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Measurement Based Analysis of Reactive Protocols in MANET

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Abstract - The main goal of an ad hoc network routing protocol is to establish correct and efficient route between a pair of mobile nodes so that messages delivered within the active route timeout interval. Route should be discovered and maintained with a minimum of overhead and bandwidth consumption. Routing is a key factor for transfer of packets from source to destination. That is Routing is a process of determining a path between source and destination upon request of data transmission. Reactive Routing Protocols are well performing in MANET. We are going to discuss the related issues and advantages and disadvantages of Reactive routing protocols and Measurement based performance of reactive protocols in wireless networks.

Key words - MANET, Reactive Routing Protocols, Route Discovery, DSR, AODV.

I. INTRODUCTION

Wireless Networks have many advantages, which come bundled along with lot of security issues. The major risk involved is that the information is transmitted through air [1]. The Routing protocols in WMN are divided into reactive and proactive & hybrid protocols. In reactive protocols, a route path is established only when a node has data packets to send that is Reactive routing that means discovers the route when needed. Proactive routing that means route available immediately and Hybrid routing that means combination of both, such as proactive for neighbourhood, reactive for far away. The common routing needs of any routing protocol are scalability, reliability, throughput, load balancing, and congestion control.

Ad hoc network is a network where there is no existence of wireless infrastructure for networking, Instead each node communicates with each other using their sole transmitter-receiver only. In this kind of network each and every node does participate voluntarily in transit packet that flow to and from different nodes. Each node do follow same routing algorithm to route different packets. Thus this kind of network have limited homogenous feature. There are not many wireless products that follow this proposed technology.

II. REACTIVE ROUTING PROTOCOLS

Whenever there is a need of a path from any source to destination then a type of query reply dialog does the work [2, 3].Therefore, the latency is high; however, no unnecessary control messages are required. In reactive routing protocols, the route is calculated only when a node needs to send data to an unknown destination. Thus, route discovery is initiated only when needed. This saves overhead in maintaining unused routes. However, this may lead to larger initial delays. During route discovery, the query is flooded into the entire network and the reply from the destination (or intermediate nodes) sets up the path between the source and destination [4]. The Reactive protocols are classified into Ad-hoc on Demand Distance Vector, Dynamic Source Routing, SRCRR, Link Quality Source Routing, and Multi radio Link Quality Source Routing.

III. DSR ROUTING PROTOCOL

Dynamic source routing protocol (DSR) is a reactive protocol (on demand routing protocol) that is known as simple and efficient, specially designed for the multi-wireless mesh network. Often called On-Demand routing protocol as it involves determining the routing on demand unlike the pro- active routing protocols that has periodic network information. This means that it discovers the route from source to the destination if required. DSR was designed to restrict the bandwidth consumed by control packets in ad hoc wireless networks, by eliminating the periodic table-update messages used in proactive protocols. DSR protocol is based on two mechanisms: route discovery and route maintenance.

A. Route Discovery

Route discovery is the process of DSR uses to find the route and to transmit the data from a source to destination where the source node is unaware of the destination route. For example [5]

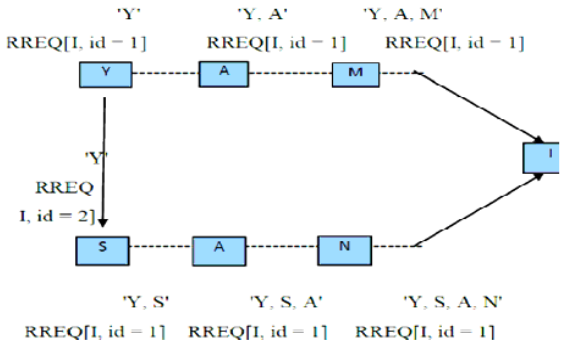

Fig.1 Route Discovery Process

Let us assume node 'Y' wants to establish a route to node 'I'.

- Initially node 'Y' transmits 'RREQ' (Route Request) will usually be received by all the participating nodes in the network.
- This Route request contains information about the source and the destination along with unique request identification (id = 1 and id = 2 respectively in the considered figure).

RREQ even maintains the information about all the intermediate nodes passed by while reaching the destination.

A. Once the destination receives the RREQ packet then it will send the 'RREP' (Reply Route) to the source node 'Y'.

B. RREP contains a copy of the route information of the RREQ then the source cache information to use in further communication process.

Route discovery algorithm [5, 6]

a) X broadcasts a Route Request Packet with the address of destination node Z.
b) The intermediate nodes V, W, Y receive the Route Request Packet from X, as shown in Fig3.
c) The receiving nodes V, W, Y each append their own address to the Route Request Packet and broadcast the packet further as shown in Fig4.
d) The destination node Z receives the Route Request packet. The Route Request packet now contains information of all the addresses of nodes on the path from the source node X to the destination node Z.
e) On receiving the Route Request Packet the destination node Z sends a reply called the Route Reply Packet to the source node X by traversing a path of addresses it has got from the Route Request packet.
f) DSR caches the route information for future use.

B.Route Maintenance

DSR protocol implements the route maintenance mechanism while communicating the packets from source to destination. But when the communication link between the source and the destination is broken or else a change in network topology is noticed. It will lead to failure of the communication between source node and destination node. In this scenario DSR protocols uses the route mechanism, to detect any other possible known route towards the destination to transmit data. If the route maintenance fails to find an alternative known route to establish the communication then it will invoke the route discovery to find the new route to destination [7].

Route Maintenance algorithm [5, 6]

a) In DSR algorithm a link break is detected by a node along the path from node X to node Z, in this case node W.
b) Then node W sends a message to source node X indicating a link break.
c) In this case, node X can use another path like X-Y- Z or it must initiate another route discovery packet to the same destination node, in this case 'Z'.

C. Advantage

The DSR protocol are: guaranteed loop-free routing, Nodes can store multiple paths to destination., support for use in networks containing unidirectional links, use of only "soft state" in routing, and rapid recovery when routes in the network change.

D.Disadvantage

One of the major disadvantages of DSR protocol is in implementing the route discovery process. Source will transmit the RREQ messages to all the neighbouring nodes to find the route to destination. It is fair and good when there are few nodes in the network, it will easily find a route and it can receive a RREP message from the desired destination. But if in case the network size is very high and participating nodes are numerous, then there will be a possibility to have so many routes to the destination. It may result in the reply storms this may cause collision of packets and it may increase

the congestion at the nodes while sending reply [8]. Another disadvantage of it is not scalable for the WMN, it is not suitable for the large networks, When the traffic load is high congestion will occur and it has poor mechanisms for controlling congestion, When network size, node mobility, network load increases then delay rate increases more when compared to other protocols.

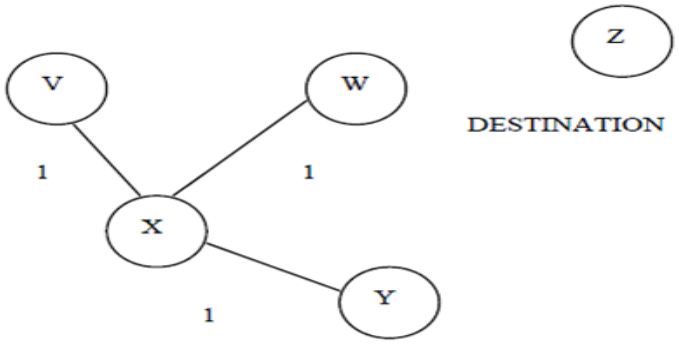

Fig.2 DSR algorithm routing process

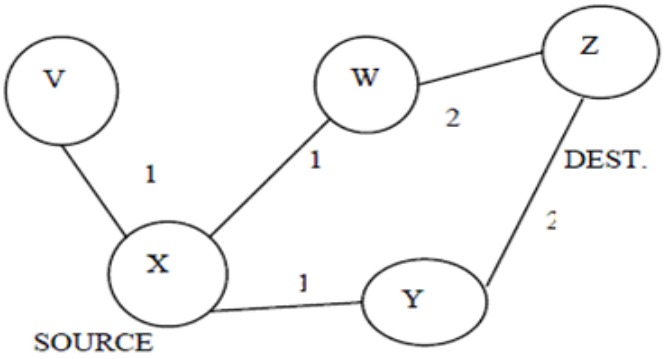

Fig.3 Re-broadcasting by nodes V, W, Y

IV. AD-HOC ON DEMAND DISTANCE VECTOR

Ad-hoc on Demand Distance Vector routing protocol is developed as an improvement to DSDV routing algorithm. The purpose of DSDV is to reduce the number of broadcast messages sent throughout the network and reduces the routing overhead, but introduces some initial latency due to the on demand route setup. This is achieved by discovering routes on-demand instead of keeping complete up-to-date route information. AODV uses a simple request–reply mechanism for the discovery of routes. AODV protocol mainly involves 3 packets. They are [9]:

1. The route request (RREQ) is mainly used for the establishment of packets from source to destination.
2. The route reply (RREP) is sent by the destination to the source after the establishment of route.
3. The route error (RERR) is sent by intermediate node or destination in 2 conditions.
   - When there is no path to the destination.
   - When the link breaks in the valid path to the destination.

The source will first broadcast the RREQ packet by keeping the source and destination IP address in the RREQ packet. The packet will be received by the intermediate node and the intermediate node will check whether there is a valid route to the destination or not. If it has, then the RREQ is again rebroadcast otherwise route error will be sent to the source. The duplicates of route request packets can be discarded by route request id present in the RREQ packets. When the destination gets the route request packets in different paths it considers only one path as a valid path i.e. the path along which it receives the route request first, other paths are discarded. Destination sends the RREP packet back to the source with the path details from source to destination [10].

A. Advantages

This protocol is reliable for the wireless mesh networks. AODV is loop free and does not require any cartelized system to handle routing process for wireless mesh networks.

B.Disadvantages

Shortest path may be lost due to traffic during the path discovery process [10]. AODV do not utilize any congestion control or avoidance mechanism to balance traffic load [10]. The delivery ratio of AODV drops dramatically from more than 90% to about 28% when the number of connections increases from 10 to 50 [11].

TABLE 1 Measurement Based Analysis of Reactive Protocols in MANET

PROTOCOL	DSR	AODV
Scalability	No	No
Reliability	Yes	Yes
Throughput	Decrease as mobility increases	Poor for more than 20 mobile nodes
Load Balancing	No	No
Congestion Control	No	No

A network will get a better performance if these factors are considered accurately the Scalability is most challenging factor that has to be considered in all the protocols that have been used till now. The recommendations mentioned above would help improve performance of the system for wireless mesh networks.

V. Conclusion

Every reactive routing protocol has its own advantages and disadvantages. The result effectively classifies different protocols by considering different factors. We have analysed that among all the protocols Scalability is the most challenging factor that has to be considered. In these various protocols we can select an effective protocol to our network by looking the behaviour of the protocol at various conditions and if more emphasis is given on the improvement of scalability factor we can help in enhancing the overall performance of the entire network. Reactive protocols are active research area in the field of ad-hoc mobile network. There are still lots of simulations to be done in this promising field. Most of the research study shows that DSR and AODV are performing well depend upon the environment, among the reactive protocols.

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