSR is particularly suitable for large and dense networks [12]. In OLSR, each node uses the most recent information to route a packet. Each node in the network selects a set of nodes in its neighborhood, which retransmits its packets. This set of selected neighbor nodes is called the multipoint relays (MPR) of that node.

The neighbors that do not belong to MPR set read and process the packet but do not retransmit the broadcast packet received form node. For this purpose each node maintains a set of its neighbors, which are called the MPR Selectors of that node. This set can change over time, which is indicated by the selectors in their HELLO messages. The smaller set of multipoint relay provides more optimal routes. The path to the destination consists of a sequence of hops through the multipoint relays from source to destination. In OLSR, a HELLO message is broadcasted to all of its neighbors containing information about its neighbors and their link status and received by the nodes which are one hop away but they are not relayed to further nodes. On reception of HELLO messages, each node would construct its MPR Selector table. Multipoint relays of a given node are declared in the subsequent HELLO messages transmitted by this node.

III. SIMULATION ENVIRONMENT

In this scenario wireless connection of varying network size (50 nodes) for MANET is used for comparison the performance of routing protocol (AODV, DYMO, OLSR) and over it data traffic of Constant Bit Rate (CBR) is applied between source and destination. The nodes are placed randomly over the region of 1500m x 1500m. The network of size 50 nodes. The Qualnet5.0.2 simulator network simulator is used to analyze the parametric performance of Ad Hoc On-Demand Distance-Vector Protocol (AODV) Dynamic MANET On Demand (DYMO) & Optimized Link State Routing (OLSR) routing protocols. The basic scenarios parameters are listed in table 1 show the snap of simulation environment & analyze the performance of AODV, DYMO and OLSR routing protocols. The animated simulations of network size 50 are shown in Figure 1. The performance is analyzed with varying speed in network keeping traffic load and mobility constant. The results are shown in from Figure 2 to Figure 21.

Table 1. Basic Scenario

<table>
<thead>
<tr>
<th>Parameters</th>
<th>Values</th>
</tr>
</thead>
<tbody>
<tr>
<td>Simulator</td>
<td>Qualnet5.0.2 simulator</td>
</tr>
<tr>
<td>Protocols studied</td>
<td>AODV, DYMO &amp; OLSR</td>
</tr>
<tr>
<td>The number of nodes</td>
<td>50 nodes</td>
</tr>
<tr>
<td>Simulation network space</td>
<td>1500m x 1500m</td>
</tr>
<tr>
<td>Node placement</td>
<td>Randomly deployment</td>
</tr>
<tr>
<td>MAC protocol</td>
<td>IEEE 802.15.4</td>
</tr>
<tr>
<td>User mobility</td>
<td>Random way point</td>
</tr>
<tr>
<td>User speed</td>
<td>10 m/s, 60 m/s &amp; 150 m/s</td>
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<tr>
<td>Simulation time</td>
<td>30 sec</td>
</tr>
</tbody>
</table>
IV. RESULTS AND ANALYSIS

A. Application Layer

1) Analysis of Throughput for AODV, DYMO & OLSR with IPv4 & IPv6.

Throughput is the average rate of successful data packets received at destination. Figure 2, 3 & 4 shows throughput of AODV, DYMO & OLSR with variation in speed. It has observed that the performance of DYMO is better than AODV & OLSR with IPv4 whereas the performance of DYMO is better than AODV & OLSR with IPv6.

Figure 2 Comparison of Throughput for AODV.


This metric is calculated by subtracting time at which first packet was transmitted by source from time at which first data packet arrived to destination. This includes all possible delays caused by buffering during route discovery latency, queuing at the interface queue, retransmission delays at the MAC, propagation and transfer times. Figure 5, 6 & 7 shows average jitter of AODV, DYMO & OLSR with variation in speed. It has observed that the performance of low jitter corresponds to high efficiency OLSR is better than DYMO & AODV with IPV4 whereas the performance of OLSR is better than AODV & DYMO with IPV6.

Figure 4 Comparison of Throughput for OLSR.

Figure 3 Comparison of Throughput for DYMO.

Figure 5 Comparison of Average Jitter(S) for AODV.
B. Transport Layer


Figure 8 & 9 shows Packet Delivery Ratio of AODV, DYMO & OLSR with variation in speed. It has observed that the performance of OLSR is better than DYMO & AODV with IPv4 whereas the performance of OLSR is better than DYMO & AODV with IPv6.

C. Network Layer

4) Analysis of Average Packed Received for AODV, DYMO & OLSR with IPv4 & IPv6.

Figure 10, 11, 12, 13, 14 & 15 shows Total Packed Received of AODV, DYMO & OLSR with variation in speed. It has observed that the performance of OLSR is better than AODV & DYMO with IPv4 whereas the performance of OLSR is better than DYMO & AODV with IPv6 and also result shows that IPV6 performs better than IPV4.
Figure 11 Comparison of Average Packed Received for AODV in Speed 150 m/s.

Figure 12 Comparison of Average Packed Received for DYMO in Speed 60 m/s.

Figure 13 Comparison of Average Packed Received for DYMO in Speed 150 m/s.

Figure 14 Comparison of Average Packed Received for OLSR in Speed 60 m/s.

Figure 15 Comparison of Average Packed Received for OLSR in Speed 150 m/s.

D. Mac Layer

5) Analysis of Broadcast Packet Received (802.11 DCF)/Broadcast Packet Received Clearly (802.11MAC) for AODV, DYMO & OLSR with IPv4 & IPv6.

MAC describes total number of broadcast received and total number of successful broadcast received from the channel without errors. Figure 16, 17, 18, 19, 20 & 21 shows Broadcast Packed Received of AODV, DYMO & OLSR with variation in speed. It has observed that the performance of OLSR is better than AODV & DYMO with IPV4 whereas the performance of OLSR is better than DYMO & AODV with IPV6 and also result shows that IPV6 performs better than IPV4.
From the simulation results, we conclude that for IPV4 and IPV6:
- DYMO have better throughput than AODV and OLSR with IPV4.
- DYMO have better throughput than AODV and OLSR with IPV6.
QoS Measurement of various routing protocols in Mobile Ad-Hoc Network.}

REFERENCES


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