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Performance Analysis of DSR Routing Protocol in MANET

Dr. Khin Khat Khat Kyaw
Associate Professor
Information Technology Department
West Yangon Technological University, Yangon
Myanmar

Abstract: Since the usage of mobile applications gets higher, the availability of MANET needs better performance. The topology of MANET dynamically changes because of mobility. Consequently, the routing protocols used in MANET must be fast and save. Therefore, the performance analysis of MANET routing protocols becomes an interesting case in networking research area. In this paper, the performance of DSR routing protocol has been analysed in term of throughput, end-to-end delay, PDR and packet loss.

Keywords: MANET, DSR, NS2, routing, PDR, throughput

1. INTRODUCTION

Mobile ad hoc network (MANET) is a collection of independent mobile nodes with no centralized administration. Mobility makes network topology unstable and results various changes in connection between two hosts. Routing path can be broken frequently and so its routing is more complex than that of wired networks.

In MANET, to support mobile computing, a mobile host must be able to communicate with other mobile hosts which may not lie within it's radio transmission range. Hence routing protocols will need to perform four important functions as determination of network topology, maintaining network connectivity, transmission scheduling 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[1].

In general, ad hoc routing protocols can be classified into three groups: reactive (on-demand), proactive (table-driven) protocol, and hybrid protocol.

Reactive (on-demand) routing protocols find routes by using the route request packet. It is a bandwidth efficient on-demand routing protocol for Mobile Ad-Hoc Networks. The protocol deals with two main functions of Route Discovery and Route Maintenance. The discovery of new route is decided by Route Discovery function and the detection of link breaks and repair of an existing route is decided by Route Maintenance function. Reactive or on-demand routing protocols route is discovered when required. Distribution of information is not required in reactive protocols. The popular reactive protocols are AODV and DSR. These protocols do not maintain permanent route table. Instead, routes are built by the source on demand.

Proactive protocols maintain the global topology information in the form of tables at every node. These tables are updated frequently in order to maintain consistent and accurate network state information. The well-known examples are DSDV, WRP, and STAR.

A hybrid routing protocol such as ZRP effectively combines the best features of both proactive and reactive routing protocols. The key concept employed in ZRP is to use a proactive routing scheme within a limited zone every node, and use a reactive routing scheme for nodes beyond this zone.

Each protocol type has its specific network behavior. Therefore, the performance analysis of these protocols is a must task to know the behavior and efficiency rate in that environment. Several factors will affect the overall performance of any protocol operating in an adhoc network. For example, node mobility may cause link failures, which negatively impact on routing and quality of service (QoS) support. Network size, control overhead, and traffic intensity will have a considerable impact on network scalability along with inherent characteristics of ad hoc networks may result in unpredictable variations in the overall network performance.

2. RELATED WORK

Dynamic Source Routing(DSR) protocol adapts quickly to routing changes when host movement is frequent, yet requires little or no overhead during periods in which hosts move less frequently[1].

Source routing is a routing technique in which the sender of a packet determines the complete sequence of nodes through which to forward the packet; the sender explicitly lists this route in the packet's header, identifying each forwarding "hop" by the address of the next node to which to transmit the packet on its way to the destination host. When a host needs a route to another host, it dynamically determines one based on cached information and on the results of a route discovery protocol.

To send a packet to another host, the sender constructs a source route in the packet's header, giving the address of each host in the network through which the packet should be forwarded in order to reach the destination host. The sender then transmits the packet over its wireless network interface to the first hop identified in the source route. When a host receives a packet, if this host is not the final destination of the packet, it simply transmits the packet to the next hop identified in the source route in the packet's header. Once the packet reaches its final destination, the packet is delivered to the network layer software on that host.

A host initiating a route discovery broadcasts a route request packet which may be received by those hosts within wireless transmission range of it. The route request packet identifies the host, referred to as the target of the route discovery, for which the route is requested. If the route discovery is successful the initiating host receives a route reply packet listing a sequence of network hops through which it may reach the target.

Dynamic Source Routing (DSR) protocol was extended and termed as Energy Efficient Secure Dynamic Source Routing (EESDSR)[3]. The protocol was based on an efficient, power aware and distributed trust model that enhances the security of Dynamic Source Routing (DSR) protocol. The model identified the nodes exhibiting malicious behaviors like: gray hole, malicious topology change behavior, dropping data packets and dropping control packets.

The performance of optimized dynamic source routing protocol (DSR) was investigated for MANETs. To find the optimal paths between the communicating nodes, traditional DSR algorithm was modified by using the Fire fly algorithm. In recent times, a population based method named as Firefly algorithm was stimulated by the surveillance of real firefly and its brightness behaviour. So firefly algorithm was used for their proposed method on MANET which improved the DSR routing performance with well-organized packets transfer from the source to destination node. Optimal route was found based on link quality, node mobility and end to end delay. Simulations were conducted with 25 nodes and the performance of the traditional DSR, link quality based DSR for selecting a route and proposed firefly algorithm for optimal route finding are compared by the parameters such as throughput, end to end delay, number of retransmitted packets and the number of hops to the destination[4].

Energy Secure Dynamic Source Routing (ESDSR) Protocol has been proposed in [5]. This study analyzes DSR protocol on the basis of energy consumption by using a mechanism in which nodes having less energy will not use in route selection to prolong the life time of network. This Energy Secure DSR (ESDSR) uses basic mechanism of existing DSR with little modification to optimize DSR performance in the sense of energy consumption as well when ESDSR is compared with some additional parameters like delay, throughput and packet delivery ratio and it showed better performance than DSR..

3. SIMULATION DESIGN

The system was implemented in SUMO and NS2 simulation tools. The aim is to evaluate performance parameters of DSDV routing protocol in different conditions.

1) Simulation Parameters: The paper focuses on the following parameters: throughput, end-to-end delay, number of dropped packets, packet loss and PDR.

Throughput means the measure of how fast a node can actually sent the data through a network. So throughput is the average rate of successful message delivery over a communication channel.

$$Throughput = \frac{number\ of\ received\ packets}{number\ of\ sent\ data\ packets}$$

End-to-end delay is the time taken for an entire message to completely arrive at the destination from the source. The average end-to-end delay is calculated as:

$$End\text{-}to\text{-}end\ delay = \frac{total\ packet\ duration}{total\ number\ of\ packets}$$

Packet Delivery Ratio (PDR) is the ratio of the total data bits established to total data bits sent from source to destination.

2) Mobility Parameters Values: Table 1 shows the mobility parameters that were used in experiment. The test case-1 was implemented for various numbers of nodes: 30, 50 and 100. In these three cases, the number of connection is set the same: 10 TCP connections.

The next case (case-2) was considered for various numbers of TCP traffic: 10 and 20. In this case, the number of nodes is set to constant value 30.

The last case is similar to case- 2 except the number of nodes is set to constant value 100.

Table 1. Parameter Values

Parameter	Value
Number of connection	10,20
Number of nodes	30,50,100
Packet type	TCP
Maximum packet size	1000 byte
Traffic speed	64 kbps

4. SIMULATION RESULTS

NS2 is the most well-known simulator to the development and examining of mobile ad- hoc networking protocols. The mobility model was implemented in SUMO mobility model tool. The following section shows simulation results and discussion on performance of DSR protocol.

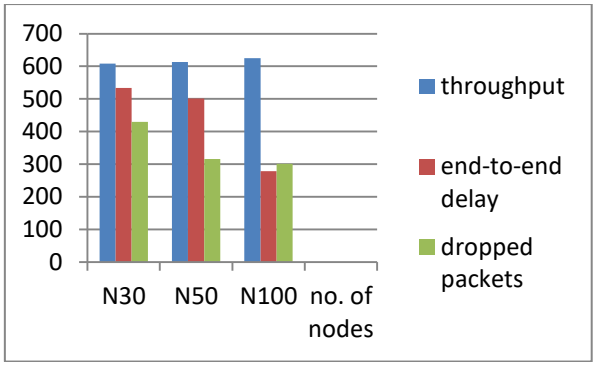

Figure. 1 Performance of DSR in various numbers of nodes

According to Figure1, throughput is nearly similar in all cases. However, end-to-end delay decreases with the increased nodes. The number of dropped packets gets less with the increased number of nodes. Therefore, it can be concluded that DSR provides fast speed for a large number of nodes.

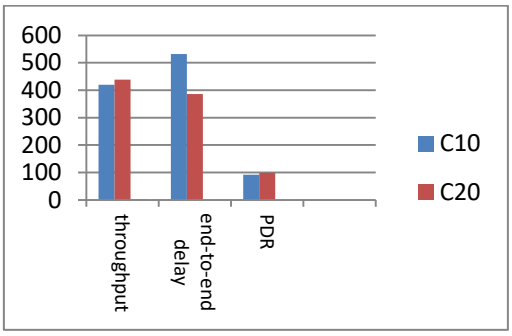

Figure. 2 Performance comparison in various number of connection on 30 nodes

According to Figure 3, the higher connection provides the higher throughput. End-to-end delay decreases with the improved number of connection. The larger traffic produces the higher PDR. Here, it is clearly seen that DSR is a good choice for complex connection.

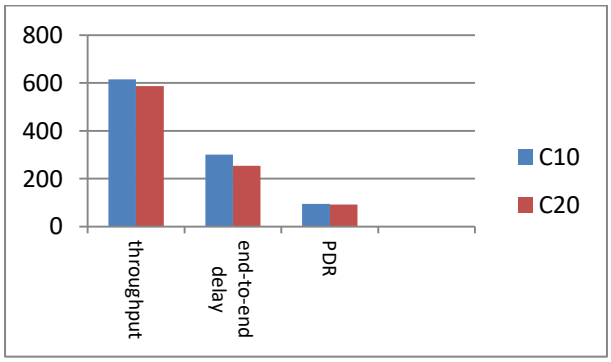

Figure. 3 Performance comparison in various number of connection on 100 nodes

As shown in Figure 3, when the number of traffic increases from 10 connections to 20 connections, throughput decreases, end-to-end delay decreases, and PDR decreases.

6. CONCLUSION

DSR is a famous reactive protocol in MANET routing protocols. This paper implements the mobility and traffic models to observe the performance of DSR protocol. The experiments have done on various numbers of nodes and various numbers of connections. According to the results, DSR is suitable for complex connections in many nodes.

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