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REVIEW OF ROUTING PROTOCOLS IN MANET

Navdeep kaur[1], Mandeep kaur[2], Gurpadam Singh [3]

[1]Student of M.Tech (ECE)
[2]Assistant Professor (ECE)
[3]Associate Professor (ECE)
Dept. of Electronics &Communication Engineering, BCET (Gsp), Punjab, India

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Abstract - In this paper, we will describe different Routing protocols in MANET. Routing protocols used in MANET have to face many challenges due to dynamically changing topologies, route discovery, device discovery, bandwidth constrained, low transmission power and asymmetric links .Mobile ad hoc networks (MANETs) are autonomously self-organized networks without infrastructure support. In a mobile ad hoc network, nodes move arbitrarily; therefore the network may experience rapid and unpredictable topology changes. Because nodes in a MANET normally have limited transmission ranges, some nodes cannot communicate directly with each other.

Key Words: **MANET, Routing Protocol, Proactive, Reactive, Hybrid.**

1. **INTRODUCTION: MANET** is a group of wireless nodes that are randomly located and forms a temporary network without using centralized administration typically multiple hops are required to establish a data transmission between two nodes, because of limited transmission range of nodes. Routing protocols for MANETs can be categorized as topology-based protocols and position-based protocols.

1.1 Overview of Routing Protocol in MANET

The routing protocols are basically categorized into three main categories i.e.:

- Proactive Routing Protocols
- Reactive Routing Protocols.
- Hybrid Routing Protocols

Proactive: Proactive routing protocols are also called as table driven routing protocols. In this protocol routing tables are maintained for each known destination. Since the routes are maintained, there is reduction in the amount of control traffic overhead as the packets are forwarded using the maintained routes. But the timely updation of the routing tables is required which uses memory and nodes have to send update message regularly to their neighbors. Even if there is no traffic, the bandwidth is wasted . Proactive routing is not suitable for highly dynamic networks. Examples are: Destination sequenced distance vector protocol (DSDV), Optimized link state protocol (OLSR), etc.

Reactive: These types of protocols route is created only when the source requests a route to a destination .The route is create through a route discovery procedure. In which route request packets (RRP) are flooded in whole network starting from the immediate neighbors of the source. Once a route or multiple routes are found for the destination, the route discovery process ends .A route maintenance procedure used to maintain the continuity of the route. Examples of reactive routing protocols are AODV, DSR etc.

Hybrid: Hybrid protocols attempt to combine the advantage of proactive and reactive routing Protocols. zone routing protocol is one of the example of hybrid protocols. In position based routing protocols assume that the individual nodes are aware of the locations of all the nodes within the network .The best and easiest technique is the use of the Global Positioning System (GPS) to determine exact coordinates of these nodes in any geographical location .then this location information is then utilized by the routing protocol to determine the routes. Examples are LAR, DREAM, GPSR, and LARDAR etc. The Location Aided Routing: It is a reactive unicast routing scheme. LAR take advantage of position information using any position service such as gps etc and this information is used to enhance the efficiency of the route discovery procedure by restrict the range of route request flooding. In route discovery phase, location information of source and destination is contained in route-request packets then this packet is broadcasted in the request zone where all node forwards these packets to neighboring nodes. Nodes which are outer side of the zone discard the message. As the route request packet arrive to the destination node, the destination replies with a route reply packet. Route request packet contains the current position of the destination node. nodes in the network forward the route request to their neighboring nodes, and this process goes on until route request arrive to the destination node.

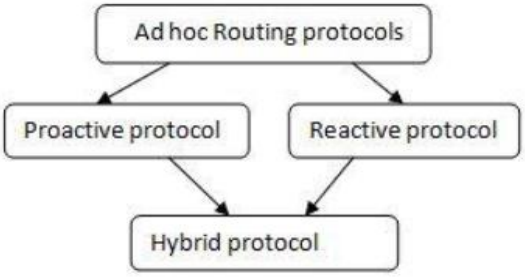

Fig. 1 : Classification of Routing protocols

1.2 MANETS CHARACTERISTICS:

- **Distributed operation**: The control of the network is distributed between the nodes.
- **Multi hop routing**: when a node want to send information to other nodes which is not in transmission range of node then the packet can be forwarded via other intermediate nodes.
- **Autonomous terminal:** In MANET each mobile node can be function as both a host and a router.
- **Dynamic topology**: In mobile adhoc networks nodes are randomly move with different speeds so that the network topology may change randomly.

1.3. ADVANTAGES OF MANET

- MANETs are Self-configuring network.
- Nodes are also act as routers.
- They are less expensive as compared to wired network.
- Improved Flexibility.
- mobile as hoc network is Robust

1.4. MANETS CHALLENGES

1. Limited bandwidth
2. Dynamic topology
3. Routing Overhead

1.5 MANETS APPLICATIONS

1. Some of the typical applications include:
2. Military battlefield
3. Collaborative work
4. Personal area network and Bluetooth

2. ROUTING PROTOCOLS FOR MANETS:

AODV: AODV is one of the reactive protocol in which source node initiates data packet to destination node only when requires the route discovery is occur. there are no periodical exchanges of routing information.The Protocol consist of two phases:Route Discovery&Route Maintenance.

i. Route Discovery: AODV routing protocol uses a broadcast route discovery mechanism and it depends on dynamically established route. AODV builds routes by using a route request (RREQ)/ route reply (RREP) query cycle. When a source node requires a destination route for which it does not have a route already, it broadcasts RREQ packet across the network. Thenodes receiving this packet update the information for the source node and sets up backward pointer information for the source node in the routing table. A lifetime is associated with each reverse route entry, i.e. if the route entry is not used within the lifetime it will be removed. As shown in fig.

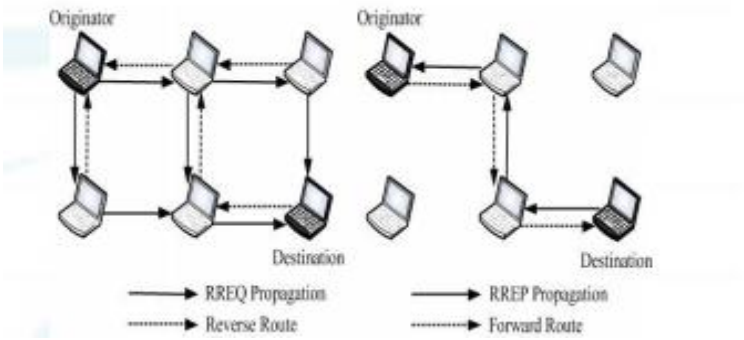

Figure 1: AODV route discovery process

ii. Route Maintenance: The second phase of the protocol is called route maintenance. It is performed by the source node and can be subdivided into: i) source node moves: source node initiates a new route discovery process, ii) destination or an intermediate node moves: a route error message (RERR) is sent to the source node. Intermediate nodes receiving a RERR update their routing table by setting the distance of the destination to infinity. If the source node receives a RERR it will initiate a new route discovery. To prevent global broadcast messages AODV introduces a local connectivity management. This is done by periodical exchanges of so called HELLO messages which are small RREP packets containing a node's address and additional information.

Optimized Link State Routing Protocol (OLSR): It is definitely an optimization of a natural link state protocol for mobile ad hoc networks. Each node in the network selects some neighbor nodes called as multipoint relays which retransmits its packets. The neighbor nodes that are not in its MPR set can just only read and process the packet. This procedure reduces the amount of retransmissions in a broadcast procedure.

Dynamic Source Routing (DSR) In DSR, when a mobile (source) needs a route to another mobile (destination), it initiates a route discovery process which is based on flooding. The source originates a RREQ packet that is flooded over the network. The RREQ packet contains a list of hops which is collected by the route request packet as it is propagated through the network. Once the RREQ reaches either the destination or a node that knows a route to the destination, it responds with a RREP along the reverse of the route collected by the RREQ. This means that the source may receive several RREP messages corresponding, in general, to different routes to the destination. DSR selects one of these routes (for example the shortest), and it maintains the other routes in a cache. The routes in the cache can be used as substitutes to speed up the route discovery if the selected route gets disconnected. To avoid that RREQ packets travel forever in the network, nodes, that have already processed a

RREQ, discard any further RREQ bearing the same identifier. The main difference between DSR and AODV is in the way they keep the information about the routes: in DSR it is stored in the source while in AODV it is stored in the intermediate nodes. However, the route discovery phase of both is based on flooding. This means that all nodes in the network must participate in every discovery process, regardless of their potential in actually contributing to set up the route or not, thus increasing the network load.

Associativity-Based Routing (ABR) ABR protocol defines a new type of routing metric "degree of association stability" for mobile ad hoc networks. In this routing protocol, a route is selected based on the degree of association stability of mobile nodes. Each node periodically generates beacon to announce its existence. Upon receiving the beacon message, a neighbor node updates its own associativity table. For each beacon received, the associativity tick of the receiving node with the beaconing node is increased. A high value of associativity tick for any particular beaconing node means that the node is relatively static. Associativity tick is reset when any neighboring node moves out of the neighborhood of any other node.

The Robust Multipath Source Routing (RMPSR) protocol is a multipath extension to DSR. The basic idea behind RMPSR protocol is to discover multiple nearly disjoint routes between a source and a destination. To increase the probability of discovering multiple disjoint routes, the path selection criteria include the following properties: disjoint nodes, small distance between the primary (shortest) and the other paths, and small correlation factor. The correlation factor of two node disjoint paths is defined as the number of links connecting the two paths. A route set consists of a primary route and several alternative routes. The primary route connects a source and a destination node, and alternative routes connect an intermediate node to a destination. The destination node collects multiple copies of RREQ packets of the same session within a time window, then builds multiple nearly disjoint route sets, and returns primary routes to the source node, and alternative routes to corresponding intermediate nodes. The RMPSR protocol uses a per-packet allocation scheme to distribute video packets over two primary routes of two route sets. If one transmitting primary route is broken, the intermediate node that detects a broken link will send a Route Error (RERR) packet to the source node. Upon receiving the RERR packet, the source node removes the broken primary route from its route cache, and switches the transmission to another primary route. The RMPSR protocol was designed taking into account the QoS requirements for video applications. It does not deal with issues like route coupling, as it selects nearly disjoint routes. In addition, the traffic allocation algorithm does not take into account the link quality while selecting the routes to send data, which means that routes with high packet loss may be selected, further degrading performance.

MeDSR: MeDSR is a reactive routing protocol, in which a node issues RREQ packets only when it has data to send. RREQ packets are flooded through the network, each node appending its own address to each request it receives, and then re-broadcasting it. The request originator issues a new RREQ packet for the same destination after an exponential back-off time if no RREP packet is received. Multipath Extension to Dynamic Source Routing protocol (MeDSR). The basic idea is to build disjoint route sets for the source-destination pair. to increase the probability of discovering multiple disjoint routes, when a node receives a RREQ packet, if it is the first time this RREQ packet is received or the path included in this message is node disjoint relative to the path included in a previously cached copy of the same RREQ packet, then the node will cache it and broadcast it again. In other cases, the node will discard this message. The route sets are built at the destination node, since the destination node knows the entire path of all available routes. The route sets consist of a primary route, connecting a source-destination pair, and the information about all the neighbors of the nodes in the route. The neighborhood information is collected by all nodes upon the route discovery process and is added to the RREP packet as it travels back to the source node. Some procedures were implemented to manage RREQ and RREP packets, at the destination and source node respectively. The destination node collects RREQ packets and builds route sets, and the source nodes collects paths from received RREP packets and uses them during the multipath selection process. During the multipath selection process, the paths are grouped according to their correlation factor, and the ones with the smallest correlation are selected. The MeDSR protocol is a multipath routing protocol that takes into account the route coupling issue, but it does not consider link quality over the selected routes, nor does it attempt to distinguish collisions from routing failures.

Signal Stability–Based Adaptive Routing Protocol (SSA) SSA protocol focuses on obtaining the most stable routes through an ad hoc network. The protocol performs on demand route discovery based on signal strength and location stability. Based on the signal strength, SSA detects weak and strong channels in the network. SSA can be divided into two cooperative protocols: the Dynamic Routing Protocol (DRP) and the Static Routing Protocol (SRP). DRP uses two tables: Signal Stability Table (SST) and Routing Table (RT). SST stores the signal strengths of the neighboring nodes obtained by periodic beacons from the link layer of each neighboring node. These signal strengths are recorded as weak or strong. DRP receives all the transmissions and, after processing, it passes those to the SRP. SRP passes the packet to the node's upper layer stack if it is the destination. Otherwise, it looks for the destination in routing table and forwards the packet. If there is no entry in the routing table for that destination, it initiates the route finding process. Route-request packets are forwarded to the neighbors using the strong channels. The destination, after

getting the request, chooses the first arriving request packet and sends back the reply. The DRP reverses the selected route and sends a route-reply message back to the initiator of route request. The DRPs of the nodes along the path update their routing tables accordingly. In case of a link failure, the intermediate nodes send an error message to the source indicating which channel has failed. The source in turn sends an erase message to inform all nodes about the broken link and initiates a new route-search process to find a new path to the destination.

Temporally-Ordered Routing Algorithm: Each node constructs a directed cyclic graph by broadcasting query packets. On receiving an issue packet, if the node includes a path to destination it'll send a reply packet, else it drops the packet. A node on receiving a reply packet will update its height only when the height of packet is minimum than other reply packets. The Temporally Ordered Routing Algorithm (TORA) is a highly adaptive, efficient and scalable distributed routing algorithm based on the concept of link reversal. TORA is proposed for highly dynamic mobile, multi-hop wireless networks. It is a source-initiated on-demand routing protocol. It has a unique feature of maintaining multiple routes to the destination so that topological changes do not require any reaction at all. The protocol reacts only when all routes to the destination are lost. In the event of network partitions the protocol is able to detect the partition and erase all invalid routes. The protocol has three basic functions: Route creation, Route maintenance and Route erasure.

Optimized Link State Routing (OLSR) Protocol:This protocol is based upon link state algorithm and is a point to point routing protocol.In this protocol, each node maintains the information regarding the topology and is exchanged periodically.The main advantage of OLSR is that it reduces the size of control message and thus minimizes the number of rebroadcasting nodes by using multipoint replying strategy. When the topology changes, each node selects its neighboring nodes to retransmit the data.These set of nodes are called as multipoint relays for that node. OLSR uses two types of control messages i.e. “hello” message and“topology control” message. Hello messages are for the status of link and host’s neighbors. While the topology control messages are for its own neighbors and used for broadcasting information.

3. Conclusion

This paper basically presents three types of routing protocol i.e.proactive, reactive and hybrid. From the study it is clear that due to the random behavior of the node, routing becomes complex.Many routing protocols are used in the MANET and each hasits unique features. Based on network environments, we have to choose a suitable protocol. Proactive protocols are best suited for small networks. For dense and large network, reactive protocols are used. And hybrid protocols are combination of proactive and reactive protocols. So when high performance is required in large network then hybrid protocols are used.

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