International Journal of Modern Engineering Research (IJMER)
www.ijmer.com Vol. 3, Issue. 3, May.-June. 2013 pp-1832-1836 ISSN: 2249-6645

EZR: Enhanced Zone Based Routing In Manet

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ABSTRACT: *Proposed system makes use of both proactive and reactive mechanisms. The core idea behind the topic deals with an efficient routing mechanism in MANET. It uses a hybrid scheme that combines the advantages of both proactive and reactive schemes. By dividing the entire network into different zones, we implement the idea of keeping data in source trees in each node and by making use of GPS mechanism we can parallely monitor the speed and co-ordinates of all nodes in the network. Within a zone we are making use of proactive routing mechanism and outside the zone we are implementing a dynamic routing mechanism. The main benefits of this routing mechanism include bandwidth efficiency, less control messages, saving of battery power etc.*

KEYWORDS: *GPS, hybrid, MANET, routing, zone*

I. INTRODUCTION

MANET (MOBILE AD-HOC NETWORK) is a collection of mobile nodes that communicates wirelessly with each other or by relaying other nodes as routers. It doesn't rely on any base station and don't have a fixed infrastructure of their own. Routing in MANET is made possible by hop by hop forwarding. There exists various metrics like number of hops, traffic density for effectively selecting the route to forward the packet. The MANET environment is highly dynamic. So a good routing protocol for MANET was designed by considering the dynamic nature and battery constraint. So a good routing protocol should minimize the computing load on the host and traffic load in the network. There exist several routing protocols in MANET. The most prominent among them are reactive, proactive and hybrid protocols.

In proactive scheme each node maintains complete routing information of the network in routing tables. If there exist any possible change in network topology it broadcasts network status information in the entire network and the routing tables are updated periodically. To maintain up to date status of the network it needs a lot of network resources including memory. It's not suited when the network mobility is high. Examples include Global state routing (GSR), hierarchical state routing (HSR), destination sequenced distance vector routing (DSDV).

In reactive routing protocol each node maintains only information about the active routes in the network. In order to find a new route to destination it need to issue a route request which reduces the communication overhead in proactive scheme. But there exists sufficient delay in route discovery and forwarding of data packet. Examples of reactive protocol are ad-hoc on demand distance vector routing (AODV), Dynamic source routing (DSR), temporally ordered routing algorithm (TORA).Hybrid routing protocols offer an efficient framework that contains the strengths of proactive and reactive routing protocols. Zone routing protocol (ZRP) comes under this category.

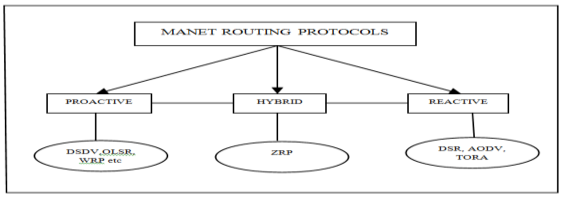

Fig 1: MANET routing protocols

II. RELATED WORK

II.1 STAR: Source Tree Adaptive Routing: The STAR protocol comes under the classification of Proactive routing. Proactive routing protocols maintain their information continuously. A node which is using proactive or table driven protocol has a table which contains information on how to reach other nodes in the network. Changes in the topology are regularly propagated in the network, thereby keeping the table up-to-date. Since STAR uses table driven approach, all routes are already present in routing table. Therefore the latency in finding new routes is low. But the routing overhead is rather high in terms of control messages. The STAR protocol is based on link state Algorithm. But the difference is in periodic updating procedure. The core idea behind the STAR protocol is to maintain a source tree at each node in the topology. A source tree is nothing but connects a node to all the destinations through loop free tree branches. Or source tree can be viewed as a set of links containing preferred paths to different destinations. Also, a source tree is much lighter compared to a routing table.

The STAR protocol can be run by 2 approaches. It is done either by LORA or by ORA approach. The aim of the LORA approach is not to find a shortest path, but instead find paths which are reasonable with respect to some metric. LORA can keep the overhead of routing messages to minimum. STAR also supports ORA approach if required. ORA approach implies that the source trees will be exchanged by the nodes which are the routers only when the router detects a change in the source tree rather than the periodic updating scheme with link state routing. For the purpose of saving transmission bandwidth and energy, only when a router detects changes like possibility of looping, node failure, network partitions etc. It will report changes to the source tree. The deletion of a link to reach at a destination is evident with the addition of a new link to the same destination. So link deletions need not be communicated by the router. Only in case of loss of path to one or more destinations by a router, there is the need of communicating its neighbors. In the STAR protocol, the topology of a network is modelled as a directed graph G=(V,E), where V is the set of nodes and E is the set of edges connecting the nodes. Consider a link between a router u and a destination router v. For this, router u is called the head node of the link in the direction from u to v. By way of exchange of hello messages, link level protocol is assumed that keeps track of neighbourhood information. Each and every node in the network maintains a source tree connecting the router to all destinations in the network that are known to the router. Thereby the router can know about all its neighbours. Through the exchange of source trees with the neighbouring routers, routers can also know about their source trees. The basic update unit used to communicate changes to source trees is the link state update (LSU). An update message will contain one LSU which is used to report the characteristics of a link. An LSU for a link i -> j can be represented as $LSU_{i,j}$ =(i, j, l, t), where i and j are the source and destination routers also l, which denotes link cost and t, the timestamp or sequence number of the last update. To keep track of latest routes, STAR make use of sequence numbers as we already said. Validation of LSU is done with the help of these sequence number. So when a router receives an Link State Update, it can check whether it contain more recent information. This is done by comparing sequence number of the new with that of the link stored locally. Like that a router keeps their own source tree and the source tree reported by its neighbours. This forms a partial topology graph for a router. This partial topology graph is maintained for each and every node in network, thereby STAR protocol need significant memory. Also the processing overhead will be very large when considering a large mobile network.

II.2 DREAM-Distance Routing Effective Algorithm For Mobility : DREAM protocol belongs to the category of proactive routing protocol. It makes use of a GPS system through which it gets an idea of its geographical coordinates. It stores a routing table called location table which is exchanged between the nodes which significantly reduces the bandwidth. But reactive protocol makes use of less bandwidth. So it is better idea to make use of both the ideas and implement a protocol. The control messages which are used in reactive protocols are shorter than the control messages used in proactive protocols. But since the route has to be discovered before sending the data, a delay may also be incurred. Here the mobility of nodes also imposes a big problem .The speed of the nodes also may vary.

The DREAM protocol is a combination of both proactive and reactive protocol. Here the concept is based on zones. There are inter zones and intra zones discovery. If the receiver is within the zone at a distance <=k from the sender, then an intra-zone discovery is done which is based on proactive way. If it locates in another zone different from that of the sender, then it uses a reactive way. The choice of the zone is static which is based on node movement. When a source node S wants to send information packets to a destination node D, it retrieves the location information of D stored within it location tables. Using this location information as a reference, S determines those nodes amongst its neighbours who are "in the direction" of D, and forwards the message packet to them. On receipt of this information packet, the intermediate neighbouring nodes in turn perform a lookup into their location tables to retrieve the location entry for the destination D. The intermediate nodes in turn forward the message packet to those nodes, amongst it neighbours who are in the direction of D, similar to S. This process continues until the destination D is eventually reached. This effectively results in using a reactive approach, as individual nodes in the path determine the next hop in an on-demand manner. In the DREAM algorithm, each node participates in the transmission of control messages containing the current location of a particular node to all other nodes within the network, in the form of Location Update messages. The frequency of such updates is determined by the distance factor and mobility rate of each node.

The advantages of the DREAM protocol are as follows:

1) It efficiently uses the bandwidth and the energy since the control message carries only the coordinates and the identifier of a node.
2) It is inherently loop-free, as each data message propagates away from its source in a specific direction.
3) It is robust as the messages reach the destination by following specific paths.
4) It is adaptive to mobility.

II.3 LAR-Location Aided Routing: Reactive protocols are better preferred compared to proactive since it maintains the active routes and a new route is discovered only on demand. Reactive protocols are divided into two categories: source routing and hop-by-hop routing Source routing maintains a route to forward the packet to destination which is a major drawback in large network. On the other hand the hop-by-hop routing depends on the routing table in each node to forward the message. Here the header contains the destination and next hop address only.

LAR mainly based on the concept of flooding and location awareness node knows its position by means of a GPS. Here the sender forwards a message to destination containing its id and id of destination by means of flooding algorithm. The neighbour node on receiving it forwards the message to its neighbour and so on. If a node receives duplicate message (recognized by checking the sequence number) it discards any one of them to save the bandwidth. Each neighbour node appends its own ID to the message header and forwards it further to destination through the active routes. Destination on receiving it resends a Route reply along the route in the message header or piggybacks it with another route request to the source. In LAR the source node calculates the expected zone to flood the packet. If the source node knows more mobility information of the destination node the size of the expected zone can be reduced which helps to increase the performance. Each node defines a request zone to forward the route request. All the nodes in that region receive the route request packet. The request zone includes the expected zone and possible surroundings around it. A time-out period is set by each node in the network. If the route is not discovered before time-out, the source node will consider expanded request zone and forwards route request again. To optimize the route discovery process collects information from an intermediate node which contains best location information to the destination node (assuming that source information is out of date compared to intermediate node).

LAR mainly focuses on reducing the control message overhead of Ad-hoc on-demand distance vector (AODV) routing protocol. It floods only the portion of the message that contains the route to destination. So the bandwidth of the network can be saved by using this approach. The main drawback of this approach is that every node should know the speed and location of the destination node and it can't dynamically learn about the neighbour nodes in the network.

III. PROPOSED SYSTEM

Proposed system makes use of both proactive and reactive mechanisms. When a network is newly initialized, by the use of hello messages a node comes to know about its neighbours. Each node knows about the nodes in the network by means of GPS, thereby it can monitor both its speed and coordinates. The collected information is then stored in a tree called source tree. A source tree is maintained for each and every node in a network. Source trees are exchanged only when the router detects a change in the network.

The basic update unit used to communicate changes to source trees is the link state update (LSU). An update message will contain one LSU which is used to report the characteristics of a link. An LSU for a link I -> J can be represented as $LSU_{I,J}$ =(I, J, L, T), where I and J are the source and destination routers also L, which denotes link cost and T, the timestamp or sequence number of the last update. Validation of LSU is done with the help of these sequence number. So when a router receives an Link State Update, it can check whether it contain more recent information. This is done by comparing sequence number of the new with that of the link stored locally. A source tree is much lighter when compared to a routing table. We can make use of Dijiksra's algorithm in source tree to find shortest path between nodes.

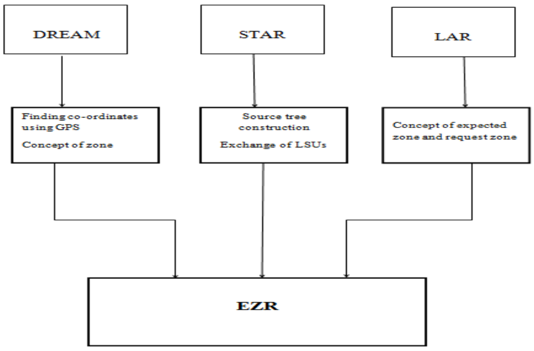

Fig 2: The EZR protocol

When a source node wants to transmit data to destination, first of all source node needs to define a zone. Zone is defined with a radius which can be calculated with the formula Displacement=Speed * Time. That is R=speed*(t1-t0), where speed is the average speed of the destination, t0 is the time in which speed is calculated and t1 is the time in which source node is trying to send the data.

Proposed system makes use of request zone and expected zone to forward the data from source to destination. The zone defined by the source is equivalent to its request zone where the expected zone is one in which the destination resides. For this first the source node check whether the destination is in the request zone. If yes, then with the help of immediate neighbours, it will forward data to the destination. If the destination lies outside the zone, then we can expand the request zone in the direction of destination by including the nearest neighbour of the request zone. Then the node in the boundary of a zone forwards the route request to the nearest neighbour. And finally it reaches the destination. So when the destination sent route reply, it also includes the public key of the destination. For security, data is encrypted with that public key and at the destination; it decrypts the data with the private key of destination.

III.1 Algorithm: STEP 1: Initialize Total number of nodes in the network.
STEP 2: Obtain geographical co-ordinates of the node with GPS.
STEP 3: Broadcast hello messages to nodes in zone.
STEP 4: Receive Hello message.
STEP 5: Each node creates source tree.
STEP 6: All nodes initialize sequence number of links to 0.
STEP 7: Stores the co-ordinates, neighbor node id and link state information with sequence number in source tree.
STEP 8: If an event occurs, exchange LSU's.
STEP 8.1: If Sequence number of new LSU > Sequence number of link information, then goto step 8.1.1
STEP 8.1.1: Update source tree.
STEP 8.2: Else, discard LSU.
STEP 9: If Source wants to transmit final destination, then goto step 9.1
STEP 9.1: Define request zone with radius R= Speed*(t1-t0).
STEP 10: If destination is within the request zone, then goto step 10.1
STEP 10.1: Then forward the data directly.

STEP 11: Else, expand request zone in the direction of destination.
STEP 11.1: Define expected zone containing destination node.
STEP 11.2: Forward RREQ to nearest neighbor within the border of request zone.
STEP 12: Destination receives RREQ.
STEP 13: Destination sends RREP with its public key.
STEP 14: Source sends data encrypted with public key of destination.
STEP 15: Stop.

IV. SIMULATION RESULTS

We simulated the protocols DSDV, DSR and EZR using network simulator NS2 for 8 nodes. We analysed the packets dropped in each protocol using AWK script. And the results we obtained are
DSDV: 154222
DSR: 132464
EZR: 101605

The simulation results of 3 protocols are shown in figure 3, 4, 5. And the graphical analysis of packet dropping is plotted in figure 6. When we analysed the graphical result, the EZR which we proposed outperforms the other two.

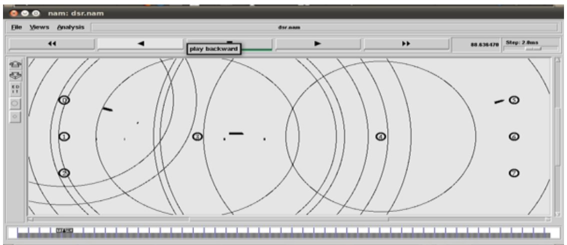

Fig 3: DSDV Protocol

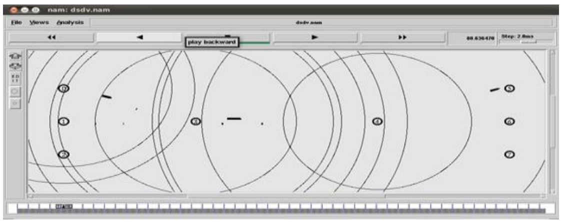

Fig 4: DSR Protocol

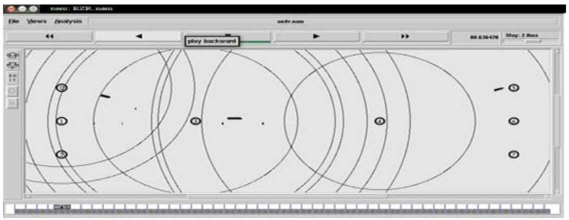

Fig 5: EZR Protocol

Fig 6: Comparison of DSDV, DSR, EZR

V. CONCLUSION

In this paper, 3 routing protocols of MANET are compared. And also by overcoming almost all disadvantages we proposed a new routing scheme. The compared protocols are STAR, DREAM and LAR. The core idea behind the STAR protocol is to maintain a source tree at each node in the topology. A source tree is nothing but connects a node to all the destinations through loop free tree branches. By the proper exchange of source trees, routers can know about their neighbours. The basic update unit used to communicate changes to source trees is the link state update (LSU).

In DREAM, using GPS a node's location co-ordinates are found out. Then through the exchange of these on the basis of expected destination's direction data is sent. This scheme is actually a combination of reactive and proactive routing mechanisms. Here control messages are less. Also this is having high bandwidth efficiency and is also robust. LAR is a reactive scheme, which is on demand. Flooding and Location awareness by GPS are 2 schemes for sending data. This scheme is also bandwidth efficient.

Proposed system makes use of both proactive and reactive mechanisms. When a network is newly initialized, by the use of hello messages a node comes to know about its neighbours. Each node knows about the nodes in the network by means of GPS, thereby it can monitor both its speed and coordinates. The collected information is then stored in a tree called source tree. By dividing the entire network into different zones, we implement the idea of keeping data in source trees in each node and by making use of GPS mechanism we can parallely monitor the speed and co-ordinates of all nodes in the network. Within a zone we are making use of proactive routing mechanism and outside the zone we are implementing a dynamic routing mechanism. The main benefits of this routing mechanism include bandwidth efficiency, less control messages, saving of battery power etc. From simulation results, EZR is having high performance than DSDV and DSR routing protocols.

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