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A SURVEY OF ROUTING PROTOCOLS IN MOBILE AD HOC NETWORKS

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Abstract : *This survey explores routing protocols in Mobile Ad hoc Networks (MANETs). MANET is a network consisting of a group of portable devices which communicates with each other without any dedicated infrastructure. Mobile nodes move in the network freely therefore there is no any fixed topology. MANET protocols are broadly classified into two types i.e. Proactive and reactive. In reactive routing protocols, route discovery process is used to search a route between source and destination. Broadcasting mechanism is used for route discovery, where each node sends a received route request packet to other nodes in the network until it finds a path to the destination. Broadcasting causes many problems such as redundant retransmissions, collisions and contentions. This paper provides an overview of routing protocols which can overcome broadcast storm problem, reduce routing overhead and improve the routing performance.*

Keywords*: MANET, AODV, broadcasting techniques, Neighbour Coverage Knowledge, Probabilistic broadcasting, Rebroadcast Probability, Load balancing.*

1. INTRODUCTION

MANET is a network consisting of a group of portable devices which communicates with each other without any dedicated infrastructure. Mobile nodes move in the network freely therefore there is no any fixed topology. Nodes have limited transmission range. If destination node is located within the source node's transmission range then they can directly communicate with each other. On the other hand, if destination node is located outside the source node's transmission range then they can communicate through intermediate nodes.

Many routing protocols are proposed for MANET. They are broadly classified into two types: Proactive routing protocol and Reactive routing protocol. In proactive routing protocols, each

mobile node maintain routing table which contain list of all available destinations. These tables are updated by transmitting routing information periodically throughout the network. The advantage of maintaining routing table is that if routes are available in table then nodes can communicate with each other without any delay. If route is not available in the table for particular destination then packet should wait in a queue until node receives routing information related to its destination. When routing information is transmitted among nodes, large number of control signals is generated in the network. In highly dynamic environment, significantly large amount of resources are required to keeping the routing information up-to-date and. Widely known proactive routing protocols are Destination Sequence Distance Vector (DSDV), Optimized Link State Routing (OLSR), Wireless Routing Protocol (WRP).

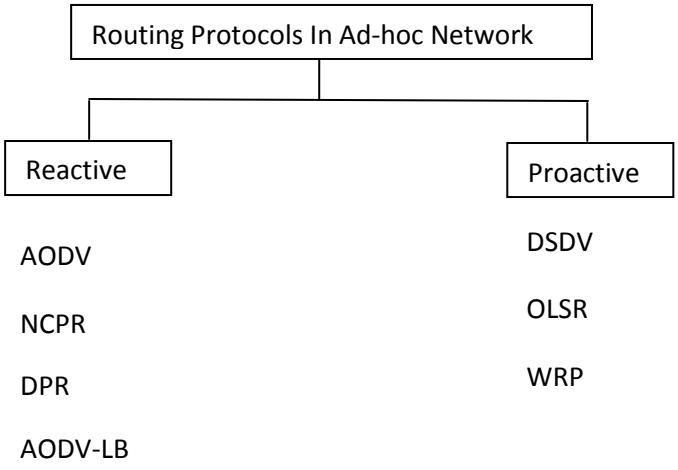

Fig.1. Ad-hoc Routing protocol classification

In Reactive routing protocols, route is established only when it is needed. Reactive routing protocol contains two processes: route discovery and route maintenance. When a source node wants to communicate with destination node, it starts a route discovery process by broadcasting route request packet to its neighbours. This process repeats until it finds destination path and send route reply packet to source node. The route maintenance process is used when source node detects any change in topology or destination becomes inaccessible or the route is no longer available. Unnecessary periodic updates are avoided therefore these protocols require less bandwidth as compared to proactive protocols. A route discovery process is required for every unknown destination. Well known reactive routing protocols are Ad hoc On-demand Distance Vector (AODV) and Dynamic Source routing (DSR).

In reactive routing protocols, broadcasting mechanism is used for route discovery, where each node sends a received route request packet to other nodes in the network until it finds

a path to the destination. Williams and Camp [3] classified broadcasting techniques into four families: Simple Flooding, Probability Based Methods, Area Based Methods and Neighbour Knowledge Methods. In simple flooding method, source node broadcasts a packet to its neighbours and neighbour nodes rebroadcast the packet to their neighbours exactly one time and this process repeats until find a destination. Retransmission of packet causes congestion in the network. In probability based methods, when node receives route request packet first time some probability is assigned and rebroadcast the packet to neighbours with this probability. In network, if nodes share very less transmission coverage then probability is set to high otherwise set to low. When probability is one, this approach is similar to flooding. In area based methods, node calculates the additional coverage area and by using this scheme they can decide whether to rebroadcast the packet or not. In neighbour knowledge method, each node obtains its 1-hop neighbours by using Hello packet and based on they can decide whether to rebroadcast the packet or not.

The remainder of this paper organized as follows: Section 2 Different routing protocols in MANET will be explained briefly. Section 3 concludes the paper.

2. DIFFERENT ROUTING PROTOCOLS IN MANET

2.1 Ad hoc On-demand Distance Vector (AODV) [1]

AODV is very simple and advantageous routing protocol for MANET which does not have any fixed topology. In this protocol route is established when it is needed. Source node broadcast a RREQ packet to neighbour nodes. Neighbour node has receives a packet and searches a route to destination in routing table. If a route is available then generate a RREP packet, and send back to source. Each node set forward path to the node from where it is received. If a destination route is not available then it set a reverse entry path and rebroadcast a received RREQ packet to its neighbour nodes. This process continuous until it finds destination path. AODV uses Simple flooding technique in route discovery process which causes broadcast storm problem.

AODV protocol reduces control message overhead also it consumes less bandwidth and less storage space is required to store routing information. AODV uses flooding mechanism which causes redundant retransmission, collision and contention. Latency is increased due to route discovery process.

2.2 Neighbour coverage-based probabilistic rebroadcast protocol (NCPR) [2]

NCPR protocol combines the approach of probabilistic method and neighbour knowledge method. This protocol solve broadcast storm problem as well as decrease routing overhead and increase performance.

In NCPR, each node maintains their neighbour list. If source node wants to communicate with destination node, it broadcasts a RREQ (route request) packet with its own neighbour list to all the 1-hop neighbours. Consider neighbour node N1 receives a RREQ packet from source node, it uses neighbour list of source node to calculate uncovered neighbour set (UCN). The initial UCN is calculated by comparing its own neighbour set with neighbour set of its previous node. After calculating initial UCN, N1 set timer. Before timer expired, if N1 receives same RREQ packet from its other neighbour then it recalculate UCN. It calculates rebroadcast delay to discover forwarding order. Rebroadcast delay is used to set a timer. After timer expired, Rebroadcast Probability is estimated by combining additional coverage ratio and connectivity factor. Additional coverage ratio is the ratio of number of nodes covered by broadcast to total number of neighbour nodes. By considering rebroadcast probability, node can decide whether to broadcast a packet or not.

NCPR protocol reduces redundant retransmission of packet. Due to this collision and contention is reduced. Also it reduces end to end delay and increase packet delivery ratio. But the overall broadcasting delay is increased.

2.3 Probabilistic broadcasting based on coverage area and Neighbour confirmation [4]

The probability based and area based method is incorporated in this approach. In probability based method all mobile nodes set fixed predefined probability. But in MANET nodes can change their topology dynamically so there is no use of fixed probability. In this approach author should set the rebroadcast probability dynamically. Probabilistic broadcasting is depending on coverage area and neighbour confirmation. Coverage area scheme is used to set a rebroadcast probability and neighbour confirmation scheme make sure that all nodes should receive the broadcasting packet. If a node is situated near to source node then its coverage area is small and if a node situated far from source node then its coverage area is large. Coverage area is obtained by considering distance between source node and destination node and distance is calculated using signal strength or global positioning system (GPS). If destination node is situated far from source node then rebroadcast probability is set to high and if it is situated near then rebroadcast probability is set to low.

The neighbour confirmation scheme confirms that all neighbours should receive a RREQ packet. Consider node N1 rebroadcast a packet to its neighbour and wait for certain time interval. After time expired, N1 make sure that all neighbours rebroadcast packet or not. If any neighbour didn't receive packet, N1 retransmit packet. Author compares this approach with flooding method. This approach requires less rebroadcasting than flooding and also decrease collision. Due to random intervals, the overall broadcasting delay is increased.

2.4 Dynamic Probabilistic Route Discovery (DPR) [5]

In general probabilistic broadcast method, source node broadcast a packet with predefined broadcasting probability. In MANET, mobile nodes change their topology dynamically so we need to adjust probability dynamically. In this approach, each node after receiving packet, forward the packet with probability P which is obtained by considering covered neighbour set and local density of the node. It overcomes a broadcast storm problem.

In this approach, neighbourhood information is collected using Hello packet. In hello protocol node sends hello packet periodically. If node receives hello packet from its neighbour and if there is no entry for that node in Neighbour list then it makes entry for neighbour node in its own neighbour list. If node does not receive hello packet from its neighbour within certain time interval, remove the entry of that node from neighbour list.

In DPR approach, probability is dynamically calculated by considering its local density and neighbours covered by broadcast. If more neighbours are covered by broadcast, probability is set to low and if less nodes are covered, set probability high. DPR generates less routing overhead as compared to conventional AODV protocol.

2.5 Load balancing in MANET shortest path routing protocols [8]

In MANET, routing protocols use a shortest path for communication and most of shortest paths use centrally located nodes as intermediate nodes of path. Therefore these centrally located nodes carry too much load which increases congestion, large delay and decreased performance. In this paper, load balancing approach is proposed which distribute the central load to other nodes located far from the central nodes. In this approach, intermediate nodes compare routes using eccentricity metric. Eccentricity is nothing but the size of its routing table.

When source node wants to communicate with destination, it sends RREQ packet with size of its routing table as eccentricity. After receiving RREQ packet, intermediate node calculates average eccentricity by using previous nodes eccentricity and its own eccentricity and sends this average eccentricity with RREQ packet to its 1-hop neighbours. This process is repeated until it find destination. Destination node receives different RREQ packets from different routes. It compares all received eccentricities and selects a path with less eccentricity by sending RREP packet. This mechanism distribute central load which decreases congestion and improve performance. Pham and Perreau assumes that nodes in network are uniformly distributed. This hypothesis not studied for non uniform node distribution.

3. CONCLUSION

This paper gives a survey on recently proposed reactive routing protocols in mobile ad hoc networks (MANETs) which are based on Neighbour knowledge method and load balancing approach. Broadcasting mechanism is used to descover a route. Neighbour knowledge broadcasting technique is used to reduce retransmissions, collision and contention in network. Load balancing approach is used to distribute load of central network. Many research paper has been focuses on performance metric for comparing the performance of routing protocols. Performance metrics are Packet Delivery Ratio, End-Ti-End Delay, and Normalized Routing Overhead.

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