Performance Evaluation of Proactive and Reactive Routing Protocols in Mobile Ad Hoc Networks

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***Abstract*—Mobile Ad hoc networks (MANETs) can perform the difficult tasks of multi-hop communication in an environment with mobile nodes and changing network topology. As one of the most fundamental problems, routing protocols have been accumulated for MANETs, and which can mainly be divided into two categories: proactive and reactive ones. In this paper, we analyze and compare typical proactive (*i.e.* DSDV) and reactive (*i.e.* AODV and DSR) routing protocols by using NS2 simulations and give detailed performance evaluations with different performance metrics.**

I. INTRODUCTION

Mobile ad hoc network (MANET) is a kind of complex distributed system that comprises wireless mobile nodes that can dynamically self-organize into temporary ad hoc network topologies, allowing people or devices to internet work in areas without pre-existing communication infrastructure, such as environmental monitoring, military communications and disaster relief [1].

In order to facilitate communication within the network, routing protocols are generally used to discover routes between mobile nodes, allowing packet to be forwarded through other nodes towards its destination. However, MANET routing protocols have to consider bandwidth and power constraints mainly because that multi-hop ad-hoc relies on each mobile node in the network to act as a router and packet forwarder. Hence, traditional routing protocols used in wired networks are unsuitable for MANET.

Routing protocols for MANETs have attracted much attention. Numerous solutions have been proposed [2], and they can be classified into two categories: proactive and reactive ones [3]. This paper analyzes and compares several typical proactive and reactive routing protocols by using NS2 simulations and gives detailed performance evaluations.

II. ROUTING PROTOCOLS FOR MANETS

A. Proactive protocols

Proactive protocols exploit the periodic exchange of control messages between routers ensuring that the route to every host is always known. Ad hoc Link state routing algorithm attempts to conserve bandwidth by reducing both the size and the number of control messages. Destination-Sequenced Distance-Vector Routing (DSDV) [4] is a typical proactive protocol we study here. Its main contribution is to solve the routing loop. Each entry in the routing table contains a sequence number which is generated by the destination. And the emitter needs to send out the next update with this number. Routing information is distributed between nodes by sending full dumps infrequently and smaller incremental updates more frequently.

B. Reactive protocols

Reactive protocols (or on-demand) routing protocols discover routes as needed, build and maintain routes. Two typical protocols are studied as follows.

(a) Ad hoc On-Demand Distance Vector (AODV) [5]

A source node that wants to send a message to a destination for which it does not have a route, broadcasts a request RREQ packet. All the nodes receiving this packet update their information for the source node and maintain only the next hop's address in a routing table. The response packet RREP is sent by either the destination or a node that has a route to the destination. The route is established once the source node receives the RREP.

(b) Dynamic Source Routing (DSR) [6]

DSR is an on-demand protocol designed to restrict the bandwidth consumed by control packets by eliminating the periodic table-update messages required in the table-driven approach. The basic idea during the route construction phase is to establish a route by flooding *RouteRequest* packets in the network. Once the destination node receives the *RouteRequest* packet, it will respond by sending a *RouteReply* packet back to the source, which carries the route traversed by the *RouteRequest* packet received.

III. PERFORMANCE EVALUATION

Using the NS2 simulator, the performance comparison of typical proactive and reactive routing protocols for MANETs has been investigated. In the simulation, *setdest* is used to generate random motion scenario, and 50 mobile nodes are involved. The size of simulation region is $500*500m^2$. The average speeds of nodes are $0m/s$, $1m/s$, $5m/s$, $8m/s$, $10m/s$, $20m/s$ and $30m/s$, respectively. And the simulation time is set as $100s$. In addition, source adopts *cbr* data stream, the maximum of on-line is 30, the bit rate is 1.0, and 512B data packet will be produced per second.

We compare the performance of AODV, DSR and DSDV based on four performance metrics.

A. Network delay

Network delay includes all the possible delays caused by buffering during route discovery, queuing at the interface queue, retransmission delays at the MAC, propagation and transfer times. From the curves shown in Fig.1, we can find that when the speed of mobile node increases, the network delay will increase. When the speed of node is low, DSDV provides lower network delay as compared to the other two

because of the availability of routes to all destinations in network. However, the reactive routing gives better performance results compared to the proactive one especially in the case of high speed of node.

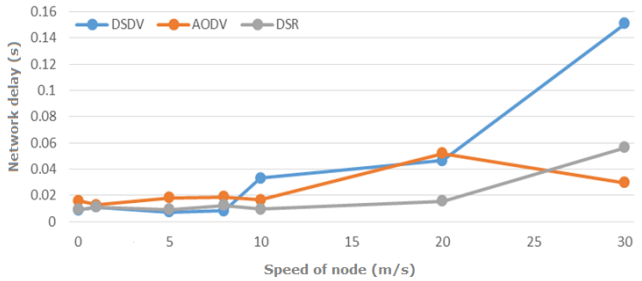

Fig. 1. Comparison on network delay

B. *Packet delivery ratio*

Packet delivery ratio is the ratio of data packets delivered to the destinations to those generated by the constant bit rate. Fig.2 shows that the reactive routing consumes higher packet delivery ratio as compared to the proactive one. It is because that the proactive routing need consume lots of link bandwidth via the periodic exchange of control messages between routers, which directly cause the decrease of packet delivery ratio.

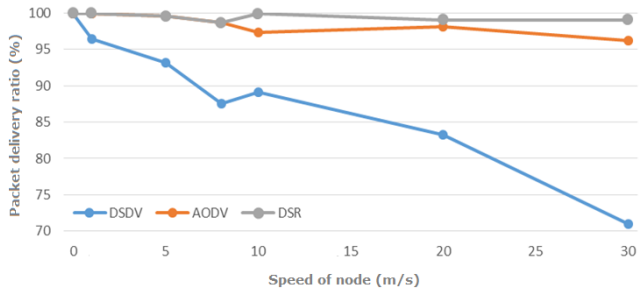

Fig. 2. Comparison on packet delivery ratio

C. *Routing overhead*

Routing overhead is the total number of routing packets transmitted during the simulation. For packets sent over multiple hops, each transmission of the packet (each hop) counts as one transmission. From the curves given in Fig.3, we can conclude that AODV and DSR provide higher routing overhead load as compared to DSDV. Since DSDV is a table-driven routing scheme, there is no much correlation between routing overhead and the speed of node.

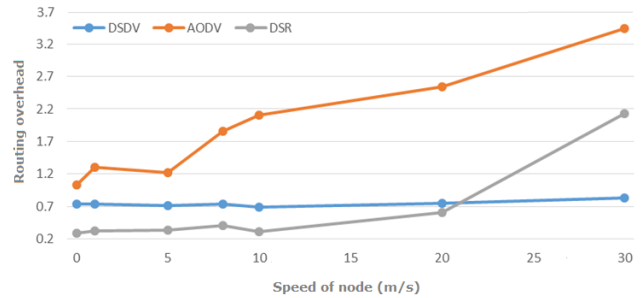

Fig. 3. Comparison on routing overhead

D. *Throughput*

Throughput is the measure of how fast we can actually send through network, and can be denoted as the number of packets delivered to the receiver provides the throughput of the network. From Fig.4, we can find that AODV and DSR can provide higher throughput as compared to DSDV. It is mainly because that high speed of node will cause link failure during periodic broadcast in DSDV.

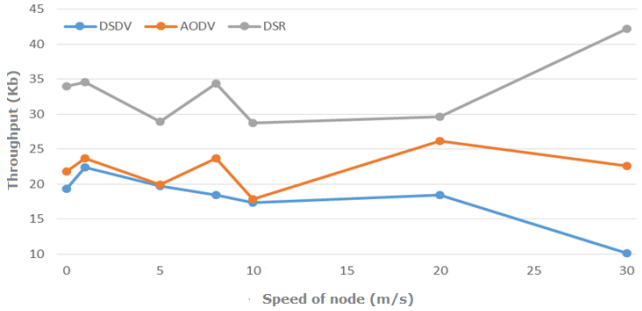

Fig. 4. Comparison on throughput

IV. CONCLUSION

In this paper, we evaluate the performance of proactive (*i.e.* DSDV) and reactive (*i.e.* AODV and DSR) routing protocols in MANETs environment, and thus give some detailed discussions.

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