Quantitative Performance Evaluation of DSDV and OLSR Routing Protocols in Wireless Ad-hoc Networks

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Abstract:
The advancements in wireless communication made the present day technologies to move towards the ubiquitous computing which enables the user to access the information whenever and wherever required that has led to the evolution of mobile ad-hoc networks. MANET is a complex distributed system and a new networking paradigm for mobile hosts that do not require the intervention of any centralized administration. In such an environment, the nodes act as both host as well as router and forwards the packets to the destination and this special feature brings the MANET severe challenges like Quality of Service(QoS), routing. Many secure and robust routing protocols have been designed to handle the routing issues of MANET’s. This paper majorly discusses about two proactive routing protocols- OLSR (Optimised Link State Routing) and DSDV (Destination Sequenced Distance vector). The performance of these routing protocols are compared and evaluated based on mobility and various traffic scenarios.

I. INTRODUCTION
Due to the proliferation of wireless devices, the present day technologies are inclining towards the use of mobile ad-hoc networks and therefore a large number of recent studies focused on MANET. In the next generation of wireless communication systems, there is a tremendous need for the rapid deployment of independent mobile users. A network of such users is referred to as Mobile Ad hoc Network (MANET). At present MANET’s are used in various applications such as video streaming, military, live conferences and disaster recovery. Though MANET’s offer several advantages over traditional networks, routing is a major problem in a decentralized environment as the topology varies frequently. Routing is an active research area and numerous routing protocols have been designed for MANET’s. The efficiency of the network depends on the routing scheme employed.

Routing protocols for mobile ad hoc networks are divided into two categories: table-driven or proactive and on-demand or reactive routing protocols. In table driven routing protocols, consistent and up-to-date routing information of all nodes is maintained at each node whereas in on-demand routing the routes are created only when desired by the source. DSDV (destination sequenced distance vector routing) and OLSR (optimised link state routing) protocols are proactive routing protocols. DSDV is based on classical Bellman-Ford routing mechanism and the improvements made to the Bellman-Ford algorithm include freedom from loops in routing tables. OLSR aims at large and dense MANET’s and is based on multi-point relaying (MPR) flooding technique to reduce the number of topology broadcast packet. In this paper we concentrated on two proactive routing protocols DSDV, OLSR and the evaluation results are compared based on mobility and various traffic scenarios.

The following sections are structured as follows: Section-II describes the related work. Section-III gives the overview of the OLSR and DSDV routing protocols. In section-IV we have discussed about simulation environment and later the performance results using network simulator-2(ns-2). Finally concluding remarks and future work are depicted in section-VII.

II. RELATED WORK
Several researchers have done the analysis of routing protocols for different performance metrics through simulation. Elizabeth M. Royer et al. examined routing protocols and evaluated the protocols based on a set of parameters such as time complexity, critical nodes, routing metric and multi cast capability. Many possible applications and challenges in mobile ad-hoc networks have been identified. Mehran Abolhasan et al. discussed about wide range of routing protocols by comparing performance of all routing protocols and suggested which protocol performs best. However, none of these works provide any algorithm that best suits for all scenarios. Sunil Taneja et al. Concentrated on the comparative study and performance analysis of various on-demand routing protocols (DSR, AODV, TORA) basing on the performance metrics such as routing overhead, throughput, average delay, packet delivery ratio. David B. Johnson et al. have evaluated the operation of DSR through detailed simulation on a variety of movement and communication patterns.
through implementation and significant experimentation in physical outdoor ad-hoc networking test bed and demonstrated the performance of the protocol. Jorjeta G. Jetcheva et al. presented on performance evaluation of AMDR, MAODV, ODMRP, focusing on the effects of the protocols’ relative degree of on-demand behaviour and their performance in different multicast scenarios.

Patil V.P. et al. evaluated the performance of two MANET routing protocols AODV, DSDV based on TCP and CBR traffic patterns. The author compared the protocols and performs simulation for different network metrics like Packet delivery ratio, Average end-to-end delay, throughput for different number of nodes. After the simulation, author analyzed that reactive protocols are performing better in terms of average end-to-end delay and packet delivery ratio. K.Prabhu et al. analyzed the performance of several reactive routing protocols like DSR, AODV and TORA based on performance metrics like routing overhead, average end-to-end delay, packet delivery ratio and path optimality. The author evaluated the behaviour of routing protocols with respect to low mobility, low traffic and high mobility, high traffic and author observed that DSR and AODV outperforms TORA in all cases.

III. OVERVIEW OF ROUTING PROTOCOLS

Destination Sequenced Distance Vector Routing Protocol (DSDV):

The Destination-sequenced Distance-Vector (DSDV), a table driven routing protocol is a modified version of the Bellman-Ford algorithm. In DSDV every node maintains a routing table that contains hop count, destination address, next hop address and a sequence number that is generated by the destination. The sequence numbers helps to identify the fresh routes and create loop free paths. If the sequence number of two or more routes is same then the route with least hop-count is chosen.

Each node transmits update information to their neighbouring nodes periodically and all the nodes update their own routing table upon receiving the information. The update packets are broadcasted and every node increments the sequence number, hop count and next hop address. The broadcasted packets may contain either whole routing information that is a full dump packet or some part of routing information which is called incremental packet. Routing information is sent through NPDU (Network Protocol Data Units). An incremental packet must be smaller than a single NPDU so that it fits into it. The size of the full dump packet depends on the size of the ad-hoc network and may be more than a single NPDU.

Broken links may occur due to the movement of the nodes. A node changes all its routing tables hop counts to infinity and sequence numbers are changed to an odd number which represents that the path is no longer reachable. Then the update information is passed on to the neighbouring nodes. Even sequence numbers indicate a working route.

![Fig-1: Node A’s routing table prior to move](image1.png)

Node X moves from its first position where it is a neighbour of node B, to a new position where it is a neighbour of node E, and then the table is updated as

![Pros of DSDV:](image2.png)

**Pros of DSDV:**
- Routing loop problem is avoided.
- Count to infinity problem is eliminated.
- DSDV maintains best path rather than multiple paths to destination.

**Cons of DSDV:**
- DSDV uses small amount of bandwidth even if the Network is idle for regular updates of information in routing tables.
- A sequence number is required whenever the topology changes.
- DSDV is not suitable for highly dynamic networks.
Fig-3: Flooding

OLSR (OPTIMIZED LINK STATE ROUTING PROTOCOL):

OLSR is a point-to-point routing protocol in which each node maintains topology information by exchanging the link-state packets. OLSR is based on a Multipoint Relaying (MPR) flooding technique to reduce the number of topology broadcast packets. Each node periodically broadcasts hello messages to its one hop neighbours to select the MPR’s. The subset of the list of nodes in the hello messages is selected in such a way that all the nodes at a two hop distance are included and this subset of nodes is MPR’s. An optimal route to every known destination is determined by each node from the topology table.

Pros of OLSR:

- The size of broadcast packet is reduced.
- With global topology information stored and updated at every node, a shortest path from one node to every other node could be computed with Dijkstra’s algorithm, which goes along a series of MPR node.
- Number of retransmissions is reduced.

Cons of OLSR:

- Rediscovering of broken links takes more time in OLSR.
- More processing time is consumed while discovering an alternate route.

IV. SIMULATION ENVIRONMENT

Our simulation provides an analysis of OLSR and DSDV routing protocols is implemented using ns-2. A mobile ad-hoc network of 10, 20, 30, 40, 50 nodes is simulated in a simulation area of 1000mx1000m. The parameters considered in our simulation are as follows:

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Channel</td>
<td>Channel or wireless channel</td>
</tr>
<tr>
<td>Propagation model</td>
<td>Propagation/ Two ray ground</td>
</tr>
<tr>
<td>Antenna</td>
<td>Antenna/ Omni antenna</td>
</tr>
<tr>
<td>Simulator</td>
<td>ns-2</td>
</tr>
<tr>
<td>Number of nodes</td>
<td>10, 20, 30, 40, 50</td>
</tr>
<tr>
<td>Routing protocols</td>
<td>OLSR, DSDV</td>
</tr>
<tr>
<td>MAC layer</td>
<td>802.11 IEEE</td>
</tr>
<tr>
<td>Simulation time</td>
<td>200 seconds</td>
</tr>
<tr>
<td>Simulation area</td>
<td>1000mx1000m</td>
</tr>
<tr>
<td>Node movement</td>
<td>Model random way point</td>
</tr>
<tr>
<td>Traffic type</td>
<td>CBR</td>
</tr>
<tr>
<td>Data payload</td>
<td>512 Bytes/Packet</td>
</tr>
</tbody>
</table>

Fig-4: MPR Mechanism

Figure-3 shows the flooding of link state packets and Figure-4 shows the MPR nodes which are at two hop distance.

V. PERFORMANCE EVALUATION

Throughput: Throughput is the average rate of successful message delivery over communication channel and is measured in bps (bits per second).

End-to-End delay: Time taken by the packets to reach the destination. The delay may occur due to propagation time, waiting in data buffer and in the network interface queue.

Good put: Good put is the average rate of successful message delivery over communication channel after removal of protocol overhead bits retransmitted data packets.
Packet delivery ratio (PDR): PDR is defined as the ratio of the number of packets received by the destination to the number of packets generated by the source.

VI. PERFORMANCE RESULTS

![Fig-5: End-to-end delay](image1)

Figure 5 shows the end-to-end delay for 10, 20, 30, 40 and 50 nodes respectively with different pause times. From the figure it is observed that DSDV routing protocol has more delay than OLSR routing protocol because DSDV regularly updates the topology information throughout the network and allows long delay in transmission of packets.

![Fig-6: Throughput](image2)

Figure 6 explains the throughput for 10, 20, 30, 40 and 50 nodes respectively with different pause times. From the figure it is observed that OLSR routing protocol outperforms DSDV routing protocol because OLSR maintains multipoint Relays which minimizes the flooding.

![Fig-7: Packet delivery ratio](image3)

Figure 7 depicts the packet delivery ratio for 10, 20, 30, 40 and 50 nodes respectively with different pause times. From the figure it is observed that OLSR routing protocol outperforms DSDV routing protocol because OLSR maintains multipoint Relays which minimizes the flooding.

![Fig-8: Goodput for 10 nodes](image4)

Figure 8 shows the goodput for 10, 20, 30, 40 and 50 nodes respectively with different pause times. From the figure it is observed that OLSR routing protocol outperforms DSDV routing protocol because OLSR maintains multipoint Relays which minimizes the flooding.

VII. CONCLUSION AND FUTURE WORK

In this paper we have presented the performance evaluation of two proactive routing protocols OLSR and DSDV. The performance is evaluated based on the parameters such as throughput, good put and packet delivery ratio and end-to-end delay on UDP traffic for 10, 20, 30, 40, 50 nodes. Simulation results show that OLSR outperforms DSDV in terms of throughput, packet delivery ratio and good put. Considering the end-to-end delay it was observed that DSDV has more delay than OLSR as it takes more time for the transmission of packets. In MANET’s routing protocols are vulnerable to security attacks. For future work, a study on attacks can be done and security measures against these attacks can be implemented.
REFERENCES


