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Review on Routing Protocols in Manets

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***Abstract*—** A very interesting research area in infrastructureless wireless network is Manet. Manet stands for Mobile ad hoc network. Mobile means moving or changing position and ad hoc networks are those having no fixed infrastructure and dynamic topology. Manets have a variety of applications in different areas like in research and rescue operations, in military environments, emergency operations like fire- fighting etc. Due to dynamic nature of such networks, they need attention in many areas like topology control, bandwidth, security, routing, power consumption etc. Routing packets in such a network is a very challenging task and is of great interest of many researchers. Such networks require dynamic routing algorithms which can update routing table dynamically depending on the changes in topology and traffic. Performance of such networks depends on effectiveness of these routing algorithms .There are many routing techniques proposed for such networks. This paper gives an overview of such routing protocols proposed in literature for manets and also comparison among them.

***Keywords*—** Ad hoc; dynamic; manet; networks; review; routing protocols.

I. INTRODUCTION

Manet is a network of mobile devices connected together wirelessly having no infrastructure and is contiuously self-configuring.Such multi-hop wireless network doesn't require any central administration like routers, access points or base stations. They can be easily deployed anywhere anytime depending on need.The main attraction of such networks is mobility of nodes and flexibility that they provide. Manet is a very popular research area because of the various challenges it face in areas like security, routing, topology control, power consumption, bandwidth etc. Routing is a very challenging task in such infrastructureless network. Mobility of devices leads to some limitations like limited battery power, weight and physical size limitation (necessary for their mobility), leading to less available memory and computation power which are necessary for performing routing tasks. Routing protocols are a set of rules which define how a packet will travel from source to destination. Routing protocols that are used in manets are classified into three categories: proactive, reactive and hybrid routing protocols.

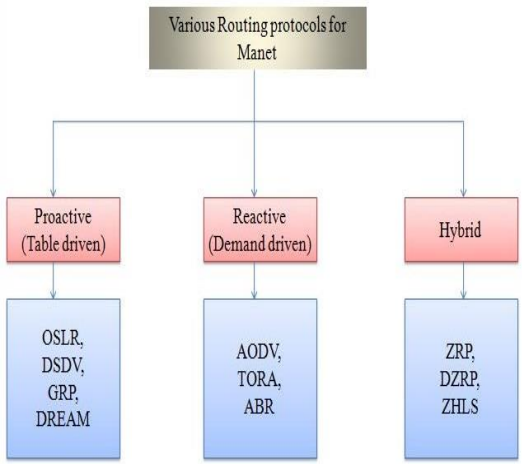

Fig 1. Classification of routing protocols.

II. PROACTIVE ROUTING PROTOCOLS

Proactive routing protocols route packets from each node to every other node in the network. Routing information is usually maintained in different tables that are updated periodically or in case of change in topology. They are also called as table driven routing protocols. Every node maintains information about network topology which proves helpful for datagram traffic but suffers considerable traffic and power consumption. When the network topology changes, the protocol responds by propagating updates throughout the network so as to maintain a consistent view. Some of the existing proactive routing protocols are discussed below:

A. Optimised Link State Routing (OLSR)

Optimised link state routing **(**OLSR) is a point to point routing protocol which inherits the stability of link state routing algorithm. OLSR is basically an optimization of pure link state protocol. It employs multipoint replaying strategy(MPR) which helps in reducing control packet's size and number of rebroadcasting nodes during each topology update. Each node in a network chooses only a set of neighbouring nodes called as multipoint relays of that node, to retransmit it's packet during each topology update. Those nodes which are not in the set cannot retransmit but can read and process each packet. For selecting MRP's, list of one hop neighbours is periodically broadcasted by each node using Hello message. Now, from that list of nodes in the Hello messages, a subset of one hop neighbours is selected by each node, which covers all of its two hop neighbours.

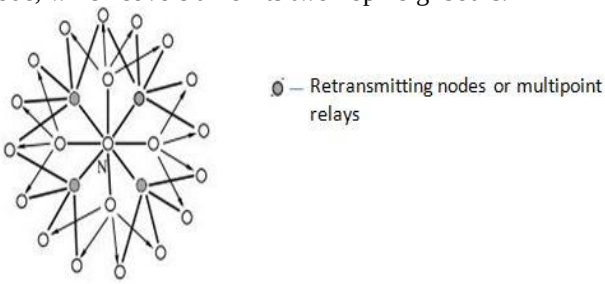

Fig 2. Multipoint relays

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In this Fig 2, N selects shaded nodes to be MPR since they cover all the nodes that are two hops away.

B. *Destination Sequenced Distance Vector (DSDV)*

Destination Sequenced Distance Vector (DSDV) is a proactive protocol which is based on Bellman- Ford algorithm and guarantees loop free routes. Each node maintains a routing table which stores number of hops, sequence number, destinations, next hop address. To reduce the amount of overhead transmitted over the network, two types of update packets ie "full dump" and "incremental" packets are used. All the available routing information is contained in the full dump packet and the incremental packet carries only the information changed since the last full dump. Compare to full dump packets, incremental packets are sent more frequently. However, DSDV still introduces large amounts of overhead to the network due to the requirement of the periodic incremental update messages.

III. REACTIVE PROTOCOLS

Reactive protocols create routes on-demand. If a node wants to initiate communication with another node only then it will start route discovery process within the network. Once a route has been set up , it is maintained by a route maintenance procedure until either the route is no longer required or the destination becomes inaccessible along every path from the source. Different reactive protocols are given below:

A. *Ad Hoc On-Demand Distance Vector (AODV)*

Ad hoc On-demand Distance Vector (AODV) performs route discovery using on-demand route requests (RREQ) just like DSR protocol and utilizes sequence numbers and routing beacons from DSDV.However there are two huge differences between DSR and AODV. One difference is that in AODV each packets carry the destination address only unlike DSR in which each packet carries full routing information. This is the reason why AODV has less routing overhead than DSR. The other difference is that route replies in AODV only carry the destination IP address and the sequence number whereas in DSR, it carries the address of every node along the route. It consumes more bandwidth as the network's size increases and there can be large delays during route construction and link failure. It is adaptable to highly dynamic networks which is an advantage of AODV protocol..AODV avoids the "counting to infinity" problem which was there in distance vector algorithm by using sequence numbers for every route.

B. *Temporally ordered routing algorithm (TORA)*

Temporally ordered routing algorithm (TORA) is another on-demand routing protocol ,based on Light weight mobile routing protocols (LMR). It's main objective is to limit control message propagation in highly dynamic mobile ad hoc network. Whenever a node wants to send a message to destination, it has to explicitly initiate a query. TORA belongs to a class of algorithms called the link reversal algorithm. Each node only maintains routing information to its neighbours thereby avoiding storage overheads associated with maintaining complete routes and extra delays. TORA can be used to provide multicasting, by using it in conjunction with lightweight adaptive multicast algorithm (LAM). TORA has decreased the far-reaching control messages to a set of neighbouring nodes, where the topology change has happened. There is one disadvantage of TORA that is, this algorithm may also produce temporary invalid routes just as in LMR.

IV. HYBRID ROUTING PROTOCOLS

Hybrid routing protocols combines features of distance vector routing and link state routing protocols. It is similar to distance vector in the sense that it shares it's knowledge of the complete network with its neighbours and to link state routing in the sense that the routers in the network tell every other router on the network about its closest neighbours. It is also known as Balanced Hybrid routing. It serves activated devices via reactive flooding. Hybrid protocols use distance vectors to find out the best path between source to destination. Routing information is reported only when there is a topology change in the network. In comparison to link state routing, it requires less memory and processing power.

A. *Zone Routing Protocol (ZRP)*

Zone routing protocol (ZRP) is a combination of reactive protocols and proactive protocols. This protocol divides networks into local neighbourhoods called as zones.Each device or node in the network has a zone associated with it. Zone is basically a collection of nodes whose minimum distance from the node is less than the radius of the node. Minimum distance is calculated in terms of number of hops from that node .Nodes which lie inside routing zone are internal nodes and those which define boundary of zone are peripheral nodes. Routes are immediately available for nodes that are within the routing zone as each node within that zone has maintained the network connectivity proactively and for those nodes that fall outside the routing zone, routes are discovered reactively ie on-demand by using any reactive routing protocol to find route to the destination. One of the main advantage of using this protocol is that it has considerably reduced the amount of overhead in communication compared to proactive protocols. This protocols helps in finding out routes faster thereby reducing the delays associated with on-demand protocols. However, it can behave like a pure proactive protocolfor bigger values of routing zones or as a pure reactive protocol for small values of routing zones , this is one of its disadvantage.

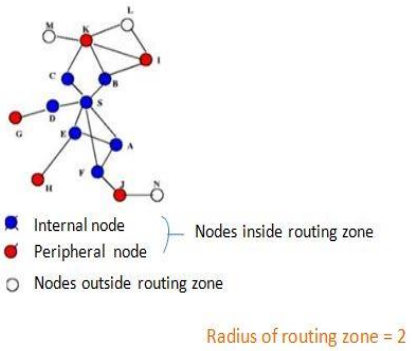

Fig. 3. Zone routing protocol.

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B. *Zone-Based Hierarchical Link State Routing Protocol (ZHLS)*

Zone-based hierarchical link state routing protocol (ZHLS) is a hierarchical protocol in which the network is divided into non-overlapping zones. Each node has a zone id and a node id which is calculated using a locating system like GPS. It has two levels of hierarchical topology- node level topology and zone level topology. Each node only knows the zone connectivity of the entire network and the node connectivity within its zone. To all the nodes, the zone-level topology information is distributed.This protocol has no processing overhead as it doesn't have any location manager or cluster head to coordinate the data transmission. Therefore, traffic bottlenecks and single point of failure can be avoided. In it, source broadcasts zone level location request to all the other zones when a route to a remote destination is required thereby reducing communication overheads which were there in pure reactive protocols because of their flooding approach. Another advantage of this protocol is that it is highly adaptable to dynamic topology as for routing only the node id and zone id are required. Disadvantage of this protocol is that it may not be feasible in those applications where the geographical boundary of the network is non-static (dynamic) because of the requirement that all nodes must have a pre-programmed static zone map in order to function

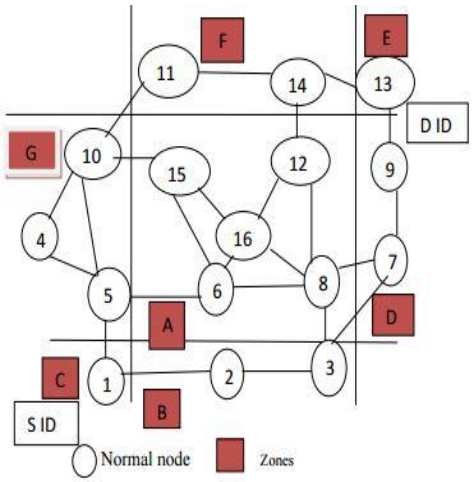

Fig 4. A topology of ZHLS protocol.

V. Comparison Among Proactive, Reactive and Hybrid Protocols

S.No.	Comparison Basis	Proactive	Reactive	Hybrid
1.	Routing structure	Both flat and hierarchical	Mostly flat	Mostly hierarchical
2.	Storage requirement	High	Lower than proactive	Depends on size of clusters
3.	Level of delay	Predetermined small routes	Higher than proactive	Small in case of local destination and large in case of interzone communication
4.	Scalability	Usually ,upto 100 nodes	Depends on level of traffic & multihopping	Upto 1000 or more nodes
5.	Control traffic	Usually high	Lower than global routing	Mostly, lower than proactive & reactive
6.	Route availability	Always available	Determined when needed	Depends on destination's location
8.	Periodic updates	Yes	Not required	Required inside zones or between gateways

VI. Conclusions

This paper studies various routing protocols that are used in mobile ad hoc network, their classification into three categories: proactive, reactive and hybrid protocols and comparison among them. Routing in a manet is a very challenging task because of its dynamic topology. Many protocols are proposed for routing packets in such a network. Each having its own advantages and limitations. So, we cannot choose one protocol that is optimum in all scenarios. Depending on the network size, performance demand etc protocols are selected for a particular situation. A particular protocol may be optimum in one situation but it won't give optimum result in all situations. This is because of the fact that under different circumstances different protocols how different performance. OLSR is a very efficient protocol in terms of scalability, throughput and delay. By reducing the number of rebroadcasting nodes using multipoint relay strategy, it helps in increasing scalability, reducing channel contention and number of control packets travelling through the network. Hierarchical routing protocols are better as they choose only selected nodes for rebroadcasting control packet but problem in such networks comes in mobility management. Usually, most reactive routing protocols, when considering the worst-case scenario, have the same routing cost as they all follow similar route maintenance and discovery procedure. In reactive protocols, AODV have scalability issues that can be increased by controlling route maintenance and discovery procedure. Hybrid protocols are better than purely reactive and purely proactive protocols since they combine the goodness of both. ZHLS is highly adaptable to dynamic topologies and may scale well to large networks. ZRP has considerably reduced the amount of overhead in communication compared to proactive protocols because only the nodes that are within are zone are connected proactively while those node which lie outside will use on demand routing for route discovery. OLSR protocol shows best result in most of the cases so we can choose OSLR protocol for larger networks and hybrid protocol for smaller networks.

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