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PERFORMANCE COMPARISON OF PROACTIVE ROUTING PROTOCOLS: OLSR, DSDV, WRP

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***Abstract*:** Mobile ad hoc networks (MANETs) are becoming more popular to wireless communications due to wide acceptance of mobile devices. In this paper, attempt has been made to evaluate the performance of proactive routing protocols through MATLAB. Simulations is carried over Optimized Link State Routing (OLSR), Destination-Sequenced Distance-Vector (DSDV) and Wireless Routing Protocol (WRP) routing protocols. We evaluate the Throughput, Packet Delivery Ratio (PDR), MAC collision, and Error Rate for said protocols.The evaluation results show that OLSR has the best performance than other protocols.

Keywords: OLSR, DSDV, WRP, Proactive protocols, MANET's

I. INTRODUCTION

In recent years, wireless multi-hop networks such as ad hoc networks, sensor networks, and vehicular networks have been receive the attention because of their applications in that areas where the wired networks can't be established for one or the other reason. Mobile Ad hoc Network (MANET) is a collection of wireless mobile terminals that are able to dynamically form a temporary network without any aid from fixed infrastructure or centralized administration [1,2]. In an infrastructure mobile network, mobile nodes have wired access points (or base stations) within their transmission range. In contrast, mobile ad hoc networks are autonomously self-organized networks without infrastructure support. In a mobile ad hoc network, nodes move arbitrarily, therefore the network may experience rapid and unpredictable topology changes [3] which may lead to routing problem. According to these characteristics, routing is a critical issue and we should choose an efficient routing protocol to makes the MANET reliable [4]. All the nodes of MANET are capable to receive and to transmit the messages. If the source and destination nodes are directly within the range of each other they can communicate directly (single-hop) otherwise the nodes between the source and destination node can forward the data (multi-hop)[5].Routing protocols will need to perform four important functions as determination of network topology, maintaining network connectivity, transmission scheduling and channel assignment, and packet routing. Routing protocols in MANETs were developed based on the design goals of minimal control overhead, minimal processing overhead, multi hop routing capability, dynamic topology maintenance and loop prevention [6].

Remainder of this Paper is organized as follows: Section II give the details of various categories of routing protocols, Section III presents overview of the proactive protocols i;e OLSR, DSDV and WRP. Section IV provides the simulation environment and performance metrics are described in Section V and then the results are presented in Section VI. Finally Section VII concludes the paper.

II. ROUTING PROTOCOLS

A. Reactive routing protocols: These are the protocols in which route is traced only and only when they are required. When any of the nodes has data to send then and only then routes are discovered by route discovery process [7]. That route remains valid only for the duration of communication. In reactive routing protocols, to discover the route they broadcast a Route Request (RREQ) packet in the network and that request packet is multi time replicated in the network until it find the destination. It will lead to broadcast storm problem and particularly in dense networks it increase the MAC collision rate and reduce the packet delivery ratio. As the route discovery is needed prior to each data transmission so latency is also high [8-9].

B. Proactive routing protocols: In these routing protocols, the paths to the destination are computed automatically and independently at the start up and maintained by using a periodic route update process [10]. The tables contain the information about nodes to maintain the latest view of network. As the nodes move away from one another then the network topology changes which propagate update messages throughout the network in order to maintain consistent and up-to-date routing information about the whole network. These routing protocols differ in the method by which the topology change information is distributed across the network and the number of necessary routing-related tables [11].

C. Hybrid routing protocols: Proactive or reactive protocols alone work well within limited region of network setting but the combinations of proactive and reactive protocols, called as hybrid routing protocol, can work very well for any particular network. It may work as for any nearby routes (for example, maximum two hops) are kept

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up-to-date proactively, while far-away routes are set up reactively. Both proactive and reactive routing protocols prove to be inefficient under these circumstances. Hybrid routing protocol combines the advantages of the proactive and reactive approaches. Hybrid protocols include: SHARP, ZHLS routing protocols [12].

III. MANET ROUTING PROTOCOLS

In this section, we briefly describe the key features of the OLSR, DSDV, and WRP protocols. But before that the basic differences in these protocol implementation lies inthe mechanisms they followed according to routing strategy based classification as reactive and proactiveprotocols. In Reactive or on-demand routing routes are only discovered when they are actually needed [13-15].Hence, a node that wants to send a packet to another node, the reactive protocols searches for the route inan on-demand basis and establishes a connection to transmit and receive a packet. The route discoverytypically consists of network wide flooding of request message. In proactive routing eachnode continuously maintain route between pair of nodes. Hence, route creation and maintenance isaccomplished through some combination of periodic and event-triggered routing updates derived fromdistance-vector or link-state method.

Destination Sequenced Distance Vector (DSDV)

DSDV is a hop-by-hop distance vector routing protocol requiring each node to periodically broadcast routing updates based on the idea of classical Bellman-Ford Routing algorithm [16]. The improvement made to the Bellman-Ford algorithm includes freedom from loops in routing tables by using sequence numbers. Each node maintains a routing table listing the “next hop” for each reachable destination, number of hops to reach destination and the sequence number assigned by destination node. The sequence number is used to distinguish stale routes from new ones and thus avoid loop formation. The stations periodically transmit their routing tables to their immediate neighbors. A station also transmits its routing table if a significant change has occurred in its table from the last update sent. So, the update is both time-driven and event-driven. The routing table updates can be sent in two ways: a “full dump” which is a packet that carries all the information about a change or an “incremental” update which will carry just the changes thereby, increasing the overall efficiency of the system.

Optimized Link State Routing (OLSR)

OLSR is a table driven protocol, that stores and update the routes and whenever a route is required, it select that route with no delay. It is an optimization of pure link state algorithm [17], uses the concept of Multi point Relays(MPR) for forwarding control traffic, and may reduce the overhead of packet transmission compared to flooding mechanism [18]. The MPR set isselected such that it covers all nodes that are two hops away. Due to proactive nature, OLSR works with aperiodic exchange of messages like Hello messages and Topology Control (TC) message only through itsMPR [19]. The parameters used by OLSR to control the protocol overheads are Hello-interval parameter, TCintervalparameter, MPR coverage parameter and TC-redundancy parameter. So, contrary to classic linkstate algorithm, instead of all links, only small subsets of links are declared.

Wireless routing protocol (WRP)

In Wireless Routing Protocol [20]each node in the network maintains four tables:

• Distance table
• Routing table
• Link-cost table
• Message retransmission list (MRL) table

The MRL table contains the sequence number of the update message, a retransmission counter, an acknowledgment-required flag vector with one entry per neighbor, and a list of updates sent in the update message. The MRL records which updates in an update message need to be retransmitted and which neighbors should acknowledge the retransmission [20].

Nodes tells each other of link changes through the update messages. An update message is sent only between neighboring nodes and contains a list of updates (the destination, the distance to the destination, and the predecessor of the destination), as well as a list of responses indicating which nodes should acknowledge (ACK) the changes. Nodes send update messages after processing updates from neighbors or detecting a change in a link to a neighbor. If link breaks between two nodes, the nodes send update messages to their neighbors. The neighbors then alter their distance table entries and search for alternate routes to destination and these changes are updated in corresponding tables. So the nodes come to know the existence of their neighbors from the receipt of acknowledgments and other messages. If a node is not sending messages, it must send a *hello* message within a specified time period to ensure connectivity. Otherwise, the lack of messages from the node indicates the failure of that link; this may cause a false alarm. When a mobile receives a *hello* message from a new node, that new node is added to the mobile’s routing table, and the mobile sends the new node a copy of its routing table information. In WRP, routing nodes communicate the distance and second-to-last hop information for each destination in the wireless networks to get the loop free route.

IV. SIMULATION ENVIRONMENT

To verify the results through the simulation using MATLAB, the simulation parameters are as per table 1. The traffic sources are CBR (continuous bit rate). The source-destination pairs are stretch randomly over the network. The mobility model uses ‘random waypoint model’ in a rectangular filed of 1000m x 1000m with 125 nodes. During the simulation, one randomly selected node start the data transmission to randomly selected node. By all the protocols, route has been discovered and data transmission takes place. Speed of the nodes and transmission range of any particular node is fixed for simulation. Due to the random movement of nodes, the topology is ever changing. That’s why different protocols perform differently in the same environment.

TABLE 1: Simulation Parameters

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Simulation Parameter	Values
Simulator	MATLAB R2010a
Channel Type	Wireless Channel
Area	1000*1000 m^2
Transmission Range	200 m
Packet size	100
Speed	5 m/s
Pause time	0 sec
MAC type	Mac 802_11
Antenna model	Omni Antenna
Routing Protocol	OLSR/DSDV /WRP

V. PERFORMANCE ANALYSIS

(a) MAC Collision Rate: MAC collision rate is the number of data packet collisions occurring at MAC layer in a network over a specified period of time. It indicates the rate at which data packets collide or are lost in collisions. It is measured as a percentage of the data packets successfully sent out.

(b) Normalized routing overhead: It is the ratio of total packet size of control packets (including the RREQ, RREP, RERR and Hello) to the total packet size of data packets delivered to the destination.

(c) Packet delivery ratio: It is the ratio of number of data packet successfully received by the CBR (constant bit rate) destination to the number of data packet generated by the CBR source. It measures the loss rate by transport protocols. Mathematically, it can be expressed as:

$$PDR = \frac{\sum(\textit{all the packets received by destination})}{\sum(\textit{all the packets sent by source})} \ldots\text{(i)}$$

(d) Error rate: It is the rate at which error may occur in the transmitted data packets. More error means the higher losses in data packets and more retransmissions are required which increase the overheads and reduce the throughput.

(e) Average Throughput: Throughput is defined as the total number of packets delivered over the total simulation time. Mathematically, it can be defined by equation (ii) as:

$$\text{Throughput} = \frac{N}{1000}\ldots\ldots\ldots\ldots\text{(ii)}$$

Where N is the number of bits received successfully by all destinations. And average of the total throughput is called as average throughput.

VI. RESULTS AND DISCUSSIONS

Figure 1 shows the MAC collision rate for OLSR, DSDV and WRP, under same simulation environment. For more dense environments the collisions are high, and with OLSR the minimum value is 0.78 and maximum is 4.42 with the average of 2.36. The average value is 7.78 and 19.71 for DSDV and WRP respectively.

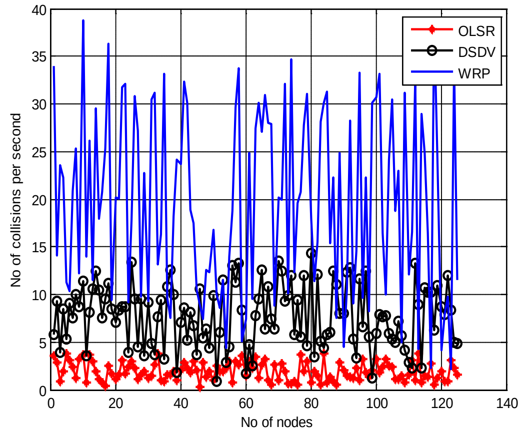

Figure 1 MAC collision rate vs Number of Nodes

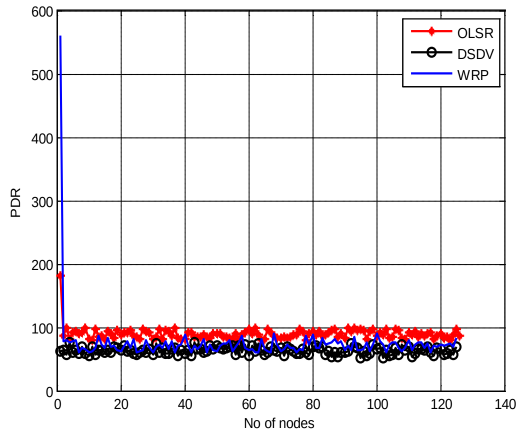

Figure 2 Packet delivery vs Number of Nodes

Figure 2 compares the packet delivery ratio of three protocols. For OLSR it is always better than DSDV and WRP.It remains 89.89% on an average with minima 80.17 and maxima 99.86 for OLSR in comparison to DSDV and WRP in it is 73.03% and 62.56% respectively. This result indicates that the OLSR protocol is the more efficient among the three protocols.

Normalized routing overheads are shown in figure 3. OLSR has lowest routing overheads as compared with DSDV and WRP. In OLSR, average routing overheads are 11.53whereas for DSDV and WRP average routing overheads are 33.76 and 48.67.

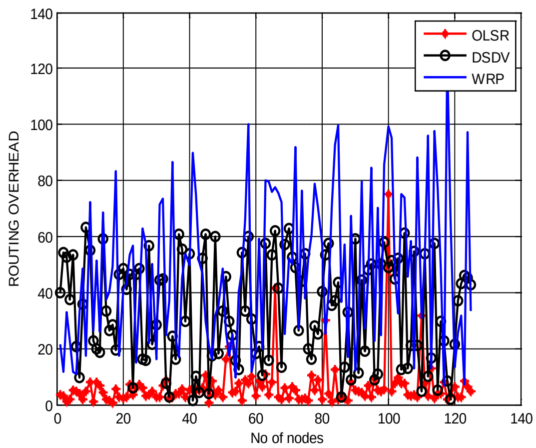

Figure 3 Average routing overheads vs Number of nodes

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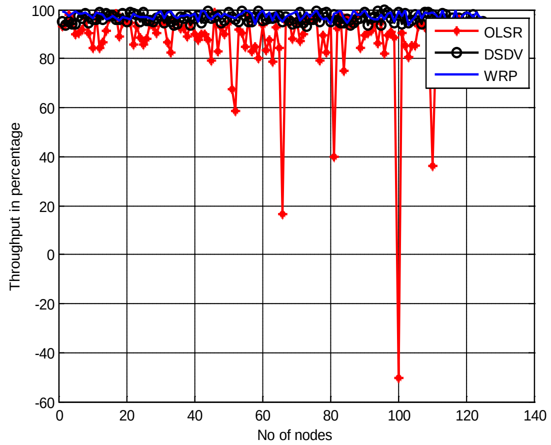

Figure 4 Throughput vs Number of nodes

Figure 4 compare the throughput of OLSR, DSDV and WRP protocols. The Average throughput of OLSR is 87.44% that is less than the DSDV and WRP. The average throughput of DSDV and WRP is 96.34% and 97.48%.

In figure 5, error rate for OLSR, DSDV and WRP is shown. The average error rate for OLSR is 2.44 that is lower than DSDV and WRP. Error rate for DSDV is 14.26 and for WRP it is 166.92.

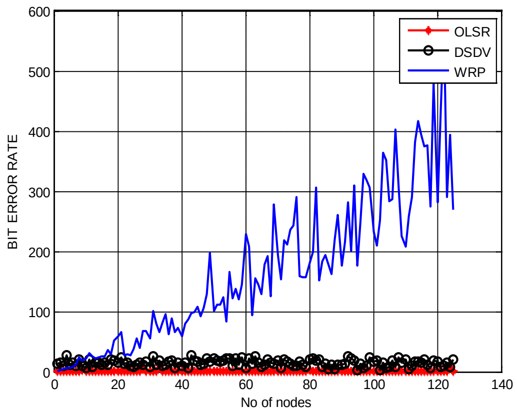

Figure 5 Error rate vs Number of nodes

VII.CONCLUSION

In this paper the performance of OLSR is compared with DSDV and WRP on the basis of packet delivery ratio, normalized routing overheads, Throughput, error rate and MAC collision rate by using Matlab. From the simulation results it is clear that for the same simulation environment protocols behave differently. This is because of their way of working. The overall performance of OLSR protocols is better than DSDV and WRPwhen compared on the basis of packet delivery ratio, normalized routing overheads, error rate and MAC collision rate but throughput of WRP is very near to the throughput of DSDV and it is slightly better than OLSR.

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