Illustration of Routing Protocols for Mobile Ad Hoc Network

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Abstract— A mobile ad hoc network is a collection of mobile nodes that communicate with each other, generally not having any infrastructure. It uses traditional TCP/IP structure to provide end to end communication between the nodes. Nodes are temporally connected to each other; a network does not have any central control station. All the nodes act as routers and participate in path discovery and maintenance to the other nodes in the network. This allow user to create their PAN. The network topology keeps on changing as per requirement of the user, because of this changing scenario, network management, routing update and other tasks cannot be performed easily. Hence there are lots of challenges which shall remain unfulfilled. Various types of routing protocol have been introduced to accomplish requirements of ad hoc network, in this paper different types of routing protocols & their routing strategies have been discussed.

Key words: DSDV, OLSR, DSR, AODV, ZRP, FSR, DREAM, LAR

I. INTRODUCTION

In an ad hoc network, communication between various nodes takes place through wireless links. Direct communication can take place between nodes that are within the communication range of the antenna of the respective node, otherwise communication is achieved through Multi-hop routing. These networks are very flexible and are established especially to provide application in various fields like military, battlefield and defense etc. An ad hoc network should freely determine its configuration parameters that include- addressing, routing etc. So the ad hoc network should be a self-organized network. Communication between various nodes is accomplished by transferring data packets. A path chosen for communication between nodes is called routing.

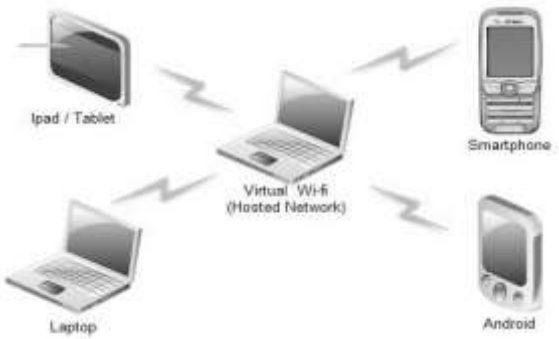

Fig. (a): An Ad Hoc network

A protocol that constructs and maintains routing in ad-hoc network is known as routing protocol. The requirement of routing protocol is to send and receive data packet among the nodes with minimum delay and with best suited paths. Establishing correct and efficient path is the primary focus of routing protocol. Routing protocols in mobile ad hoc are classified depending on routing strategy and network structure. According to the routing structure routing protocol are classified as, proactive, reactive and hybrid. According to network structure they are classified as geographical routing, flat routing, and power aware routing protocol.

A. *Types of Protocol*

The existing routing protocol in MANET can be classified into 5 categories:

1) Proactive or Table driven protocol.
2) Reactive or on demand protocol.
3) Hybrid protocol.
4) Hierarchical protocol.
5) Geographic routing protocol.

II. RELATED WORK

In this paper the description of various ad hoc routing protocols is given. Proactive protocol maintains route automatically, reactive protocol maintains routes on demand. Hybrid protocols like ZRP includes the working of both, using reactive protocol outside the zone and proactive inside the zone. Hierarchical protocol provides route according to level in which the node resides, geographic routing protocol uses location information to reduce overhead. These different protocols provide different routing schemes in ad hoc, so the user can choose them according to their needs.

III. PROTOCOL PRESENTATION

A. *Proactive Protocol*

These protocols attempt to maintain regular up to date information, from each mobile node to another, periodically. With this advantage the source traffic does not have to incur any route delay in the network. Automatically all nodes maintain one or more routing tables where it stores routing information about another nodes in the network. This is done by using link state protocols or distance vector protocols. E.g. DSDV, OLSR.

1) Destination Sequence Distance Vector

In this protocol all the mobile nodes in the network maintain routing table which keeps the information about – the entire available destination, no of hop to reach at the destination and sequence no that is stamped by the destination node. A mobile node sends this routing table to its nearest node, to which it wants it communicate or when any changes occur due to last update in the network. These updates can be sent by two ways, in the first way full routing table is send to neighboring node this is called full dump. In the second way only those entries from the table are sent that has metric change since the last update and it must fit in a packet, it is called Incremental update, they are sent to avoid extra traffic in the network. Sequence number is used to make difference between the state routes and the new one. Routing update with routing Information also carries a sequence number

assign by the transmitter. A short route is preferred always, the whole network should be known to all nodes.

2) Optimization Link State Routing Protocol

In OLSR nodes provide information about the topology of the network. Each node selects a subset of its neighbour node as multipoint relay with symmetry. Nodes those are selected as MPR are responsible for forwarding control traffic into the entire network. MPR node declare Link state information for their MPR selector, additional link state information is also

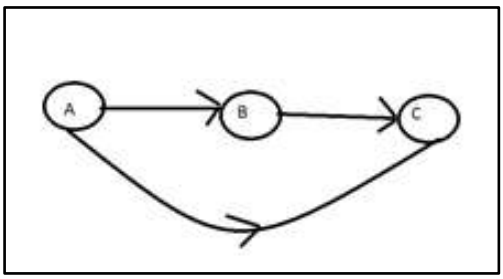

Fig. (b): A can communicate to C through B

Each node selects a subset of its neighbour node as multipoint relay with symmetry. Nodes those are selected as MPR are responsible for forwarding control traffic into the entire network. MPR node declare Link state information for their MPR selector, additional link state information is also utilized. Node that are selected as MPR declare this information periodically in their control message, after that node announce that it has selected as much MPR it has to be selected. OLSR minimizes the overhead by flooding the control traffic by using MPR'S to retransmit control message. Its operation mainly consists of updating and maintaining information into a variety of tables. The date in these tables is based on received control traffic. Control traffic is generated on information retrieved from these tables. Route calculations are also driven by the table.

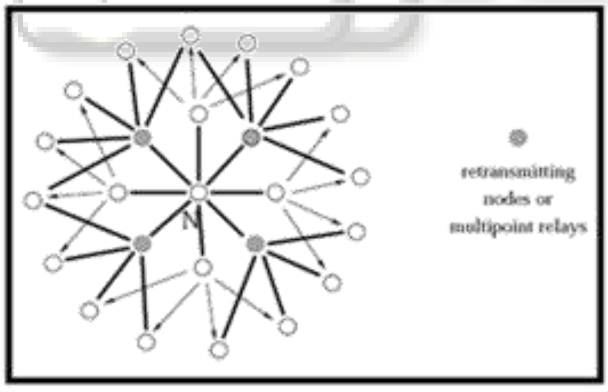

Fig. (c): MPR'S selection in OLSR

B. Reactive Protocol

These protocols do not maintain route discovery automatically. Route is determined only when a node that wishes to send or receive packet has ordered for it. This is accomplished by sending route request to all the node in the network and building a route by receiving the response from the node that are willing to communicate. This advantage leads to avoid incurring the cost of maintaining routes that are not used. Because routes are created on demand source traffic has to experience delay in the network. These protocols are attractive to use where the network traffic is bursty and is directed towards the small subset of nodes. E.g. AODV, DSR

1) Dynamic Source Routing Protocol

This protocol is based on the concept of source routing; it is a simple protocol which is design especially for multi-hop network. It has two mechanisms i.e. route discovery and route maintenance.

Route reply and route request message with entire path information are used for discovering the route to the destination. The advantage of this protocol is that intermediate hop does not need to maintain routing information in order to route the packet they receive, because packet itself contain all the necessary routing information. These protocols are intended for networks in which mobile nodes move with moderate speed.

2) Ad Hoc on Demand Distance Vector

This protocol establishes a route to destination only as per demand by the source node. Multicast, unicast and broadcast all type of routing can be performed by it. It is combination of DSR and DSDV, it takes route discovery and route maintenance from DSR and uses hop by hop Routing, node sequence no and regular update property of DSDV. The main advantage is that it is not necessary to include source route with each message. Each node in the network maintains a routing table with the routing information grasp by the neighbour sequence no, a broadcast id and perform path discovery by broader casting route request message to its Neighbour.

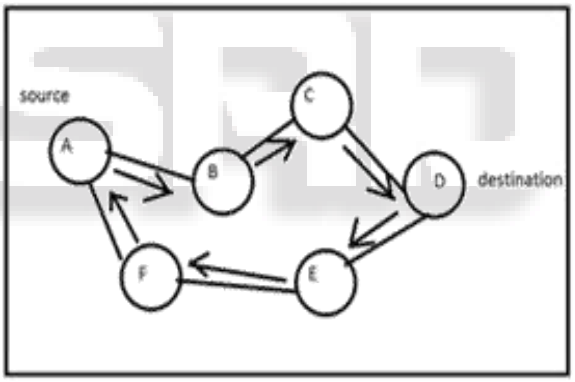

Fig. (d): Route request process in AODV & DSR

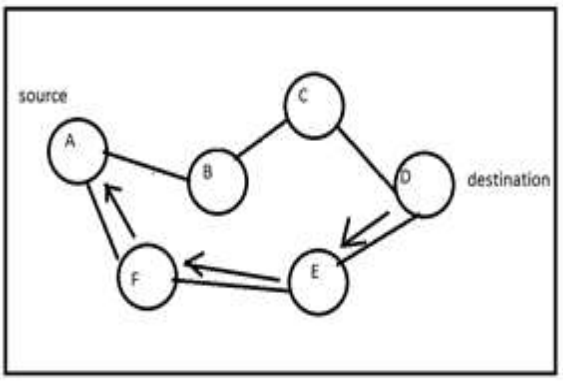

Fig. (e): Route reply process in AODV & DSR

A node that is willing to communicate accept the request by comparing the Destination sequence no with its routing table ,if the no is less than it ,it broadcast to Another node otherwise it unicast a route reply to the node from which it has receive request.

C. Hybrid Protocol

These protocols take advantages of both proactive and reactive protocol. The combination of both the protocols is better than to take them independently. Because of these advantages delay caused by using proactive and large bandwidth utilization by using reactive approach can be overcome. Initially the route is established proactively and later on is served as per demand by the network. E.g. ZRP

1) Zone Routing Protocol

In this protocol complete network is divided into zone, each node has its own zone of radius þ. Zone includes nodes that are hop count away from each other. The node with a hop count equal to zone radius is called as peripheral node, hop count less than þ are called as interior node, hope count more than þ are called as exterior node. The communication between interior nodes is guided by Intra zone routing protocol (IARP).

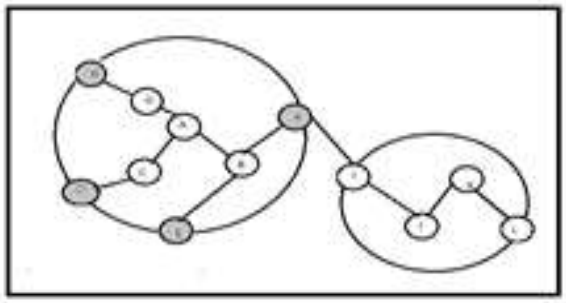

Fig. (f): Zone of source A with radius (þ) =2, L is the destination node

The communication between exterior nodes is guided by Inter zone routing protocol (IERP). IARP is performed in a reactive manner, while IERP is performed in pro-active manner. A node uses a neighbour discovery protocol in order to know about its neighbour, this is done by sending hello beacons in the network. If the node receives a response to such network it may note that it has direct point to point connection with its neighbour. The node that wants to send packet to other zone , first send this packet to the peripheral node reactively which maintain routing formation from other nodes and then send it to peripheral node of other zone that forward packet to the destination node.

D. Hierarchical Protocol

In this type of protocol the choice of routing depends upon the hierarchical level on which the node stays. Complete network is divided into group of nodes called cluster. Cluster head is than elected. In the large network super clusters are also made. Traffic between clusters is routed by cluster head this is an advantage that routing protocols does not need to deal with all the nodes in the network. Packet travels from cluster to cluster head and down again as in a tree therefore it is names as hierarchical protocol. Cluster nodes broadcast their link information to each other. Cluster head summarizes this information and send it to other cluster head via gateway. Cluster head are member of cluster at higher level; they exchange their link information and summarize lower level information. A node at each level floods the information to its lower level that it obtains after the algorithm has run on that level. E.g. Cluster based routing protocol, Fish eye state routing protocol.

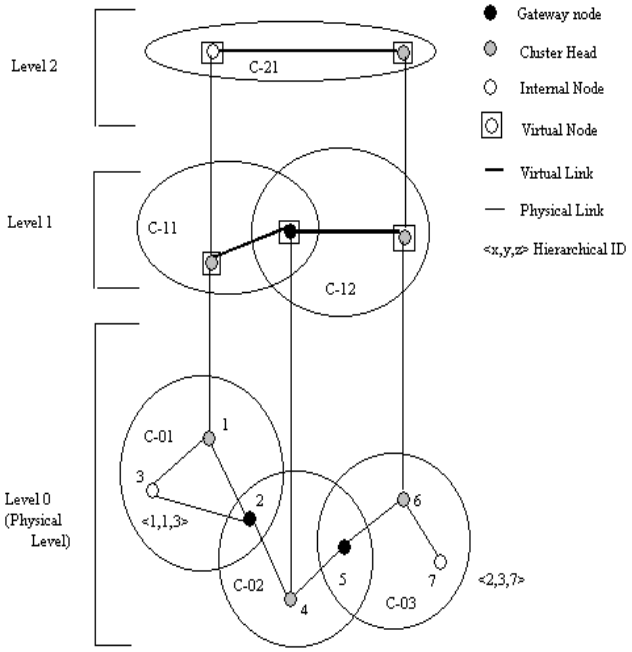

Fig. (g): Hierarchical routing

1) Cluster Based Routing Protocol

This protocol divides the nodes of the network into a group of overlapping node called as cluster into a distributive manner. A cluster head act as the temporary base station is selected for each cluster to maintain cluster membership information. By using this information inter cluster route are discovered. Nodes are clustered into group which minimizes the traffic, speed up the process and improves network scalability. Each node uses a neighbour table where it stores information about its node such as their ID's, their role and status of the link. Neighbour table is maintained by periodically broadcasting hello message.

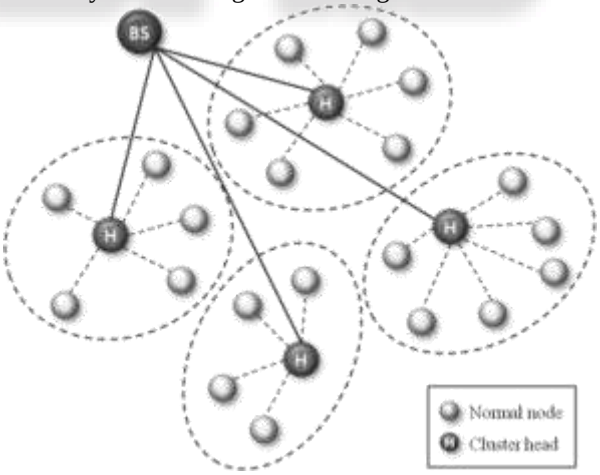

Fig. (h): A cluster based routing protocol.

2) Fish Eye State Routing Protocol

In this protocol, each node has a unique identifier, nodes move around changes its speed and direction independently. FSR concepts originates from global state routing .GSR is a special form of FSR. GSR uses improved link state routing by avoiding flooding of routing messages. In FSR node maintain a link state table based on up to date information received from the neighbour node and it keeps on exchanging it periodically with its local neighbour on demand. Each updated message does not contain information about all the nodes instead of this it

communicate with neighbour node more nicely than to the farther one, this reduces the size of updated packet. So each node gets accurate information about their neighbour. In this process the table entries with small sequence is replaced by the big ones. The centre (red) of the node contains most accurate information about the entire node in a white circle and so on. This is called as scope of fish eye for centre node. Protocol was developed to reduce the size of data.

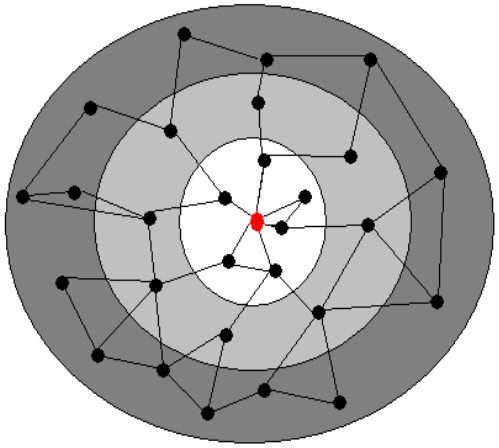

Fig. (i): Fish eye scope

E. Geographic Routing Protocol

Geographic routing is a technique to deliver a message to a node through multiple hopes by means of position information. Nodes participating in geographic routing protocol must be aware about their geographic position, by this more time used in widely searching for destination is saved. Control and data packet can be sent in the general direction of the destination if the recent geographical coordinates are known. This reduces control overhead in the network but uses more bandwidth as the knowledge of geographic position is known to all nodes. In this neither routing tables nor route discovery is necessary. E.g. DREAM, LAR.

1) Distance Routing Effect Algorithm for Mobility (DREAM)

Dream makes use of distance effect and mobility rate to regulate the frequency of topological update. As per this protocol the greater the distance between two nodes low their mobility and faster the node move the higher is their frequency of location update. Thus the node that is far apart needs to update their location less than nodes that are close to each other. Mobility rate allows each node to self-optimize its dissemination frequency, thus transmitting location information only when needed and without sacrificing the route accuracy.

A node records the location table for its entire peer node in the network, which include the location information of the node. Using this location information, node send data packet to a set of neighbouring node that lie in the direction of destination. Data packet is dropped if no such neighbours are found. Destination replies with ACK. If only one path between the source and destination is made, the source will than send data packet through that path preferring the shortest path.

2) Location Aided Routing Protocol

This protocol makes use of location information provided by Global positioning system, to reduce routing overhead. It helps node to know about its physical location. But the location information provided by the GPS includes some amount of error as the difference measured in real and GPS coordinates. Mobile nodes move in two dimensional phase i.e. Expected zone and requested zone. Expected zone is only an estimate made by the source node to determine a region that potentially contains destination at time t. Node defines a request zone for the routing request that is determined based on the expected location of the destination node at the time of route discovery. To increase the probability the route will reach to destination request zone should include expected zone.

Two request zone schemes have been proposed. In Scheme 1 of LAR, a rectangular geographic region will be selected where nodes will forward the route discovery packet only if they are within that specific region. In Scheme 2 of LAR, the source or an intermediate node will forward the message to all nodes that are closer to the destination than itself. In order to find the shortest path in the network level, several nodes are selected for managing the route request message and each of them will put its IP address in the header of the request packet.

IV. CONCLUSION

The paper provides glimpse about different routing protocols and how they perform routing operations when used in the ad hoc network. It gives a healthy description about them. So user can easily chose routing protocol in ad hoc network as per their requirement.

There are many routing protocols used in a ad hoc network. When the network structure is understood right kind of protocol is chosen.

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