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PERFORMANCE ANALYSIS OF REACTIVE ROUTING PROTOCOLS IN MOBILE AD HOC NETWORK USING NS2

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ABSTRACT

The Mobile Ad Hoc Network (MANET) is a group of portable points establishing an immediate network without stationary topology. In this network, every node behaves in dual purpose once work like router then works as a host at the same time. Furthermore. The ability of nodes to leave or connect in the network in an easy manner. To establish efficient connection inside the network, we used routing protocols to explorer paths among nodes. The guarantee of finding optimum path formation between couples of nodes is the primary goal of the routing protocol. The MANET routing is a complicated mission that imposes to improve several diverse routing protocols in MANETs. Our main goal of this paper is to examine and differentiate the performance of two reactive routing protocols, Ad-hoc on demand Distance Vector (AODV) and Dynamic Source Routing (DSR) in MANET. We applied two performance metrics, average throughput and average end-to-end delay. We make simulation study based on Network Simulator (NS) version 2.35 to test the mentioned performance metrics of the routing protocols by varying the packet size and number of nodes. The final analysis with realistic outcomes shows that AODV has better performance than DSR in terms of throughput whereas DSR is better for the low average end-to-end delay.

Keywords: Ad hoc network, throughput, End-to-end delay, packet size, number of nodes, AODV, DSR.

1. INTRODUCTION

The promise of the future is held by MANET, with the establishing ability of networks at anytime and anywhere. MANET is a wireless network that includes mobile nodes which have a dynamic topology with no already existed infrastructure or centralized management [1]. MANET is a workable solution for many applications and environments including emergency operations (e.g. disaster recover), military environments and civilians. MANET can be deployed easily as such does not need expensive infrastructure for conventional wireless networks.

In MANET, to adjust the shift in the environment due to lacking of static network nodes and the availability of mobility, diverse routing protocols have been suggested such as AODV and DSR [2, 3]. Also, in a wireless MANET, every node has multi-work, as a router and a host, while the management of transmission of distribution of the network is between the nodes of mobile without any centralized control[4]. Because of the nodes mobility, the topology shifts. To permit communication of nodes over multi-hop routes that contain some links, there is need of efficient routing protocols. MANET own unique features, Contrast to a wired network. Which is rare in awired network, in network topology, the mobility of mobile network node may cause a frequent shift.

Because of the range restrictions of transmission of a wireless challenge, the routing in MANETs is multi-hop [5, 6]. Because of designing troubles concerning finding a suitable and effective routing protocol, MANETs routing has become the major topic of late studies. To solve the MANET troubles such as nodes mobility [7], high inaccuracy rates[8], low bandwidth and high power consumption[9], many of routing protocols have been recommended, reactive, proactive and hybrid. However, the distinctions of these protocols are based on a mechanism employed for the updating of routing information.

The aim of the paper is to study the performance of two reactive routing protocols, AODV and DSR. The study is based on average throughput and average end-to-end delay performance metrics varying packet size and number of nodes using NS2.

2. BACKGROUND

2.1 Ad-hoc on-demand distance vector (AODV) routing protocol

AODV is a reactive protocol that essentially contains Destination-Sequenced Distance-Vector Routing (DSDV) and DSR algorithms. AODV uses route discovery of DSR and the notion of maintenance and additionally the idea of numbers of sequence and forwarding beacons of the period from DSDV [3]. To find out and maintain links, the protocol employs deferent messages: Route Errors (RERRs), Route Replies (RREPs) and Route Requests (RREQs) [10].

Initiating the route detection process by a node, when a route to the new destination is needed, i.e. When a route does not occur between two nodes. To locate the destination node, detection of the route includes flooding of RREQ messages to its neighbor. If the link has expired or broken, route discovery process can also be initiated

[11]. To configure firstly a reverse path to the source node, an intermediate node receiving the RREQ is needed. It utilizes number of sequence and transmits ID for loop-free routing. When the destination extradites a route RREQ, It reacts with an RREP message including latest destination number of sequence and the hops-number. To employ the forward path and reverse path to the destination is established, RREP is routed back to the node of the source. Associated with each reverse route entry is a time to live. If no packets are sent over it within the lifetime, this route will be deleted from the routing Table [12-14].

In AODV, each node employs hello packets to examine the link in route maintenance phase. When a link failure is discovered by a node, it sends a route error (RRER) messages to its upstream neighbors on the existing route. These error messages broadcast to the node of the source. Intermediate nodes' receiving an RERR updates their routing table. The node of source begins the route finding out process again after receiving RERR [15, 16].

Figure-1(a) shows the RREQ packet and Figure-1(b) shows the RREP packet in AODV.

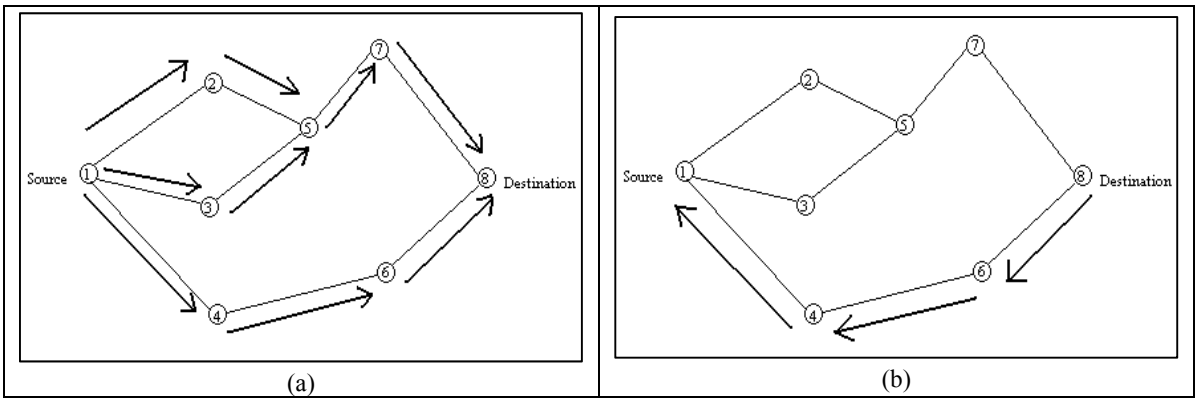

Figure-1. AODV Routing Protocol: (a) RREQ Packet; (b) RREP Packet.

2.2 Dynamic Source Routing (DSR)

DSR is a routing protocol which is yet on therequirement and in which the sender of the data can decide precisely the sequence of the nodes needed to transmit a packet. A number of average nodes for routing are contained in the header of this packet. To seizure the source route being learned, each node task is to maintain the route cache. It is illustrated that "Route Discovery and Route Maintenance" are the two major components of DSR, which both function to maintain and decide routes to random destinations.

To make limitations to the huge consumption of bandwidth caused by management packets in MANET is the reason of designing such a protocol. With omitting the messages of the updates of period needed, this process is completed, that usually seems in the table-driven approach. Moreover, for wireless networks, DSR is an auto-maintaining routing protocol. With cellular telephone systems and mobile networks with up to about 200 nodes, the protocol can also use. A dynamic source routing network can control and configure itself independently of oversight by human managers. In DSR, every cause resolves the route in order to be utilized within conveying its packets to picked destinations. Two major components are there, named route maintenance and route discovery. The path of transmission stays optimum and loop-free as network conditions change. Route maintenance assures that even if this during a transmission needs modification the route. The optimum path for a transmission between a given source and destination is decided by route discovery.

3. SIMULATION ENVIRONMENT

In this section, we present the simulation environment to study the performance of AODV and DSR, we used ns-2.35network simulator which is developed to simulate a multi-hop wireless ad-hoc environment achieved with a medium, data link, and Medium Access Control (MAC) layer models. Two types of network parameters setting are varying during the simulation experiments include packet size and number of nodes. The parameters of simulation setting are listed in Table-1.

Table-1. Simulation parameters.

Parameter	Value
Simulator	NS2 (ver. 2.35)[17]
Number of nodes	2, 3, 4, 5, 6
Simulation time	120 s
MAC type	802.11
Queue type	Drop-tail
Link Layer Type	Logical Link (LL)
Antenna Type	Omni Antenna
Radio propagation Type	Two-ray ground
Routing protocol	AODV & DSR
Traffic model	FTP
Node speed	20 m/s

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Network area size	1000 m x 1000m
Packet size	128, 256, 512, 1024, 1440 bytes
Mobility model	Random way point

3.1 Performance metrics

We used two performance metrics through our simulation for the AODV and DSR routing protocols. For evaluating the performance, the metrics used are average throughput (TP) and average end-to-end delay (e2e delay)

3.2 Average Throughput (TP)

The average TP is theamount of data received by the destination per unit of time. Average TP is calculated as below.

$$Average\ TP\,(\text{kbps}) = \frac{\text{Number of bytes received}}{\text{Simulation time}} * 8 * 1000 \quad (1)$$

3.2.1 Average End-to-End Delay (e2e delay)

Average End-to-End Delayis the average time to broadcast the packet of the data successfully from source to destination through the network. It contains all possible delays such as the propagation, buffering during discovery latency of the route, queuing at the interface queue, retransmission delay at the MAC and time of the transmission delay. The average e2e delay is computed as below.

$$\text{Average } e2e \text{ delay (ms)} = \frac{\sum_{i=1}^{n}(R_i - S_i)}{n} \quad (2)$$

where *i* is the data packet index, *Ri* is the time of received data packet, *Si* is the time of sent data packet and *n* is the total number of data packets.

4. RESULTS AND DISCUSSIONS

From Figure-2(a), we can see that AODV routing protocol has a better performance over DSR versus different packet sizes. AODV has a better performance in term of throughput because of an on-demand route discovery for routing and possibly will frequently take the fresh path whereas DSR with lesser number of routing packets below difficulty condition with the network topology still want to make adjustments to the path sometimes, this will be tending to select incorrect paths, therefore, this behavior will lead to reducing the throughput.

Figure-2(b) shows the effects of growing the number of nodes on the average throughput, the simulation results shows that both protocols suffer from a rather high decrease in the average throughput when we attempt to run the simulation for more than one node, and its reaches its lowest point when it hits just a little bit over 100 kbps for 6 nodes in DSR protocol, but in general, the results showed that AODV protocol has a superior performance than DSR protocol even when toincrease the number of nodes.

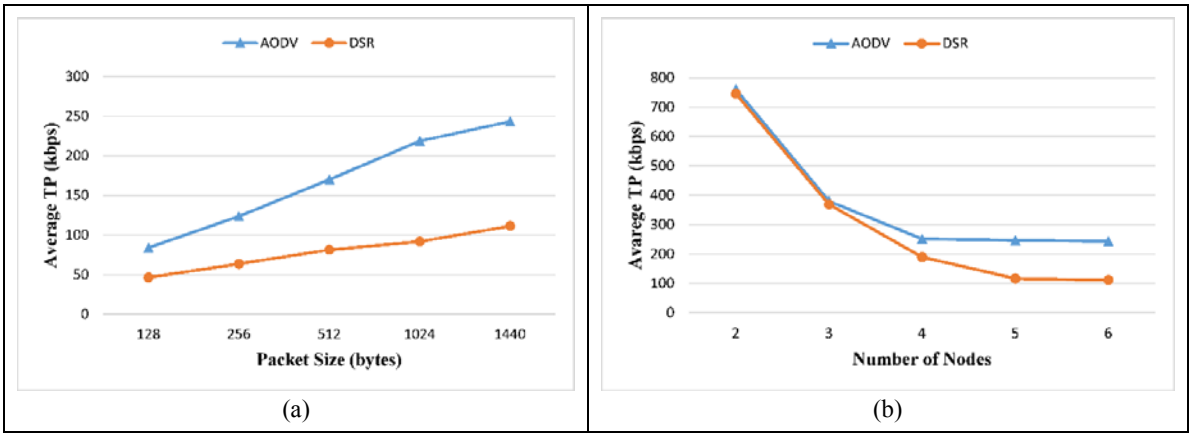

Figure-2. Average throughput versus. (a) Packet size, (b) Number of nodes.

Figure-3(a) shows average e2e delay in a variety of packet sizes, the outcomes showed that the two protocols have almost the same average e2e delay when the packet size is 128 kbps. But when to increase the packet size, we observed that DSR routing protocol has a better results in term of average e2e delay. As the routing overhead on the DSR is less than AODV that lead to consuming less bandwidth.

Figure-3(b) shows average e2e delay for multiple nodes. In this scenario, we have a maximum number of 6 nodes, as a start we run the simulation for one node and the result was almost identical for both protocol AODV and DSR, but when we increase the number of node up to 6 nodes, we saw dramatic changes in the performance of the two protocols were DSR gives way less delay than AODV. As AODV have greatly extra routing control

packets than DSR. Furthermore, those routing packets will use additional bandwidth, DSR thenwill have less delay than AODV.

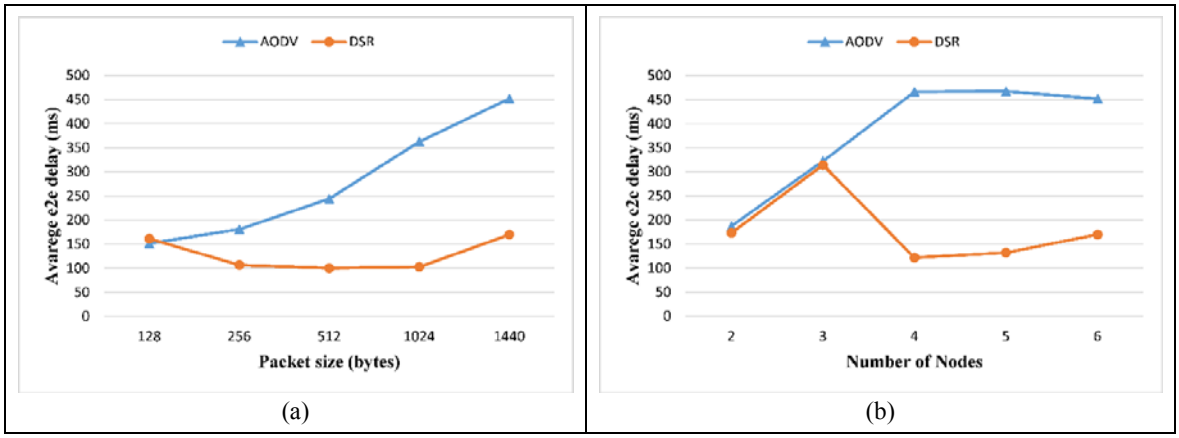

Figure-3. Average e2e delay versus. (a) Packet size, (b) Number of nodes.

5. CONCLUSIONS

This paper presented brief study and comparison to the performance of the ADOV and DSR routing protocols. We executed the simulation with same topologies and executing two diverse reactive protocols on the mobile nodes. The outcomes of this simulation show that performance of the AODV protocol is dominant to DSR in terms of throughput especially when there is increasing in packet of size but in terms of a number of nodes both protocol AODV and DSR suffers from a rather high decrease in the average throughput. However, we observed that DSR performance is better in average e2e delay especially when there is significant increasing in both packet sizes and number of nodes.

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