PERFORMANCE COMPARISON OF TWO ON-DEMANDS ROUTING PROTOCOLS FOR MOBILE AD-HOC NETWORKS

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ABSTRACT

Mobile Ad-hoc networks are the collection of mobile nodes connected by a wireless link, where each node acts as a router. Ad-hoc networks are characterized by a lack of infrastructure, and by a random and quickly changing network topology: thus the need for a robust dynamic routing protocol that can accommodate such an environment. In addition to this routing protocols face many challenges like short battery backup, limited processing capability. Two protocols AODV and DSR have compared in terms of number of routes selected, number of hop counts, number of RREQ packets and number of RREP packets. Simulation results shows that AODV compared with DSR reduces the number of hop count nodes, we will also see that AODV has less number of routes as compare to DSR, which helps AODV to be more efficient and less bulky. While comparing route request packets AODV is again better with good some of packets which made it more efficient in finding a new route and each time in replacing a stale link.

KEYWORDS: *Ad-hoc networks, Performance, AODV, DSR, Routing protocols.*

I. INTRODUCTION

A Mobile Ad-hoc Network (MANET) [2] is an autonomous network that can be formed without any established infrastructure. As these networks are rapidly deployable and they don't rely on external infracture, it makes them an ideal candidate for rescue and emergency operations, military operations in the battlefield etc .The routing protocols for MANET can be categorized into two main types: reactive and proactive. In case of proactive protocols like DSDV, STAR and GSR [2] the nodes in the adhoc network must keep track of all the routes to all other nodes. In case of reactive routing protocols such as DSR, AODV, ABR and SSA, a lazy approach is applied. The nodes do not keep the routes to all other nodes. Thus, there is no need of constant replacement of routing information between nodes which results to save limited battery power of the nodes. To find out the routes to the destinations on demand flooding of route query packets on whole network is being done. In this paper we carry out a systematic performance [3] study of the two routing protocols for mobile ad-hoc network – Ad-hoc On Demand Distance Vector Routing (AODV) and Dynamic Source Routing (DSR) protocol. We have used the means of simulation using QualNet 5.0(evaluation version) to gather data about these routing protocols in order to evaluate their performance.

This work is ordered as follows. We described the related work in section 2 and simulation model in Section 3. Section 4 details the key performance metrics used in the study. In Section 5 we present the simulation results and analysis of our observation. Finally Section 6 concludes the paper and defines topics for further research.

II. RELATED WORK IN MANET PROTOCOLS:

The key issue with ad-hoc networking is how to send a message from one node to another with no direct link. The nodes in the network are moving around randomly, and it is very difficult that which nodes are directly linked together. Same time topology of the network is constantly changing and it is very difficult for routing process. A number or routing protocols are available at present; some of them are taken here for discussion purpose.

2.1. Types of MANET Routing

Nodes in MANET function as routers that discover and maintain routes to other nodes in the network. The primary goal in ad-hoc network is to establish a correct and efficient route between a pair of nodes and to ensure the correct and timely delivery of packets. The protocols for routing can be classified as:

2.1.1 Proactive/Table-Driven Routing Protocols: In proactive routing protocols, each node maintains routing information to every other node in the network. The routing information is usually kept in a number of different tables. These tables are periodically updated and/or if the network topology changes. The difference between these protocols exists in the way the routing information is updated, and the type of information kept at each routing table. Keeping routes to all destinations up-to-date, even if they are not used, is a disadvantage with regard to the usage of bandwidth and of network resources. It is also possible that the control traffic delays data packets, because queues are filled with control packets and there are more packet collisions due to more network traffic. Proactive protocols do not scale in the frequency of topology change. Therefore the proactive strategy is appropriate for a low mobility network.

2.1.2. Reactive/ On-Demand Routing Protocols: These protocols were designed to overcome the wasted effort in maintaining unused routes. Routing information acquired only when there is a need for it. The needed routes are calculated on demand. This saves the overhead of maintaining unused routes at each node, but on the other hand the latency for sending data packets will considerably increase. It is obvious that a long delay can arise before data transmission because it has to wait until a route to the destination is acquired. As reactive routing protocols flood the network to discover the route, they are not optimal in terms of bandwidth utilization, but they scale well in the frequency of topology change. Thus this strategy is suitable for high mobility networks. Reactive protocols can be classified into two categories, Source routing and Hop-by-hop routing. In Source routed on-demand protocols, each data packets carry the complete source to destination address. Therefore, each intermediate node forwards these packets according to the information kept in the header of each packet. This means that the intermediate nodes do not need to maintain up-to-date routing information for each active route in order to forward the packet towards the destination. Furthermore, nodes do not need to maintain neighbor connectivity through periodic beaconing messages neighbors through the use of beaconing messages. In hop-by-hop routing (also known as point-to-point routing), each data occurs by coding route request packets through packet only carries the destination address and the next hop address. Therefore, each intermediate node in the path to the destination uses its routing table to forward each data packet towards the destination. Here we are discussing two on-demand routing protocols for MANET.

A*. *The Ad-hoc On Demand Distance Vector (AODV) routing algorithm is a routing protocol designed for ad-hoc mobile networks. It can perform both unicast and multicast routing. AODV is an on demand algorithm, meaning that it builds routes between nodes only as desired by source nodes. Here the routes are maintained as long as they are needed by the sources. Furthermore, it forms trees which connect multicast group members. AODV uses sequence numbers to ensure the freshness of routes. It is loop-free, self-starting, and scales to large numbers of mobile nodes [5]. AODV makes routes by a route request / route reply message packets. When a source node desires a route to a destination for which it does not already have a route, it broadcasts a route request (RREQ) packet across the network [6]. Nodes receiving this packet update their information for the source node and set up backwards pointers to the source node in the route tables. Along with the source node's IP address, current sequence number, and broadcast ID, the RREQ also contains the most recent sequence number for the destination. A node may send a route reply (RREP) message after receiving the RREQ if it is either the destination or if it has a route to the destination with corresponding sequence number greater than or equal to that contained in the RREQ. If this is the case, it unicasts a RREP back to the source. Otherwise, it rebroadcasts the route request message (RREQ). Nodes keep track of the RREQ's source IP address and broadcast ID. If they receive a RREQ which they have already processed, they discard the RREQ and do not forward it.

B*. *Dynamic source routing (DSR) is an on demand routing [9] protocol which is designed for the purpose of multihop wireless networks. DSR contains two mechanisms of route discovery and route maintenance. The route discovery [19] phase initiate when source does not know route to the destination. Route cache [20] is also maintained for the purpose of storing old routes. When source sends a message to destination it first search it into the route cache if not found it generates a RREQ message and work in RREQ/RREP fashion. The DSR protocol allows nodes to dynamically discover a *source route* across multiple network hops to any destination in the ad hoc network. Each data packet sent then carries in its header the complete, ordered list of nodes through which the packet must pass, allowing packet routing to be trivially loop-free and avoiding the need for up-to-date routing information in the intermediate nodes through which the packet is forwarded. By including this source route in the header of each data packet, other nodes forwarding or overhearing any of these packets may also easily cache this routing information for future use.

2.1.3 Hybrid Routing The combinations of reactive and proactive protocols are called Hybrid protocols. It takes advantages of these two protocols and as a result, routes are found very fast in the routing zone. Zone Routing Protocol (ZRP) is an example of Hybrid protocol.

III. SIMULATION MODEL:

We have used a detailed simulation model based on QualNet 5.0 (evaluation version), with GUI [10] tools for system/protocol modeling. The simulator contains standard API for composition of protocols across different layers. QualNet support a wider range of networks and their analysis, some of them are MANET, QoS, Wired Networks, Satellite and cellular.

IV. PERFORMANCE METRICS:

We have primarily selected the following four performance metrics in order to study the performance comparison of AODV and DSR [11].
1. ***Number of route selected***: This is defined as the number of routes offered by a routing protocol for an upcoming request.
2. ***Number of Hop count***: This is defined as the number of intermediate nodes between a source and destination.
3. ***Number of route request packets (RREQ)***: This is defined as the number of route requesting packets used by a routing protocol to establish a connection between source and destination.
4. ***Number of route reply packets (RREP)***: This defined as the number of route replying packets as a result of RREQ packets.

V. SIMULATION RESULTS AND ANALYSIS:

For doing our analysis we have chosen some set of parameters to make the comparison between two exiting protocols. The table1 summarizes the simulation parameters that we have selected in order to evaluate the performance of the two routing protocols AODV and DSR; Simulation area size-1500 x 1500; [24] Mobility model-Random way point; Traffic type-Constant bit rate (CBR) [13]; Max speed-30m/sec.

Table1. Simulator Parameters

Configured Parameters :	
Physical Layer Protocol	802.11
Routing protocol	AODV, DSR
Fading Model	Rayleigh
Shadowing Model	Constant
Energy Model	Linear
Battery power	Simple Linear
Area	1500X1500
Mobility	Random way point
Mobility Speed	0-30mps
Data Link Layer	802.11.DCF
Application Layer	CBR Traffic

Our simulation [14] experiments show the following different results for our four performance measuring parameters.

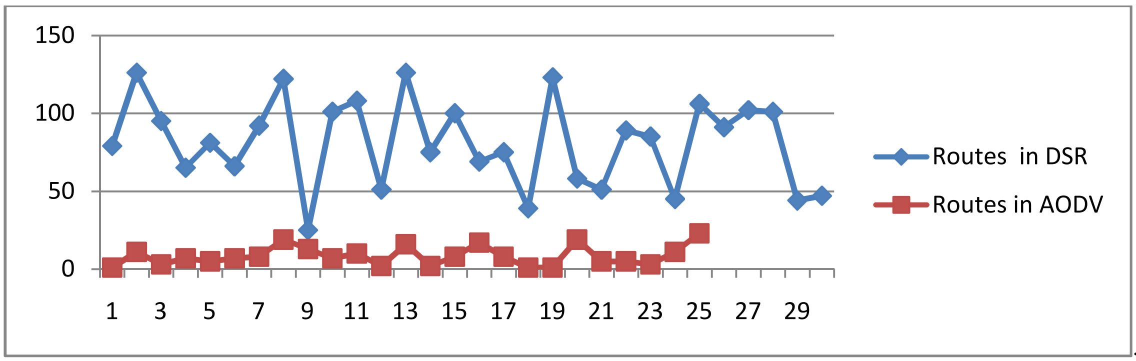

Figure 1. Number of routes selected by AODV and DSR

Figure1. gives the comparison between Routes selected by both reactive routing protocols. Considering the various configured parameters it has been observed that the AODV routing protocol uses on demand approach for finding routes. The major difference between AODV and DSR stems out from the fact that DSR uses source routing in which a data packet carries the complete path to be traversed, while in AODV the source node and the intermediate node stores the next hop information corresponding to each flow data packet transmission.

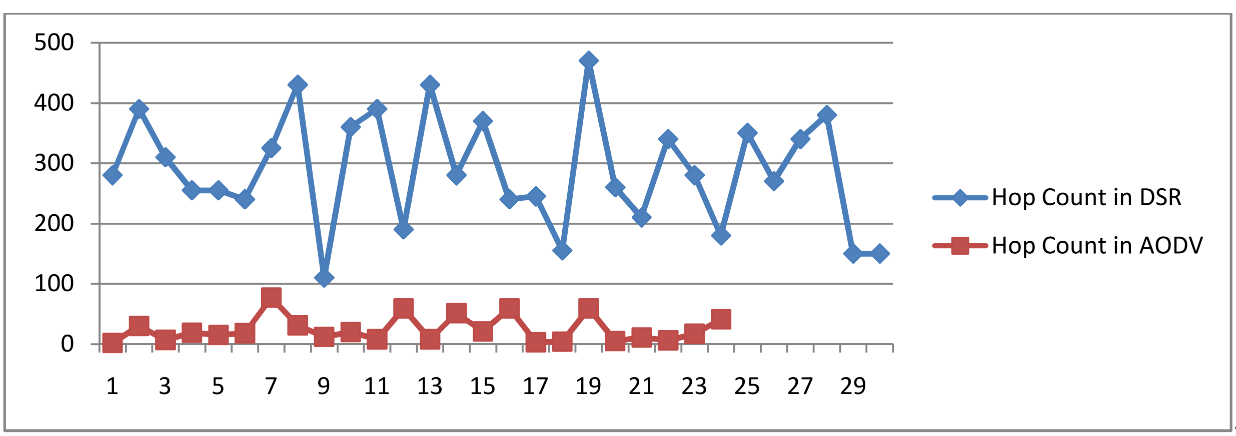

Figure 2. Comparison of Hop counts given by AODV and DSR

We see that AODV has less number of routes as compare to DSR, which helps AODV to be more efficient and less bulky [15]. Figure 2 is the comparison of Hop counts chosen by AODV and DSR.
Here again we see that AODV has less number of intermediate [16] (nodes between source and destination) nodes in comparison to DSR, which shows its efficient behavior [18] as we know that more are the intermediate nodes more is the chance of path break [17] and insecure network along with high energy consumption [19] per message transfer by a node.

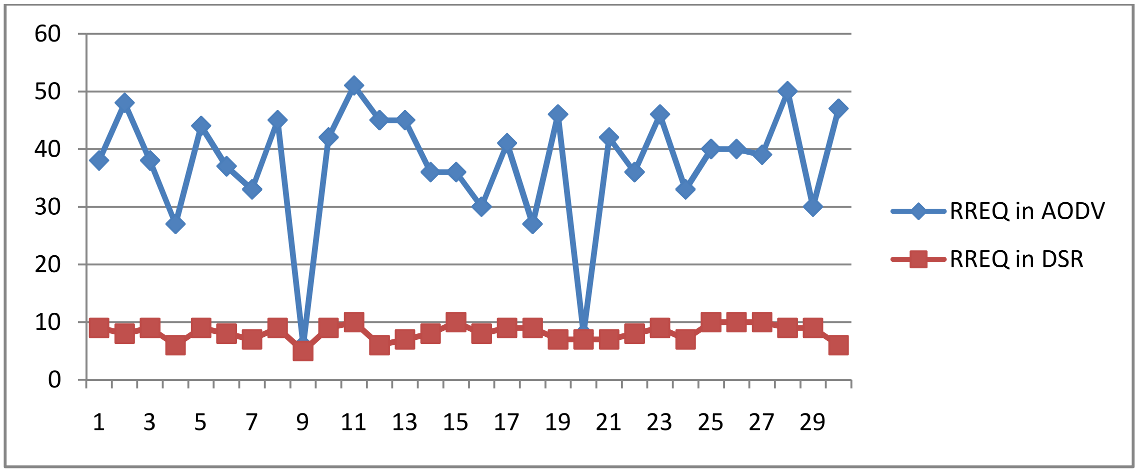

Figure 3. Comparison of route request packets in AODV and DSR

We have taken route request as the third comparison and is being shown in Figure 3. Comparing the route request made by AODV and DSR it is clear that DSR has less number of route request packets as compare to AODV, which made it less efficient in finding a new route and each time in replacing a stale link.

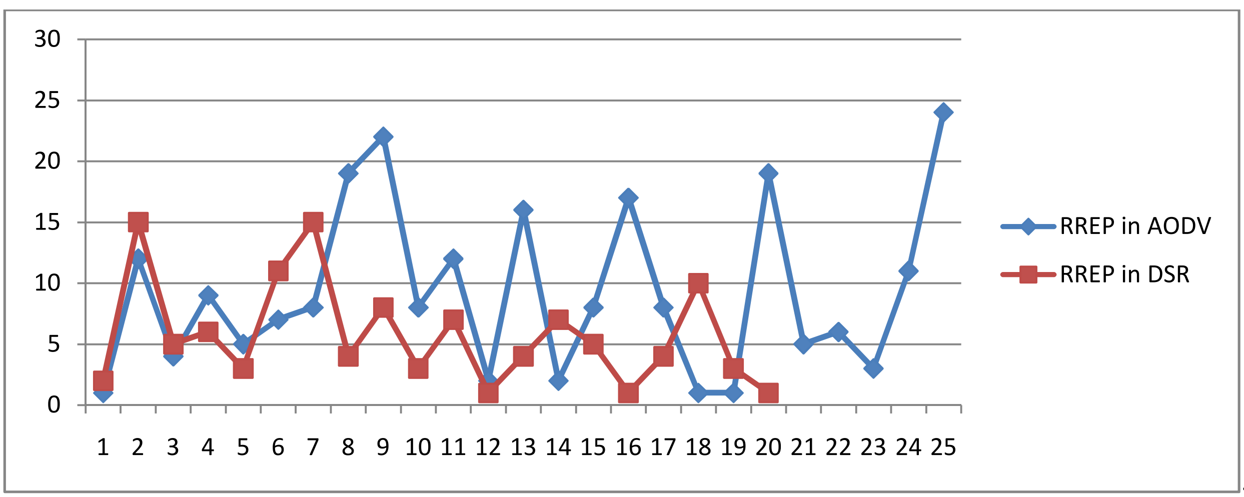

Figure 4. Route Reply packets in AODV and DSR

Figure 4 is the comparison of route reply packets made by AODV and DSR Here we see that AODV has more route reply options as compare to DSR; also DSR maintains multiple routes to the same destination in the cache. But unlike AODV, DSR has no mechanism to determine the freshness of the routes. It also does not have any mechanism to expire the stale routes. With high mobility, link breaks are frequent and there is the possibility of more routes becoming stale quickly. This requires the DSR to initiate the route discovery process which further adds to the increasing delay. From here also we can see that AODV is more efficient as compare to DSR.

VI. CONCLUSION:

Our simulation results show that the performance characteristics of these two protocols with respect to route selection are better in case of AODV. Simulation results also indicate that DSR exhibits more intermediate nods in comparison to AODV. This is due to the fact that DSR being a source routing protocol, the initial path set up time is significantly higher as during the route discovery process every intermediate node needs to extract the information before forwarding the data packet. DSR has no mechanism to determine the freshness of the routes or to expire the stale [23] routes. With high mobility link breaks will be frequent and thus there is the possibility of more routes becoming stale quickly. Simulation results also indicate that AODV has more RREQ and RREP options which made it more efficient as compare to DSR. In our future work, we plan to study the performance of these protocols under other network scenarios by varying the network size, [26] the number of source nodes, the mobility models and the speed of the mobile nodes etc.

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