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Performance Enhancement of Proactive Routing Over Reactive Routing with Various Node Density in MANET Environment

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Abstract: *The environment in which a MANET is placed has a significant impact on the success of the routing strategy. Therefore, we chose to base our concepts and analysis on the assumption that we must support what is arguably the most demanding MANET environment, a tactical military environment. Many routing protocols for such networks have been proposed so far. Amongst the most popular ones are Dynamic Source Routing (DSR), Ad hoc On-demand Distance Vector (AODV), Destination-Sequenced Distance-Vector Routing (DSDV) and Optimized Link State Routing (OLSR). This paper contains the performance enhancement of routing protocols. Our observations regarding the behavior of the above protocols, in large-scale Mobile Ad hoc Networks (MANETs) and from the analysis it is clear that the optimized link state algorithm to send data to the leader proof to offer more reduced drop packets and also increase the lifetime of the network. Based on the analysis of this simulation results, OLSR protocol offer a better solution to quality of service usage in a MANET.*

Keywords: *MANET, AODV, DSR, DSDV, OLSR and NS-2.35.*

1. INTRODUCTION

Mobile ad hoc networks (MANETs) are a heterogeneous mix of different wireless and mobile devices, ranging from little hand-held devices to laptops that are dynamically and arbitrarily located in such a manner that the interconnections between nodes are capable of changing on a continual basis [1].

An ad hoc network is a group of wireless mobile computers (or nodes) in which nodes cooperate by forwarding packets for each other to allow a node to communicate beyond its direct wireless transmission range. Ad hoc networks require no centralized administration or fixed network infrastructure such as base stations or access points and can be quickly and inexpensively set up as needed. In Ad Hoc Networks the individual mobile hosts (nodes) act at the same time as both the router and the host.

2. ROUTING IN AD HOC NETWORK

The routing protocols for ad hoc wireless network should be capable to handle a very large number of hosts with limited resources, such as bandwidth and energy. The main challenge for the routing protocols is that they must also deal with node density, meaning that nodes can appear and disappear in various scenarios. Thus, all nodes of the ad hoc network act as routers and must participate in the route discovery and maintenance of the routes to the other nodes. For ad hoc routing protocols it is essential to reduce routing messages overhead despite the increasing number of nodes and their mobility. Keeping the routing table small is another important issue, because the increase of the routing table will affect the control packets sent in the network and this in turn will cause large link overheads [14].

3. AD HOC ON DEMAND DISTANCE VECTOR ROUTING (AODV)

The Ad Hoc On-Demand Distance Vector (AODV) routing protocol described in [11] builds on the DSDV algorithm previously described. AODV is an improvement on DSDV because it typically minimizes the number of required broadcasts by creating routes on a demand basis, as opposed to maintaining a complete list of routes as in the DSDV algorithm. The authors of AODV classify it as a pure on demand route acquisition system, since nodes that are not on a selected path do not maintain routing information or participate in routing table exchanges. When a source node desires to send a message to some destination node and does not already have a valid route to that destination, it initiates a path discovery process to locate the other node. It broadcasts a route request (RREQ) packet to its neighbors, which then forward the request to their neighbors, and so on, until either the destination or an intermediate node with a " fresh enough" route to the destination is located. Figure 1 illustrates the propagation of the broadcast RREQs across the network. AODV utilizes destination sequence numbers to ensure all routes are loop-free and contain the most recent route information. Each node maintains its own sequence number, as well as a broadcast ID. The broadcast ID is incremented for every RREQ the node initiates, and together with the node's IP address, uniquely identifies an RREQ. Along with its own sequence number and the broadcast ID, the source node includes in the RREQ the most recent sequence number it has for the destination. Intermediate nodes can reply to the RREQ only if they have a route to the destination whose corresponding destination sequence number is greater than or equal to that contained in the RREQ. During the process of forwarding the RREQ, intermediate nodes record in their route tables the address of the neighbour from which the first copy of the broadcast packet is received, thereby establishing a reverse path. If additional copies of the same RREQ are later received, these packets are discarded. Once the RREQ reaches the destination or an intermediate node with a fresh enough route, the destination or an intermediate node responds by unicasting a route reply (RREP) packet back to the neighbor from which it first received the RREQ (Figure 1). As the RREP is routed back along the reverse path, nodes along this path set up forward route entries in their route tables which point to the node from which the RREP came. These forward route entries indicate the active forward route. Associated with each route entry is a route timer which will cause the deletion of the entry if it is not used within the specified lifetime. Because the RREP is forwarded along the path established by the RREQ, AODV only supports the use of symmetric links. Routes are maintained as follows. If a source node moves, it is able to reinitialize the route discovery protocol to find a new route to the destination. If a node along the route moves, its upstream neighbor notices the move and propagates a link failure notification message (an RREP with infinite metric) to each of its active upstream neighbors to inform them of the erasure of that part of the route. These nodes in turn propagate the link failure notification to their upstream neighbors, and so on until the source node is reached. The source node may then choose to reinitialize route discovery for that destination if a route is still desired. An additional aspect of the protocol is the use of hello messages, periodic local broadcasts by a node to inform each mobile node of other nodes in its neighborhood. Hello messages can be used to maintain the local connectivity of a node. However, the use of hello messages is not required. Nodes listen for retransmission of data packets to ensure that the next hop is still within reach. If such a retransmission is not heard, the node may use any one of a number of techniques, including the reception of hello messages, to determine whether the next hop is within communication range. The hello messages may list the other nodes from which a mobile has heard, thereby yielding greater knowledge of network connectivity [11].

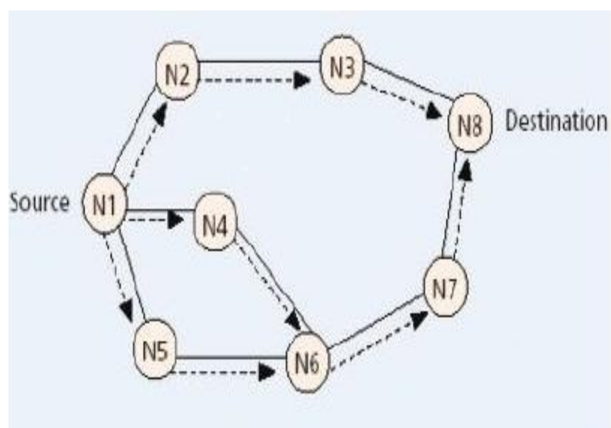

Figure 1:- Route Discovery of AODV

4. DESTINATION-SEQUENCED DISTANCE-VECTOR ROUTING (DSDV)

The Destination-Sequenced Distance-Vector Routing protocol (DSDV) described in is a table-driven algorithm based on the classical Bellman-Ford routing mechanism [12]. The improvements made to the Bellman-Ford algorithm include freedom from loops in routing tables. Every mobile node in the network maintains a routing table in which all of the possible destinations within the network and the number of hops to each destination are recorded. Each entry is marked with a sequence number assigned by the destination node. The sequence numbers enable the mobile nodes to distinguish stale routes from new ones, thereby avoiding the formation of routing loops. Routing table updates are periodically transmitted throughout the network in order to maintain table consistency. To help alleviate the potentially large amount of network traffic that such updates can generate, route updates can employ two possible types of packets. The first is known as a full dump. This type of packet carries all available routing information and can require multiple network protocol data units (NPDUs). During periods of occasional movement, these packets are transmitted infrequently. Smaller incremental packets are used to relay only that information which has changed since the last full dump. Each of these broadcasts should fit into a standard-size NPDU, thereby decreasing the amount of traffic generated. The mobile nodes maintain an additional table where they store the data sent in the incremental routing information packets. New route broadcasts contain the address of the destination, the number of hops to reach the destination, the sequence number of the information received regarding the destination, as well as a new sequence number unique to the broadcast [12]. The route labeled with the most recent sequence number is always used. In the event that two updates have the same sequence number, the route with the smaller metric is used in order to optimize (shorten) the path. Mobiles also keep track of the settling time of routes, or the weighted average time that routes to a destination will fluctuate before the route with the best metric is received (see [12]). By delaying the broadcast of a routing update by the length of the settling time, mobiles can reduce network traffic and optimize routes by eliminating those broadcasts that would occur if a better route was discovered in the very near future [12].

5. DYNAMIC SOURCE ROUTING (DSR)

Dynamic Source Routing (DSR) is a widely used reactive (on-demand) routing protocol which is designed particularly for the mobile ad-hoc networks. DSR permits the network to run without any existing network infrastructure and thus the network becomes as a self-organized and self-configured network. This protocol maintains an on-demand approach and hence extinguishes the periodic table-update messages needed in the table-driven approach. Consequently, it is able to prevent the control packets from consuming much bandwidth. Like other on-demand routing protocols, DSR does not provide the transmission of any periodic hello packet (beacon), which is essential for informing its presence to other nodes. Instead, during the route construction phase, it establishes the route by flooding a Route Request packet in the network. Each Route Request packet holds a sequence number which is generated by all the nodes through which the packet is flooded. By using this sequence number, loop formation and multiple transmission of the same Route Request is possible to be evaded. When a Route Request packet is reached to its final destination, the destination node sends a Route Reply packet to the source node through the opposite way the Route Request is travelled. Since, it cannot be an efficient mechanism for the nodes to provide continuous flooding; DSR utilizes the route caches to store the routing information [13].

In MANETs, the DSR protocol generates two mechanisms namely route discovery and route maintenance for the purpose of discovering and maintaining the route between the endpoints. Both mechanisms are utilized to support the unidirectional (asymmetric routes) links in wireless ad-hoc network.

Figure 2 shows that to commence the Route Discovery mechanism, node M floods a Route Request to all nodes which are in the wireless transmission range of M. In the network, the initiator (source node) and target (destination node) of the Route Discovery is identified by each Route Request packet. The source node also provides a unique request identification number in its Route Request packet and in Figure 4.2 this is given as ID= 3.

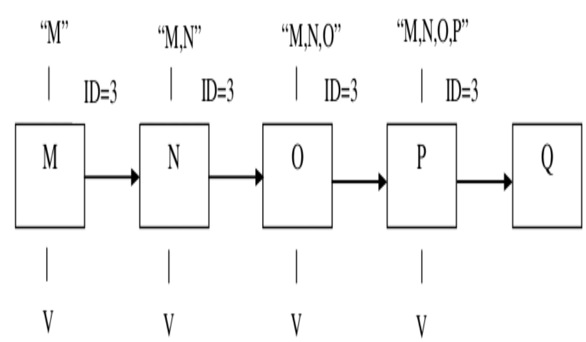

Figure 2:- Route discovery mechanism for DSR

For responding to the Route Request, the target node Q generally scans its own Route Cache for a route before sending the Route Reply toward the initiator node M.

However, if no suitable route is found, node Q will execute its own Route Discovery mechanism in order to reach toward the initiator.

6. OPTIMIZED LINK STATE ROUTING (OLSR)

The Optimized Link State Routing (OLSR) is operated as a proactive (table-driven) routing protocol i.e. frequently exchanges topology information with other nodes of the network. This protocol is basically an optimization of traditional link state protocol developed for mobile ad-hoc network. The responsibilities of OLSR protocol are to minimize the required number of control packets transmission and also to shorten the size of control packets. On top of that, OLSR trims down the control traffic overhead in the network with the help of Multipoint Relays (MPRs). The MPR concept is the key idea behind OLSR protocol which is basically a node's one-hop neighbors in the network as shown in Figure 3. For route calculation, the MPR technique is employed in order to form the route between the source and the destination in the network. In addition, the MPRs yield an efficient mechanism for flooding the control traffic by significantly minimizing the number of packet transmissions. Yet, the MPRs are to be involved in another task when the link state information is declared in the network. The task includes declaring the link-state information for their MPR selectors and hence providing the shortest paths to all destinations. In MANET, the MPRs are assigned from the one-hop adjacent nodes with "symmetric" (bi-directional) linkages. Thus, by determining the path through the multipoint relays, it is possible to keep away the difficulties experienced during the packet transmission over a uni-directional link.

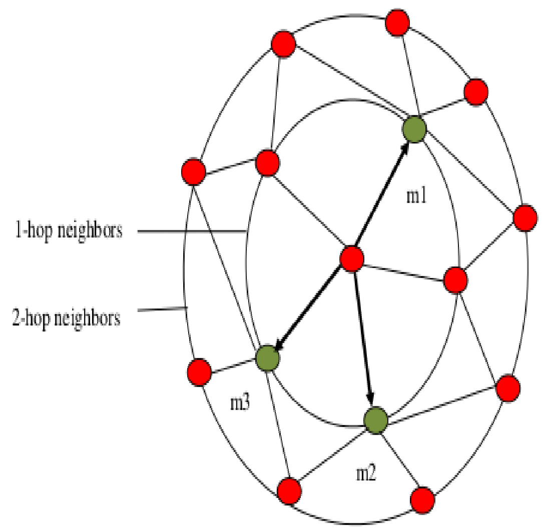

Figure 3:- Multipoint Relays of the OLSR network

OLSR employs three different types of control messages [19], namely 1) HELLO, 2) Topology Control (TC), and 3) Multiple Interface Declaration (MID). OLSR minimizes the maximum time interval while periodically transmitting these control messages and thus preserves the routes incessantly to all destinations in MANETs. This feature eventually makes the OLSR protocol to be more favorable for large and dense networks. In terms of OLSR protocol, the larger and denser a network, the more optimization can be obtained as compared to the pure link state algorithm [19]. OLSR is independent of the central entities and designed to operate in such a way where a complete distribution algorithm can be achieved.

7. RESULTS

We use the Network Simulator 2.35 in order to simulate the routing protocols involves in our study. In this work simulation environment of 30, 40, 50, 100 nodes taken which are dynamic and the pause time of 100 sec. The details of simulation parameters are given in table.

Table 1:- Performance Parameters

S NO.	PARAMETERS	VALUES
1	No of nodes	30, 40, 50, 100
2	Routing Protocols	AODV, DSDV,

		DSR, OLSR
3	Performance Metrics	Packet Delivery Ratio, Throughput, End-to-End Delay
4	Simulation Area	2000m*2000m
5	Packet Size	Random
7	Pause time	100 Seconds

In initial phase, we use 30 nodes in our scenario and simulate using mobility of the nodes for the performance metrics packet delivery ratio, end to end delay and throughput of routing protocols AODV, DSDV, DSR and OLSR.

In the second phase, we use 40 nodes in our scenario and simulate using dynamic nodes for the performance metrics packet delivery ratio, end to end delay and throughput of AODV, DSDV, DSR and OLSR the routing protocols.

In the final phase, we use 50 nodes and 100 nodes in our scenario and simulate using dynamic nodes for the performance metrics packet delivery ratio, end to end delay and throughput of AODV, DSR and DSDV the routing protocols.

Packet Delivery Ratio:- This is the fraction of the data packets generated by the TCP sources to those delivered to the destination. This evaluates the ability of the protocol to discover routes.

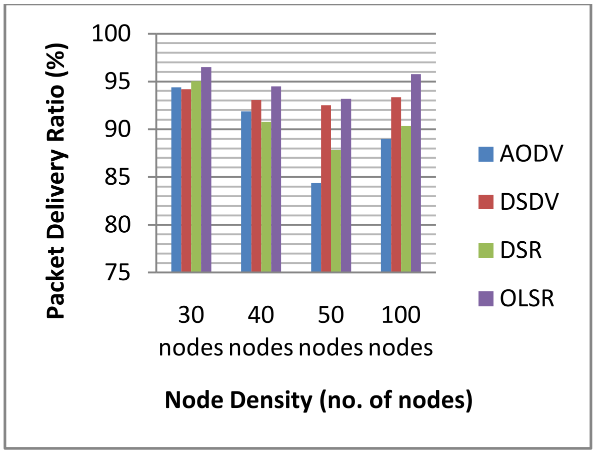

Figure 4:- Packet Delivery Ratio

End-to-End Delay:- End to End Delay is the time taken for a packet to be transmitted across a network from source to destination. End to End Throughput is the amount of data sent or received.

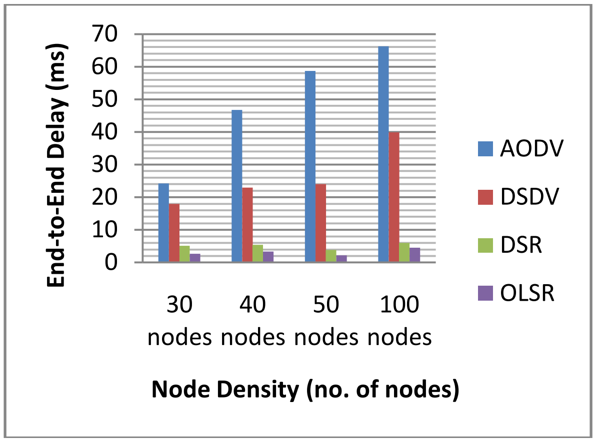

Figure 5:- End-to-End Delay

Throughout:-The average rate at which the data packet is delivered successfully from one node to another over a communication network is known as throughput. The throughput is usually measured in bits per second (bits/sec). A throughput with a higher value is more often an absolute choice in every network.

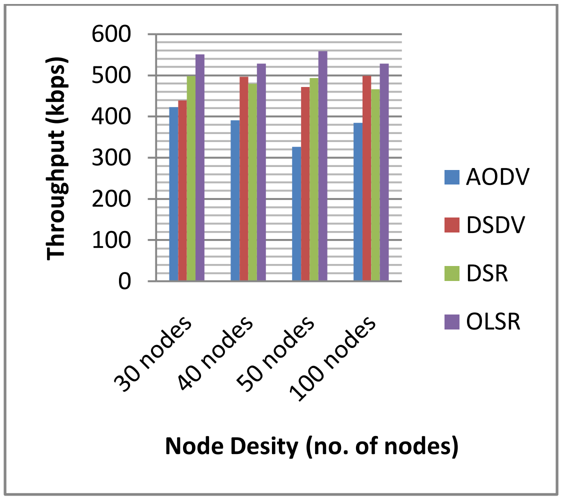

Figure 6:- Throughput

8. CONCLUSION

The overall performance of OLSR in terms of network load is best as compared to AODV, DSR and DSDV. When the network size is increased it does not affect the performance of OLSR in dynamic ad-hoc networks which means that OLSR outperforms AODV, DSR and DSDV.

OLSR is a source routing and has the characteristics of on-demand routing. The end-to-end delay of OLSR has less as compared to AODV, DSR and DSDV when the traffic load is high, which means that its performance is best in dynamic ad-hoc network. The increase in network size does not affect the performance of OLSR in dynamic ad-hoc networks. The reason is that OLSR is reactive routing protocol, which means that there are no routing tables with each node, and the packets are directly broadcasted by all nodes. In the case of throughput OLSR attains high rate in static ad-hoc networks. When the network size is increase is does not affect the performance of OLSR, which means that OLSR outperform the AODV, DSR and DSDV. OLSR is reliable in terms of large-scale environment. The reason for high throughput of OLSR in comparison with other protocols is that, for OLSR routing path are easily available due to the characteristic of reactive routing protocols.

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