Performance Comparison of Routing Protocols in MANET Varying Network Size

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Abstract - A mobile ad hoc network (MANET) consists of mobile wireless nodes in which the communication between nodes is carried out without any centralized control. MANET is a self organized and self configurable network where the mobile nodes move arbitrarily. The mobile nodes can receive and forward packets as a router. Routing is a critical issue in MANET. Therefore focus in this paper is to compare the performance of three routing protocols DSDV, DSR and AODV for CBR traffic by varying no. of nodes in terms of packet delivery ratio, end to end delay, routing overhead and throughput. The simulation is carried out on NS2.

Keywords - *MANET, Routing Protocols, DSDV, DSR, AODV, NS2.*

I. INTRODUCTION

Mobile Ad hoc Networks (MANETs) is a collection of wireless nodes which are connected without any infrastructure or any centralized control. In MANET each node can be used as either as endpoint or as a router to forward packet to next node. In contrast to fixed infrastructure networks, MANETs require fundamental changes to network routing protocols. These are characterized by the mobility of nodes, which can move in any direction and at any speed that may lead to arbitrary topology and frequent partition in the network. This characteristic of the MANET makes the routing a challenging issue.

Section II discusses the basics of few most common used routing protocols. Section III defines different parameters for evaluation of performance of routing protocols along with simulation environment followed by performance evaluation of routing protocol in section IV. Finally section V gives the conclusion.

II. ROUTING PROTOCOLS IN MOBILE ADHOC NETWORK

The routing protocols in mobile ad-hoc network can be divided into two categories:

- Proactive or table-driven routing protocols

- Reactive or on-demand routing protocols

Pro-active or table-driven routing protocols require each node to maintain up-to-date routing information to every other node (or nodes located within a specific region) in the network. On-demand routing protocols are designed to reduce the overheads in table-driven protocols by maintaining information for active routes only as and when required.

A. Table-Driven Routing Protocols

The table-driven routing protocols attempt to maintain consistent, up-to-date routing information from each node to every other node in the network [2]. These protocols require each node to maintain one or more tables to store routing information, and responds to changes in network topology by propagating updates throughout the network in order to maintain a consistent network view. The areas where they differ are the number of necessary routing-related tables and the methods by which changes in network structure are broadcast.

B. Destination-Sequenced Distance-Vector Routing (DSDV)

The Destination-Sequenced Distance-Vector Routing protocol (DSDV) is a table driven algorithm based on the classical Bellman-Ford routing mechanism [3]. The improvements made to the Bellman-Ford algorithm include freedom from loops in routing tables. Every mobile station maintains a routing table that lists all available destinations, the number of hops to reach the destination and the sequence number assigned by the destination node. The sequence number is used to distinguish stale routes from new ones and thus avoid the formation of loops. The stations periodically transmit their routing tables to their

immediate neighbours. 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" or an incremental update. A full dump sends the full routing table to the neighbours and could span many packets whereas in an incremental update only those entries from the routing table are sent that has a metric change since the last update and it must fit in a packet. If there is space in the incremental update packet then those entries may be included whose sequence number has changed. When the network is relatively stable, incremental updates are sent to avoid extra traffic and full dump are relatively infrequent. In a fast-changing network, incremental packets can grow big so full dumps will be more frequent.

C. Source-Initiated On-Demand Routing Protocols

A different approach from table-driven routing is source-initiated on-demand routing. This type of routing creates routes only when desired by the source node. When a node requires a route to a destination, it initiates a route discovery process within the network. This process is completed once a route is found or all possible route permutations have been examined. Once a route has been established, it is maintained by some form of route maintenance procedure until either the destination becomes inaccessible along every path from the source or until the route is no longer desired.

D. Ad hoc On-Demand Distance Vector Routing (AODV)

The Ad-hoc On-Demand Distance Vector (AODV) routing protocol is build on the DSDV algorithm as described previously. AODV is an improvement on DSDV because it typically minimizes the number of required broadcasts by creating routes on an on-demand basis, as opposed to maintaining a complete list of routes in the DSDV [4]. It uses traditional routing tables, one entry per destination. This is in contrast to DSR, which can maintain multiple route cache entries for each destination. Without source routing, AODV relies on routing table entries to propagate an RREP back to the source and, subsequently, to route data packets to the destination. AODV uses sequence numbers maintained at each destination to determine freshness of routing information and to prevent routing loops. All routing packets carry these sequence numbers. An important feature of AODV is the maintenance of timer-based states in each node, regarding utilization of individual routing table entries. A routing table entry is expired if not used recently. A set of predecessor nodes is maintained for each routing table entry, indicating the set of neighbouring nodes which use that entry to route data packets. These nodes are notified with RERR

packets when the next-hop link breaks. Each predecessor node, in turn, forwards the RERR to its own set of predecessors, thus effectively erasing all routes using the broken link. In contrast to DSR, RERR packets in AODV are intended to inform all sources using a link when a failure occurs. Route error propagation in AODV can be visualized conceptually as a tree whose root is the node at the point of failure and all sources using the failed link as the leaves.

E. Dynamic Source Routing (DSR)

The key distinguishing feature of DSR is the use of source routing. That is, the sender knows the complete hop- by-hop route to the destination [5]. These routes are stored in a route cache. The data packets carry the source route in the packet header. When a node in the ad hoc network attempts to send a data packet to a destination for which it does not already know the route, it uses a route discovery process to dynamically determine such a route. Route discovery works by flooding the network with route request (RREQ) packets. Each node receiving an RREQ rebroadcasts it, unless it is the destination or it has a route to the destination in its route cache. Such a node replies to the RREQ with a route reply (RREP) packet that is routed back to the original source. RREQ and RREP packets are also source routed. The RREQ builds up the path traversed across the network. The RREP route itself back to the source by traversing this path backward. The route carried back by the RREP packet is cached at the source for future use. If any link on a source route is broken, the source node is notified using a route error (RERR) packet. The source removes any route using this link from its cache. A new route discovery process must be initiated by the source if this route is still needed. DSR makes very aggressive use of source routing and route caching.

III. PERFORMANCE METRICS

The main objective of this paper is comparing the performance of DSDV, AODV and DSR routing protocols using following metrics:

A. Packet Delivery Fraction

The ratio of the data packets delivered to the destinations to those generated by the CBR sources is known as packet delivery fraction.

B. End-to-End Delay

Network delay is the total latency experienced by a packet to traverse the network from the source to the destination. At the network layer, the end-to-end packet latency is the sum of processing delay, packet, transmission delay, queuing delay and propagation delay [7]. The end-to-end delay of a path is the sum of the

node delay at each node plus the link delay at each link on the path.

C. *Routing overhead*

It gives the total number of routing packets transmitted during the simulation. It is the ratio of routing packets to the total no. of packets generated by the source.

D. *Throughput*

Throughput of the routing protocol means that in certain time the total size of useful packets that received at all the destination nodes. The unit of throughput is Kilobits per second (Kbps).

IV. SIMULATION

The simulations were performed using Network Simulator 2 (Ns-2.34). Constant bit rate (CBR) traffic was used in simulation. Simulation was done by varying no. of nodes from 10, 20, 30, 40, 60 and 80. The pause time was kept constant at 100sec in a simulation area of 500mX500m. During the simulation, each node started its journey from a random spot to a random chosen destination. Once the destination was reached, the node took a rest period of time in second and another random destination is chosen after that pause time. This process was repeated throughout the simulation, causing continuous changes in the topology of the underlying network. The following table gives the simulation parameters used during the simulation.

Parameter	Value
Simulator	NS-2.34
Simulator Area	500mX500m
No. of Mobile Nodes	10, 20, 30, 40, 60, 80
Pause Time	100sec
Max. Speed	20 m/s
Packet Size	512
Routing Protocols	DSDV, AODV & DSR
Traffic Sources	CBR
Simulation Time	900 Sec.

A. *Packet Delivery Ratio*

Figure 1 shows that the packet delivery ratio for reactive protocols AODV and DSR were better than the proactive protocol DSDV. The packet delivery ratio was approx. 0.95 for n=10 for reactive protocols and then increased to unity. The value of PDR for DSDV was also increase with no. of nodes. If we compare the performance of two reactive protocols the PDR for DSR was slightly more than the AODV protocol.
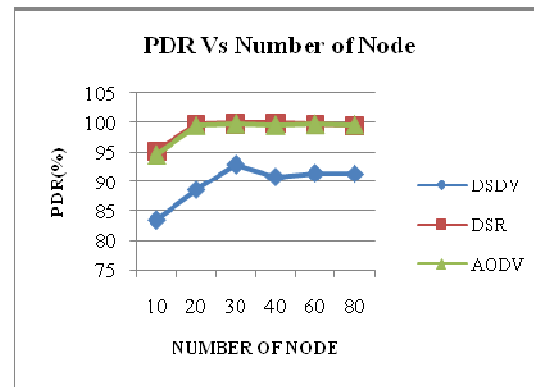

Fig. 1: Packet Delivery Ratio Vs No. of for DSDV, DSR and AODV

B. *End to End Delay*

It is clear from the figure 2 that end to end delay increased with no. of nodes. The delay was lowest for AODV protocol. The delay for DSDV was better than the DSR protocol because routing information is constantly updated in the DSDV protocol, routes to every destination were always available and up-to-date and therefore, end-to-end delay was better than DSR.
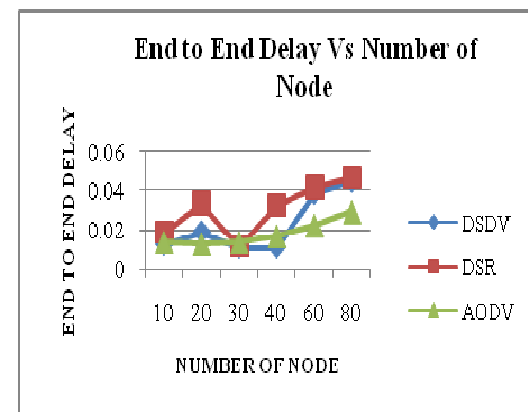

Fig. 2 : End to End Delay Vs No. of Node for DSDV, DSR and AODV

C. *Routing Overhead*

As shown in figure 3, routing overhead for DSR was minimum comparing with other two protocols. The routing overhead for AODV was better than the DSDV protocol. The routing overhead was low for less no. of nodes. Its value was approx. equal with less no. of node. The overhead increased with no. of nodes, the increasing in the value of routing overhead was more than the other two protocols.
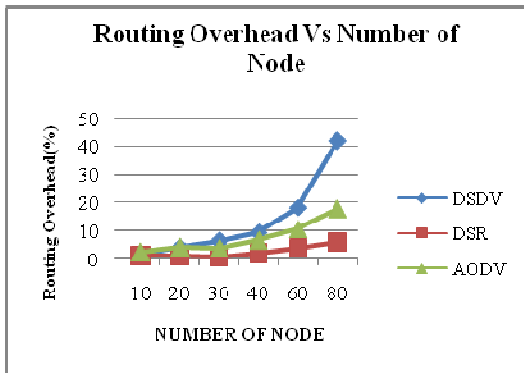
Fig. 3 : Routing Overhead Vs No. of node for DSDV, DSR and AODV

D. Throughput

Figure 4 presents the comparison of three protocols with throughput used as metrics. It was clear from the figure that throughput was lowest for proactive than the two reactive protocols. The throughput was more for DSR protocol when compared with other reactive protocol AODV.
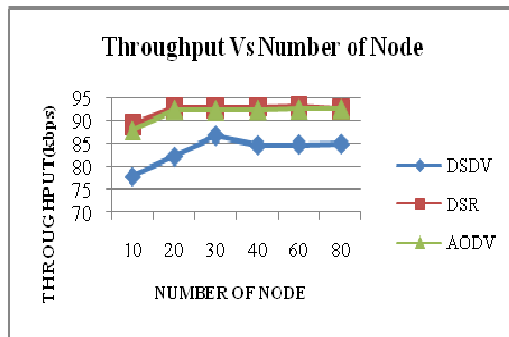

Fig. 4: Throughput Vs Pause for DSDV, DSR and AODV

V. CONCLUSION

In this paper we performed the simulation to compare the performance of two on-demand (DSR and AODV) and one table driven (DSDV) routing protocols on different performance parameters i.e. packet delivery ratio, end-to-end delay, routing overhead and throughput. The results showed that the performance of the two reactive protocols (DSR and AODV) was better

than DSDV. The overall performance of DSR was better than the other two protocols except in the case of end to end delay. The higher value of delay in DSR was mainly due to caching and lack of mechanisms to expire stale routes. The performance of AODV was comparable to DSR in case of packet delivery ratio and throughput; it was better in case of end to end delay and inferior in case of routing overhead.

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