PERFORMANCE ANALYSIS OF ROUTING PROTOCOLS IN MOBILE AD HOC NETWORK

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ABSTRACT

Mobile Ad Hoc Network (MANET) is a type of ad hoc network that can change locations and configure itself on the fly. Each device in a MANET is act as routing node and therefore change its links to other devices frequently. Each and every nodes act as routers and it follows dynamic topology without any centralized administration. A MANET can be a standalone network or it can be connected to external networks(Internet).In this paper we are considering the performance evaluation of three routing protocols in Mobile Ad-hoc Networks (MANETs). – the Destination Sequenced Distance Vector (DSDV) belongs to proactive or the table- driven protocol, Distance Source Routing and the Ad hoc On-Demand Distance Vector routing (AODV) belongs to reactive or On –Demand protocol. The performance measurements are based on the various parameters such as packet delivery ratio, average end to end delay and number of packets lost.

Keywords— MANET, AODV, DSR, DSDV, Routing protocol.

I. INTRODUCTION

Wireless communication can be classified into fixed backbone wireless system and Wireless Mobile Ad hoc Network (MANET).In the first model communication occurs with access points and later one work without any base stations is called infrastructure-less or multi-hop. Hence Mobile ad-hoc networks are composed of autonomous nodes that are self- managed without any infrastructure shows in fig 1. In this way, ad-hoc networks have an infrastructure less topology [1] such that nodes can easily join or leave the network at any time [2]. Since the nodes communicate with each other without an infrastructure, they provide the connectivity by sending packets over themselves. Due to the mobility nature of nodes, the network topology changes rapidly and erratically over time.

To support this connectivity, nodes use some routing protocols. MANET routing protocols can be classified into proactive, reactive and hybrid protocols. Proactive or table-driven protocols have to maintain up-to-date routing information from each node to every other node Reactive or on demand protocols are creates routes only when a node requires a route to a destination[15]. Hybrid protocols combine proactive and reactive schemes. Destination Sequenced Distance Vector(DSDV) is example for proactive[3], Ad hoc On-Demand Distance Vector (AODV)[4] and Distance Source

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Routing(DSR)[5] are belongs to reactive protocol. The primary goal of such an ad hoc network routing protocols are correct and efficient route establishment between a pair of nodes so that messages can be delivered in a timely manner.

Routing in ad hoc-networks has been a challenging task ever since the wire-less networks came into existence[12]. The main reason for this is the frequent change in network topology because of high degree of node mobility. Many protocols have been developed to overcome this task. Routing is the process of selecting paths in a network along which to send network traffic. In ad hoc networks, nodes do not start out familiar with the topology of their networks; instead, each and every time nodes have to discover it. The basic concept is that new node broadcast its presence and listen for announcements comes from its neighbours. Each node learns about topology of their network and routing process then only they can reach destination. Wireless ad-hoc networks have gained a lot of importance in wireless communications. Wireless communication is developed by nodes acting as routers and transferring packets from source to destination in ad-hoc networks. Routing in these networks is highly complicated due to movement of nodes and hence many protocols have been developed[14]. In this paper I have chosen three main and highly preferred routing protocols for analysis of their performance.

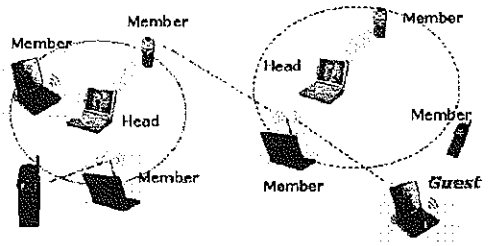

Figure. 1 MANET

The rest of the paper is organized as follows. Section 2 gives an overview of routing protocol, section 3 describes performance evaluation of protocols, and finally, conclusion of the paper is given in Section 4.

II. Overview Of Routing Protocol

A. DSDV

The destination sequenced distance vector routing protocol is a table driven routing protocol [6]that maintain a table that contains routing information regarding the connectivity of every node to all other nodes that participate in the network. It is also known as proactive and based on bellman ford algorithm. To keep the tables up to date they are exchanged between neighbouring nodes at regular intervals or when a significant topology changes are observed.

Routing information is advertised by broadcasting or multicasting the packets which are transmitted periodically as when the nodes move within the network. The DSDV protocol requires that each mobile station in the network must constantly; advertise to each of its neighbours, its own routing table. Since, the entries in the table may change very quickly; the advertisement

should be made frequently to ensure that every node can locate its neighbours in the network.

The data broadcast by each node will contain the following information for each new route:

i. Destination IP address
ii. Number of hops required to reach the destination
iii.New sequence number originated from destination and iv other information [7]

The routing tables will also contain the network address, hardware address of the mobile host transmitting them. When an information packet is received from another node, it checks the sequence number with the available sequence number for that entry. If the received sequence number is larger, then it will change the routing information with the new sequence number else if the information arrives with the same sequence number it looks for the metric entry and if the number of hops is less than the previous entry the new information is updated (if information is same or metric is more then it will discard the information). To increase the sequence number table uses even numbers only. It always incremented by 2.If a node is no more reachable then it uses odd number. It increase sequence number by 1 and set metric value is " Similarly, if a new node arrives the network, it will broadcast itself in the network and the nodes in the network change their routing information with a new entry.

In DSDV protocol, broadcasting information is done in two ways namely full dump and incremental dump. Full dump packets will carry all the routing information while the incremental dump will carry only information that has changed since last full dump. In two types, broadcasting is done in network protocol data units (NPDU). Full dump requires multiple NPDU's while incremental requires only one NPDU to fit in all the information. The main disadvantages of this protocol are Requirement for maintenance of a large amount of data at every node and slow reaction on restructuring and failures. This can be overcome by routing information is distributed between nodes by sending full dumps infrequently and incremental dumps more frequently. DSDV maintains only the best path instead of maintaining multiple paths to every node. With this, the amount of space in routing table is reduced and also it provides loop free paths.

B.DSR

The Dynamic Source Routing protocol (DSR) is a routing protocol designed specifically for use in ad hoc networks of mobile nodes. In DSR network organized as completely self-configuring, without knowing network infrastructure or administration. Route discovery and route maintenance are two important process of this protocol, which work together to make nodes to discover and maintain routes to arbitrary destinations in the ad hoc network. It comes under the category of on-demand protocol which means it establishes a route to a destination only on demand

In DSR, when a node has a packet to send to some destination and does not currently have a route to that destination in its route table, the node starts route

discovery to find a route; this node is known as the initiator of the route discovery, and the destination node of the packet is called discovery's target. The initiator broadcast ROUTE REQUEST packet and specifying the target and a unique identifier from the initiator. The RREQ packet contains a list of hops which is collected by the route request packet as it is propagated through the network. Each node receiving the ROUTE REQUEST verifies the identifier. If the node already received the same request identifier from the initiator then it, discards the REQUEST. In other case, it attach its own address to the REQUEST list and rebroadcasts the REQUEST. Once the RREQ reaches either the destination or a node that knows a route to the destination, it sends RREP in reverse path collected by the RREQ[8]. This means that the source may receive several RREP messages corresponding to different routes to the destination. DSR selects one of these routes (for example the shortest), and it store other routes in the cache. The routes in the cache can be used as substitutes to speed up the route discovery if the selected route gets disconnected.

Route Maintenance is the mechanism by which a node sending a packet along a specified route to some destination detects if that route has broken. DSR is based on source routing method. When sending a packet, the originator lists in the header of the packet the complete sequence of nodes[13] through which the packet is to be forwarded. Every node along the route send the packet to the next hop followed by the packet's header and try to confirm that the packet was received by that next node. This can be confirmed by acknowledgment. After a limited number of local retransmissions of the packet, node in the route could not make this confirmation, it generate ROUTE ERROR and send to the original source of the packet, find out link from itself to the next node as broken. Then sender has to remove this broken link from its Route Cache for subsequent packets to this destination, the sender can use some other route to that destination in its cache, or it may try a new route discovery for that target if necessary.

C. AODV

The AODV Routing protocol uses an on-demand approach for finding routes AODV doesn't keep routes for each network node, these routes are discovered as they are needed. AODV is able to provide three types of transmission[9]. They are unicast, multicast and broadcast transmission. Unicast consist of sending data from one node to another node. Multicast consists of sending information from one node to a group of nodes. Broadcast sending data from one network node to another network node.

When a node wants to start communication with another node or to send a packet to another node first it looks for an available path to reach destination node, in its

local routing table. if no route exits it establish a route towards the destination node. AODV builds routing sing a RREQ (route request), RREP (route reply) and Route errors (RERR). A RREQ message is broadcasted when a node needs to discover a route to a destination.

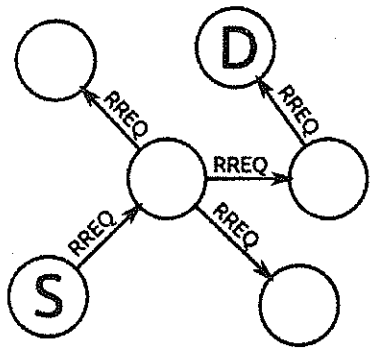

Figure. 2. AODV Process

For example In fig 2 when a node S wants to send a message to node D, node S searches its route table for a route to D. if there is no route, S establish a request a message (RREQ) to is neighbourhood node. When the RREQ message is received by the neighbourhood, they check if they have already received a RREQ message with that same source, as it is not in the case they rebroadcast the RREQ to its neighbourhood node till it reaches the destination. Request message contains, the IP address of node S and D, the current sequence number of S and the last known sequence number of D. and a broadcast ID from S. This broadcast ID increments each time when node S sends a RREQ message. When a RREQ reaches a destination node, now its time to make the inverse path using RREP. The destination route is made available by unicasting a RREP back to the source route. If the node generating the RREP is the destination node, it increases its sequence number by one and places a zero value in the hop count field of the RREP packet. If any intermediate node generates the RREP, this place the destination sequence number stored in its table to that destination and also required hops to reach it. When RREP travels back to the source node, a forward path to the destination is established. Every node which RREP is passing through updates the sequence number for the requested destination. When RREP reaches the source node, the packet from the source node is forwarded to the destination node. The source node will evaluate the RREPS, and selects the best route. When a node detects a broken link, it sends a route-error (RERR) packet to the affected node. The main advantage of AODV, no central administrative system to handle routing[10], reduced control messages quickly reacts to changes in the network.

III. Performance Evaluation of Protocols

In order to evaluate the performance of ad hoc network routing protocols, the following performance measurement were considered

i) Packet delivery ratio
ii) Number of packets lost
iii) End to end delay

I. Packet Delivery Ratio

Packet delivery ratio is the ratio of the data packets delivered to the destinations and the data packets sent from the source. It describes percentage of the packets which reach the destination. In terms of packet delivery ratio, DSR performs well when the number of nodes is less. However its performance declines with increased number of nodes due to more traffic in the network. The performance of AODV is better at the beginning and decreases slightly with increase in number of nodes. The decline of AODV is more than DSR. It is due to use of different approaches for maintaining route. The performance of DSDV is better with more number of nodes than in comparison with the other two protocols indicates in fig 3. It is due to the nature of proactive routing protocols[11]. When the number of connection sessions is increased, routing table has various alternatives for selecting the route towards destination.

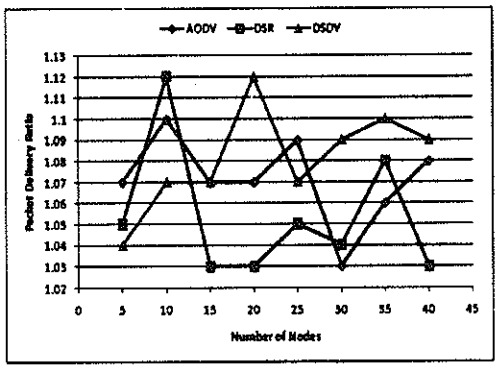

Figure. 3 Packet Delivery Ratio for AODV, DSR and DSDV

II. No of packets lost

The number of data packets that are not successfully sent to the destination. Packet loss can be caused by a number of factors including signal degradation over the network medium, corrupted packets rejected in transit, faulty networking hardware, buffer becomes full and time that exceeds the limit. Loss Packet Ratio is the ratio of the number of packets that never reached the destination to the number of packets originated by the source. In terms of dropped packets, AODV's performance is the worst. The performance goes slow down with the increased number of nodes. If the number of nodes increases the number of packet loss also increases which means that number of packets not successfully reaching the destination has also increased. In fig 4 DSDV performs consistently well with increase in the number of nodes. The number of packets dropped is negligible which means that almost all packets reach the destination successfully. DSR performs well when number of nodes is less but fails slightly to perform with increase in the number of nodes. The packets dropped are much less compared to performance of AODV.

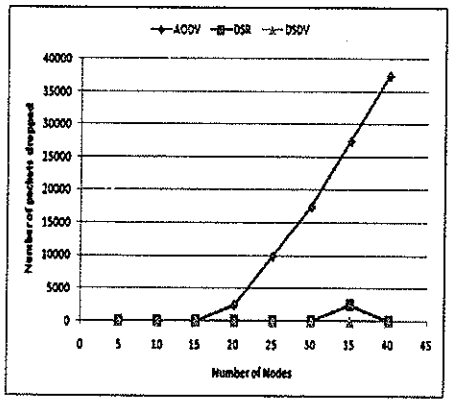

Figure. 4 Packet Loss Ratio for AODV, DSR and DSDV

III. End to end delay

There are several delays affected by buffering during route discovery duration, waiting at the interface queue and propagation and transfer times. Mostly the delay arise due to high rate of packets transmission and the packets have to be in the buffers a much longer period of time before they are sent. So the buffers become full much faster. To find out the end to end delay the difference of packet sent and received time was stored and then dividing the total time difference over the total number of packet received gave the average end to end delay for the received packets. The performance is enhanced by lower the end-to-end delay. In terms of delay the performance of DSR decreases and varies with the number of nodes. However, the performance of DSDV is degrading due to increase in the number of nodes the load of exchange of routing tables becomes high and the frequency of exchange also increases due to the mobility of nodes is given in fig 5. The performance of AODV decreases and remains constant as the number of nodes increases.

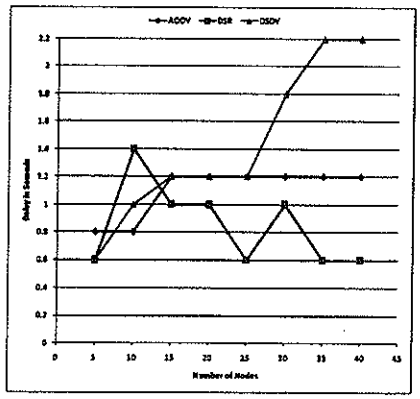

Figure. 5 Average end to end delay for AODV, DSR and DSDV

IV. Conclusion

This paper compares reactive and proactive routing protocols and illustrates the performance difference between AODV, DSR and DSDV with various network parameters such as packet delivery ratio, packet lost and time delay. It is found that AODV delivered virtually all packets at low node mobility, and failing to meet as node mobility increases. DSR was very good at all mobility rates and movement speeds and DSDV performs almost as well as DSR, but still needs the transmission of many routing overhead packets. DSDV is more expensive than DSR when the node mobility is high. I conclude that DSR/AODV performs better than

DSDV with large number of nodes. Hence for real time traffic AODV is preferred over DSR and DSDV. DSDV's performance is superior for less number of nodes and less mobility.

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