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A Location Based Terminode Routing in Manets

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Abstract: **Mobile ad hoc networks basedon multi hop routing where the deployment of the nodes are neither economically nor similar. Therefore the intermediate nodes in a distributed system ought to make sure that the packets are forwarded to their destination. Efficient routing of the packets is a major challenge in the ad hoc networks. The classification is based upon how the routes are determined. There exists three types of routing protocols, Proactive, Reactive, Hybrid and Hierarchical routing protocols to perform the route discovery in dynamic networks. In this paper we are going to present a comparative study of existing routing algorithms for MANET.**

***Index Terms*—MANET, Proactive Routing Algorithms, Reactive Routing Algorithms, Hybrid Routing Algorithms, OLSR, Babel, DSDV, AODV, DSR, IARP, IERP, BRP and terminode routing, multipoint relays**

I. INTRODUCTION

MANET is an infrastructure less network arranged by a collection of wireless nodes that are able to move moving freely. There is no predefined infrastructure such as base stations. All the mobile node acts as an end-system and router. The mobile nodes can communicate directly within their transmission range through wireless link. A multi hop route is required when the destination is apart from the coverage of the sender. Hence routing is a basic component of MANET to get best performance.

A number of routing protocols have been proposed for MANETs during the recent years. Most of these routing protocols can be classified into two categories: proactive protocols and reactive protocols. In proactive approaches, each node will maintain routing information to all possible destinations irrespective of its usage.

Many existing routing protocols, proposed in mobile adhoc networks, are designed in networks with few hundred nodes. They rely on rate concerning all links in the network or links on a route between a source and a destination.

Routing is the way of moving information within an internet work from a source to a host. But some of the intermediate nodes may be encountered due to some reason. Routing is bridged from connecting which may appear to achieve exactly the same thing to the casual observer. The important difference between the two is that connection occurs at the link layer of the OSI reference model, whereas routing occurs at the network layer. The routing and connection with dismillar data which is used in the process of transmission the data from source to the host is provided by this distinction, so the two methods accomplish their tasks in disimillar ways.

Design Issues/Challenges

MANET raises some issues while designing the network topology. Some of the major considerations include:

- Power Consumption, Battery Life and Spatial Reusability
- Symmetric (bi-directional) and Asymmetric (unidirectional) links
- Mobility pattern of nodes
- Scalability
- Quality of Service (QoS)

A routing protocol is the software or hardware implementation of a routing algorithm. A routing protocol uses metrics to select a path to transmit a packet across an internetwork. Various metrics used by routing protocols are:

- Hop count of the network layer devices along the path
- Bandwidth
- Delay
- Load
- Maximum Transmission Unit (MTU)
- Cost (in terms of Energy Consumption and Time)

Table driven or Proactive protocols:

It is an initial process of designing routing protocols for MANET. Each and every node in a network will be consisting of a routing table to establish a connection within the network. So each node must transmit information with other nodes to maintain the routing information up to date and maintaining the table consistency in such a way that no traffic in the network occurs. Thus before traffic any other routes are available means then the packets are sent without delay or else traffic packets must be waiting in queue up to the routing information to the specific destination. To make the routing more efficient the routing entry is attached with a sequence number given by the destination node. Each node that broadcasts information will be containing its new sequence number and for every new

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route node contains the accompanying data. So for each new route a new route the node will be containing the following data.

(i) Number of nodes require to reach the respected destination node
(ii) New sequence number is generated when marked by the destination.
(iii) The address of the destination.

But the most important thing is that for highly dynamic network topology for the proactive protocols require a specific amount of resources to keep the routing information updated and reliable. If the resources are not enough then less number of nodes are suitable, if the number of node is increased then routing overhead problem occurs because of the consumption of most bandwidth in the routing table. We have listed some of the proactive routing protocols with a brief explanation.

Optimized Link State Routing Protocol:

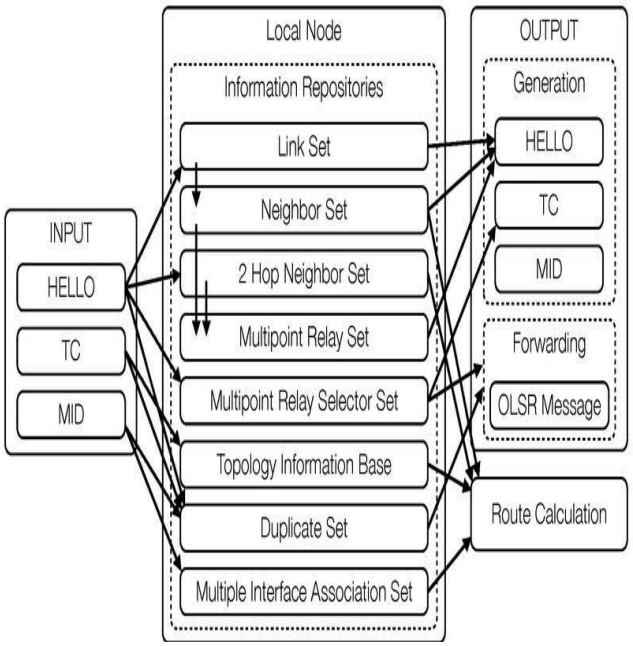
OLSR is a type of proactive routing protocol for ad-hoc mobile networks which inherits the stability of the link-state algorithm. The main advantage of this algorithm is that it has the availability of the routes whenever needed. OLSR is optimized because it reduces the control packet size rather than all links it declares only the subset of the links with their neighbors which are their multipoint relay sectors also it reduces the flooding of the control traffic only by using the multipoint relays to release the messages in the network. This protocol remembers all the destination in the network so that this protocol is suitable for both large and dense networks where more optimization is received comparing to other link state algorithms.

Hop by hop routing is used by the OLSR protocol so that the most recent information to route a packet is used. Even for mobile nodes the packets is successfully delivered by the neighboring node which is also moving with a same speed where the nodal mobility is traced through the local control messages, that is depended upon the frequency of those messages.

Functioning of the protocol:

1. Sensing the neighbor.
2. Multipoint relay selection.
3. Declaration of MPR information.
4. Calculation of routing table.

The performance of a routing protocol is coupled with many factors like physical technology choice, behavior of link layer. OLSR is a proactive (table driven) in nature,



so it favors more number of information and for frequent new route request for destination. The long delay in transmitting the data packets are neglected because this protocol goes in the favor of the application. So OLSR protocol is mainly adopted in large and dense networks where the communication is done between large numbers of nodes.

Destination-Sequenced Distance Vector Protocol:

The DSDV is another type of proactive routing protocol which is been adopted from the RIP (Routing Information Protocol) for ad-hoc networks. In this protocol a new sequence number and attribute is added to each route table and by using a new sequence number the distinguishing of stale routes to new routes can be done easily and preventing the routing loops. In DSDV every mobile node of ad-hoc network will be maintaining a table which gives all the available destinations and a sequence number generated by the destination node and by using these information the packets are routed between the nodes in the ad-hoc network. In dynamicad-hoc network topology, the updates of the routing table is been advertised periodically or when a new information is available for the maintenance of the consistent routing table.

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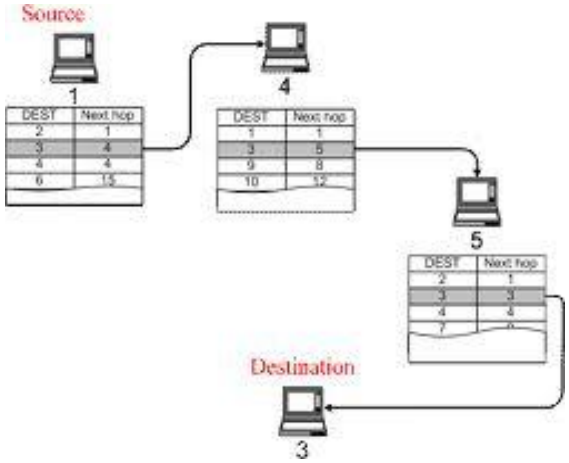


DSDV Problems:

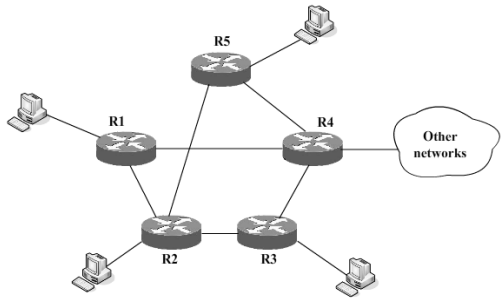
The main concept of DSDV is to address the looping problem of the conventional distance routing vector for ad-hoc networks. But the route frustration occurs because of the standard of route updates. Also DSDV does not solve the unidirectional links problem which is a common problem for all the distance vector routing protocols.

Babel - A loop-avoiding distance-vector routing protocol:

Babel is based on the techniques of DSDV, AODV and EIRGP (CISCO). It is used in highly dynamic routing networks and stable wired networks. Unlike the other distance vector routing protocols it reduces the duration of the routing loops and black holes during convergence. In the presence of mobility Babel is extremely robust, which causes a transient routing loop after an event of mobility occurs before the new topology is been filled all over the network.

Features of Babel:

(i) Efficient and robust on both wired and wireless networks.
(ii) Overlay networks are specifically supported.
(iii) Support for both IPV4 and IPV6 networks.
(iv) Source specific routing are specifically supported
(v) Implementation is simple and can be used for embedded systems.



Limitations of Babel:

Babel is not suitable for some environments because of its two limitations,

(i) It generates more traffic because of periodic routing table updates on large stable networks where other protocols updates only when the network topology changes.

(ii) Babel is not suitable for mobile networks because it forces a hold time when a prefix is retracted, but mobile networks implement the automatic prefix aggregation.

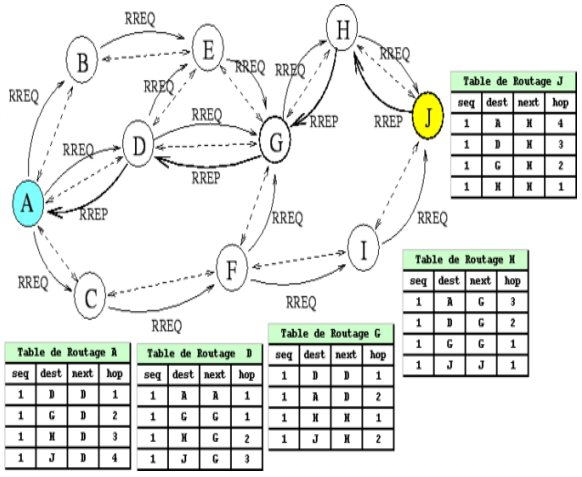
On demand or Reactive protocols:

In a Reactive protocol a node initiates route discovery all over the network only when a packet needs to be sent to a destination. Thus the routes are determined only on demand where it employs a flooding concept, thus a constant route updates of tables is not required in on demand concept for latest route topology. The route discovery process is used by flooding the route request in an on demand routing throughout a network.

Once when a route is been established the route maintenance process will maintain the routes until the destination becomes inaccessible from the source. A route search is required for unknown destination thus communication overhead is completely reduced but some delay in route search occurs. Some examples of on demand routing protocols are Dynamic source Routing (DSR), Ad hoc on-demand distance vector routing (AODV), Cluster Based Routing Protocol (CBRP), Location Aided Routing (LAR), Associativity-Based Routing (ABR), Signal Stability Routing (SSR).

Ad hoc On-demand Distance Vector(AODV):

The AODV is an on demand routing protocol to maintain the routing information which adopts one routing tables and the routes are determined only when needed. Whenever a node receives a request to send a message, the routing table is checked for route existence. The routing table has Address of Destination, Hop Address, SN Destination and Hop Count. The message is simply forwarded to the next hop when the route exists or the message is saved in a message queue and a route request is initiated to determine a route, and it sends the queued message with the routing information.



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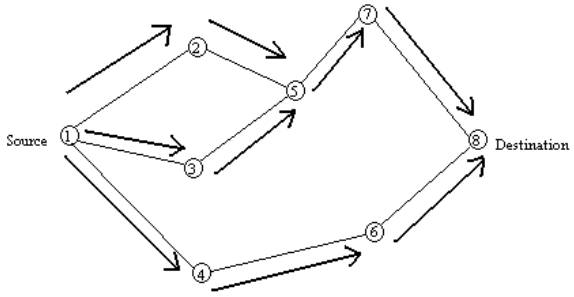
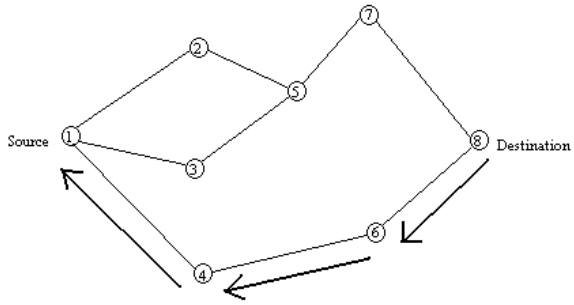


(a) Propogation of Route Request (RREQ) Packet



(b) Path taken by the Route Reply (RREP) Packet

The objectives are:

(i) Packets are discovered only when needed.
(ii) Distinguish between neighborhood detection and general maintenance of topology.
(iii) To widely spread the changes in local connectivity to neighboring mobile nodes which needs those information.

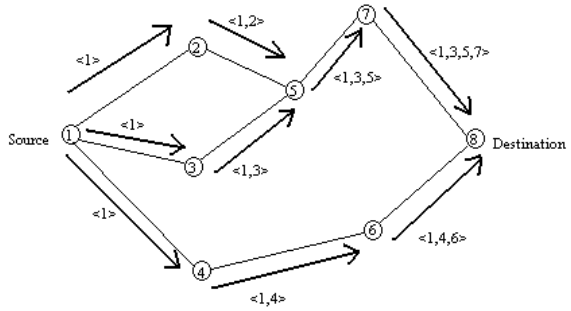
Features of AODV:

(i) Reduces memory requirement and duplications of nodes.
(ii) Broadcast need is reduced.
(iii) Can be used in large number of nodes.
(iv) By the use of destination sequence numbers the loop free routes are maintained.
(v) In active nodes the link breakage is responded quickly.

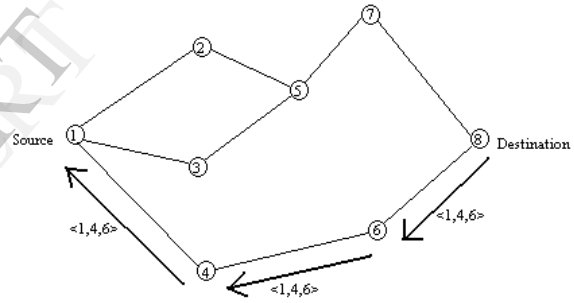
Dynamic Source Routing Protocol (DSR):

The DSR is an efficient and simple routing protocol for ad hoc mobile nodes. The network will become completely self-organizing and self-configuring by using DSR which uses no administration or infrastructure. The nodes (computers) cooperate to communicate with each other to forward the packets and allow multi hop communication with a wireless transmission range. All routing is determined and maintained by DSR since the nodes may join or leave the network. So the topology is very rich and changing rapidly since the sequence or number of intermediate hops to reach the destination may change any time.

A source route is discovered along multiple routes to any destination in a mobile ad hoc networks in DSR protocol and the data packet consists of a completely ordered list of nodes through which it must pass through in its header. So it is completely loop free and also doesn't need any route update information for forwarding the packet. For designing a DSR it must contain less overhead and must be able to react for the quick changes in networks and must use two mechanisms they are, Route Discovery and Route Maintenance. DSR provides a highly reactive service for the successful delivery of packets under any conditions like change in network and node movement.



(a) Building Record Route during Route Discovery



(b) Propogation of Route Reply with the Route Record

Hybridrouting Protocol (combination ofproactive and reactive)

In hybrid ad hoc routing protocol the advantages of both proactive and reactive routing. It is based on Global positioning system (GPS) that allows to easily identify the position far before the table routing does the identification of nodes. Hybrid routing protocol separates the network into many zones where a single zone contain multiple nodes.

Zone Routing Protocol (Zrp)

The ZRP is a combination of both proactive and reactive protocols, when the destination is in the same zone then proactive protocol uses the already stored routing table for packet delivery but when the destination route is outside the origin zone then a reactive protocol checks the successor zone to get information of the destination. This process reduces the route overhead and once the destination zone is confirmed then again the proactive protocol delivers the packet using the pre stored route table.

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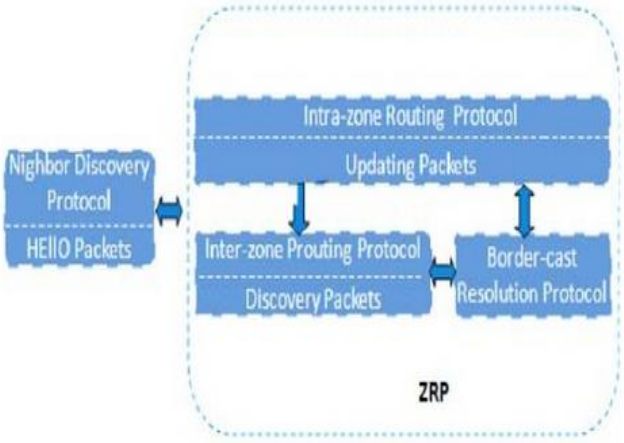
The architecture consists of three approaches they are,



Iarp (Intra Zone Routing Protocol)
It is used to communicate the nodes of interior network of a zone by using proactive routing protocol supports primary routing. Thus the proactive protocol is used and that maintains the route in the zone and updates the routing information where the nodes can be reached locally.

IERP (Inter Zone Routing Protocol)
It is used to communicate with the nodes of different zones by using reactive routing protocol by enhanced route discovery. Also it takes the help of IARP for the local connectivity. BRP (Bordercast routing Protocol) is used to transmit route request to the outlying nodes.

Bordercast Routing Protocol (BRP)
The BRP is used to transmit route request to the outlying nodes by using the topology provided by the IERP for the construction of a bordercast tree. When the route request comes from outside the areas of network, query control mechanism is used.

So the above mentioned protocols for ad hoc routing protocols uses the Proactive or Reactive routing protocol for routing the packets across the network. To increase the efficiency comparing with other routing protocol, Terminode Routing protocol is used based upon Location based routing protocol.

Terminode Routing Protocol:
Terminode routing is used for very large mobile ad hoc networks and each node is called as terminode, which consists of a permanent EUI (End system Unique Identifier) and a temporary LDA (Location Dependent Address).
Terminode is nothing but a combination of two routing protocols: TLR (Terminode local routing) and TRR (Terminode remote routing)
TLR is a mechanism which doesn't use location information for decisions in packet forwarding which allows the destinations are met in the surrounding terminode and uses the local routing tables for close terminodes maintained by the proactive terminode.
TRR is uses geographic information to send remote destinations from which it achieves reduced dependence on the systems which are free. GPF (Geodesic Packet Forwarding) is the method used in TRR which is a greedy method that forwards the packets where the destinations are closer until the location is been reached. The source uses anchored paths when the GPF cannot reach the destination. The anchored path is a fixed list of anchors (geographic points).
FAPD (Friend Assisted Path Discovery):
It is a default protocol for obtaining anchor path based on SWG (Small Word Concepts) which are large graphs which tends to be clustered, sparse, have less diameter. By TLR mechanism every terminodes knows a number of close terminodes which makes the graph highly clustered and thus the terminode has a number of good path maintaining remote friends which are connected to a short short sequence of intermediate vertices. This says that any two terminode is connected with a small number of intermediate friends.
FAPD is made up of two elements FAPDP
(Friends Assisted Path DiscoveryProtocol) and FM (Friends Management).

GMPD (Geographic Map-based Path Discovery): In order to make a terminode work we should identify the towns (areas with high density) and if two towns are connected by a many nodes between them, and are called as Highway that has a high probability where the terminodes will be connected one to another. Thus for each town the position of the center and also a square area size are is given by map and they are presented as a graph which does not change frequently. The modules of TLR protocol are:

CREATION OF SIMULATION ENVIRONMENT

By the proper arrangement of cells and nodes a simulation environment is created which constitutes a map. The cell consists of nodes and the cell consists of large number of nodes. The shape of the cell is a hexagon where each cell comprises of 6 duplicates as its shape around the sending nodes. The Location Routing class is used to develop the simulation environment. The following methods are its class.

- JFrame ( )
- getNode ( )
- getCell ()
- getId ( )
- getadjCount()
- getadjCell()

Addressing Each Node And Cell:
The terminode routing assumes that each routing has a EUI and a LDA which consists of longitude, latitude and altitude. Each node has a unique identity in simulation and each cell consists of a unique identity.
Node class is used to create and addressing the nodes, theclass involves the following methods.

- drawNode()
- setId()
- setXPosition()
- setYPosition()

Cell class is used to create and addressing the cells, the class involves the following methods.

- drawCell()

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- setId()
- setXY()

Finding And Fixing The Anchor Points:
It consists of two methods they are, Friend Assisted Path Discovery and Geographical Map based Path Discovery.

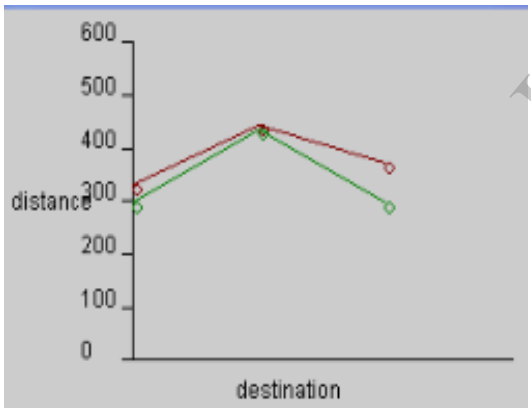
Implementation Of The Algorithm:
It uses the location information to reduce the movement of control messages. Terminode routing uses both Location based routing (TRR) and link state routing (TLR) when the destination is far and close respectively. The Geographic class is used to implement the GMPD and class involves the following methods

- getSource()
- getDesti()
- getDistance()
- findRoute()
- neighbourCount()
- fixAnchor()

The responder class is used to implement FAPD and class involves the following methods

- getSource()
- getDesti()
- getDistance()
- findRoute()
- neighbourCount()

Result And Conclusion



Various routing protocols are compared and analyzed from these our routing protocol Terminode Location Based routing protocol is efficient as per the distance parameter when compared with the Proactive and Reactive Routing Protocol.

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