A Review Paper on Ad-hoc Routing Protocols AODV FZRP and SLURP

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ABSTRACT
Mobile Ad hoc Network (MANET) represents a system comprised of a collection of nodes in motion that are arbitrarily located so that the interconnections between nodes changes dynamically. In MANET,mobile nodes tends to form a temporary network without the use of any existing centralized administration or network infrastructure . A routing protocol is used to find the routes between mobile nodes so that the communication within the network can be facilitated. The main goal of an ad hoc network routing protocol is to establish an effective and accurate route between a pair of mobile nodes so that messages delivered within the active route timeout interval. Route should be discovered and maintained with a minimum of overhead and bandwidth consumption .Broadly ad hoc network routing protocols are divided into three categories –Reactive ,Proactive and Hybrid routing protocols This paper reviews and discusses the three routing protocols Ad-hoc On-Demand Distance vector(AODV),Fisheye Zone Routing Protocol(FZRP) and Scalable Location Update based Routing Protocol(SLURP) .

General Terms
MANET, AODV,FZRP,SLURP

Keywords
Protocol,Manet,Routing,aodv,fzrp,slurp,fisheye,bordercasting, scalability,reactive,proactive,hybrid,dynamic- topology.

1. INTRODUCTION
Ad hoc networks are self-organizing and configuring wireless networks consisting of radio-equipped nodes that may be stationary or mobile. Nodes of these networks function as routers which discover and maintain routes to other nodes in the network. These networks provide connectivity in areas where construction of infrastructure is difficult or expensive Applications areas for these types of networks include military applications, casual conferences, meetings, virtual classrooms, emergency search-operations, disaster relief operations, automated battlefield and many more. The nature of changing topology in MANETs i.e. dynamic nature introduces problems in end-to-end route finding Hence Networking mechanisms such as routing protocols for MANETs require more efficient protocols than the protocols used in wired networking and Routing packets in ad hoc networks is a challenge because of the constantly changing topology of the network due to node mobility.

2. FEATURES OF AD HOC NETWORKS
The nodes in an ad hoc network act as routers in order to exchange the data packets between a pair of nodes and are equipped with wireless transmitters and receivers by using antennas, which might be highly directional (point-to-point), omnidirectional(broad-cast),some combination or probably steerable. At a given instant, depending on positions of nodes, coverage patterns of their transmitters and receivers, co-channel interference and levels and communication power levels, a wireless connectivity exists in the form of a random multihop graph or an "ad hoc" network forms among the nodes. This ad hoc topology might be changed with time as the nodes move [4].

Some more characterstics[1] of these networks are as follows:

1. Constantly or dynamically changing network topology
Due to mobility of the nodes, the change in topology is rapid and dynamic in nature[9].The connectivity of the several nodes may change with time and dynamically establish routing among them as they move about.

2. Inferior link capacity
The scalability, reliability, capacity and efficiency of the wireless links are often inferior when compared with the link establishment in the wired networks. Several sessions of route finding can use one end to end path .In Ad-hoc network, communication is done by terminals through which channel is subject to fading ,noise, interference and has less bandwidth than a wired network. This shows the fluctuating link bandwidth of wireless links.

3. Autonomous behavior
In MANET, each node acts as both host and router[9]. It means that node has the ability of a host and can also perform functions as a router so endpoints and switches are indistinguishable.

4. Multi-hop transmission
For a message, when a source node and the destination node is out of the transmission range, the MANETs Capability of multi-hop transmission can be of great use. Data packets to be sent from a source to its destination but are out of the direct wireless transmission range so the packets can possibly be sent or forwarded through one or more intermediate nodes.

5. Distributed nature of operation
As a centralized control is absent in MANET, the control and operations of the network is distributed and divided among the nodes. To implement many functions mainly routing and security the nodes should collaborate

6. Symmetric environment

All nodes have identical features with similar responsibilities and capabilities. Every node can function as a router or as a host and hence it forms completely symmetric environment.

7. Light weight feature

Mobile devices or MANET nodes with less CPU processing capability, and low power storage and small memory size.

8. Absence of Infrastructure

This is the most important feature of Ad-hoc networks so they are supposed to operate regardless of any fixed infrastructure or centralized access as base-stations in wired networks

3. ROUTING PROTOCOLS IN AD HOC NETWORKS

Routing protocol is an algorithm that specifies how used to control how nodes decide to which way the packets will be routed between computing devices in a mobile ad hoc network .In MANET, nodes are not aware about the network topology so they have to search it .There have been presented different types of routing protocols in MANET,each of them is applied according to the network condition.Figure1 shows the basic classification of the routing protocols in MANETs.

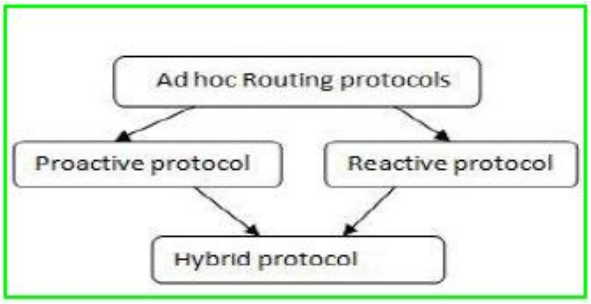

Fig :1 Classification of Routing Protocols

3.1 Classification Of Ad Hoc Routing Protocols

Existing routing schemes for MANET can be classified into three categories according to different design philosophies: (1) Proactive, (2) Reactive or On-demand, and (3) hybrid schemes.

3.2 Proactive Routing Protocols

Proactive routing protocols are also referred to as table-driven .In this each node maintains a routing table which contains the topology of the network even without requiring it. Whenever the network topology changes the routing tables are updated [12]. Proactive protocols need to maintain entries for each and every node in the network so they are not appropriate for large networks .There are various types of proactive routing protocols. Example: DSDV, OLSR,WRP ,FSR etc

Disadvantage-

To keep the up-to-date routing information proactive schemes use a large portion of the bandwidth Because of fast node mobility, the route updates may be more frequent than the route requests, and most of the routing information is never used so some of the bandwidth is wasted. [1] [10]

3.3 Reactive Routing Protocols

Reactive routing protocol are on-demand routing protocol. In this type of protocol, route is discovered whenever it is needed. Nodes initiate route discovery process when demanded not without requiring as it is done in table driven. A source node initiates a route discovery process so as to acquire a route. Reactive routing protocol has two major components:

- Route discovery
- Route maintenance

1) *Route discovery*- Source node initiates the route discovery process whenever demanded.

2) *Route maintenance*- Due to the dynamic topology of the network possibility of the route failure between the nodes arises due to link breakage etc, so route maintenance is required. Reactive protocols have acknowledgement mechanism due to which route maintenance is possible. There are a list of reactive routing protocols presented in past years, some of them are: DSR, AODV, TORA and LMR etc.

Disadvantage –

As routes are not predefined in reactive schemes Reactive route search procedure may involve significant more time due to global flooding .This delay makes reactive routing less suitable for real-time traffic.

3.4 Hybrid routing protocols

This protocol is a combination of both proactive and reactive routing protocols. Proactive routing schemes provide fast route acquisition that is less latency but have more overhead while reactive protocols have less overhead and more latency[4]. Thus a Hybrid protocol ineeded to overcome the shortcomings of both proactive and reactive routing protocols. By using on demand mechanism of reactive protocol and the table maintenance mechanism of proactive protocol as to avoid latency and overhead problems in the network hybrid routing protocol covers both the schemes effectively .It is suitable for large networks where a large number of nodes are present. In this approach ,a set of zones are created by dividing the large network where routing inside the zone is done by using proactive approach and outside the zone routing is done using reactive approach .Some of the hybrid routing protocols for MANET are ZRP, FZRP ,SLURP etc.

4. PROTOCOLS STUDIED AODV,FZRP AND SLURP

4.1 AODV

Ad hoc On Demand Distance Vector (AODV) [3] routing protocol is a reactive routing protocol designed for ad hoc mobile networks. It is also known as source-initiated routing protocol as it builds the routes between the nodes only when demanded by the source nodes for transmitting data packets. By using the "sequence numbers" on route updates to ensure the freshness of routes, it avoids the counting-to-infinity problem [4]. As it is reactive routing protocol so AODV basically involves two components1)*Route discovery* and 2) *Route maintenance*.

For discovering routes, route request (RREQ) and route reply (RREP) messages are used and for route maintenance HELLO messages and route error (RERR) messages are used. Routing table is maintained at each node that contains the path to destination node. In case if route to a destination node for which it does not already have a route, route discovery and route request (RREQ) message broadcasted across the network by source node . On receiving the RREQ message each node updates the information regarding source node. A reverse path is set up in case a node re-broadcasts a route

request, pointed by the source nodes in the route tables. The RREQ message contains source node's IP address, destination node's IP address, broadcast ID and current sequence number and, the last known (most recent) sequence number for the destination of which the source node is aware. is also contained in it. When RREQ message is received at each intermediate node ,a route is created to the source node. This RREQ message is re-broadcasted if the receiving node is not the destination node and does not have a route to the destination. The node receiving the RREQ might send a route reply (RREP) either it is the destination or it has a route to the destination with a sequence number greater than or equal to that already contained in the RREQ. If this case arises, a RREP back message is unicasted to the source in a hop-by-hop fashion. The route request's source IP address and broadcast ID is recorded by each node. If already processed RREQ is received by any node, It will discard the RREQ and do not forward it further .The next hop to destination is also recorded by the intermediate nodes forwarding the RREP Forward links to the destination are setup when RREP travels along the reverse path to the source. The source node saves the route to the destination and when it receives the RREP then can begin forwarding the data messages to the destination node. Due to route discovery process the sending of the data messages is delayed to the destination. If the source node later receives a RREP containing a greater sequence number or contains the same sequence number with a smaller hop-count, it may update its routing information for that destination node and begin using better route.

4.2 FZRP

Fish Eye Zone Routing Protocol (FZRP)[5] is an extension of

Zone Routing Protocol (ZRP) a hybrid routing protocol adopting the concept of Fisheye State Routing (FSR)-a hierarchical proactive routing protocol .

FSR uses the "fisheye" technique proposed by Kleinrock and Stevens[14] to reduce the size of information needed to represent the graphical data. The eye of a fish captures the pixels near the focal point in high detail and as the distance from the focal point increases the detail decreases. In routing, the fisheye approach is used to maintain the accurate distance and path quality information about the immediate neighborhood of a node.

Zone Routing Protocol(ZRP[7] is a hybrid routing protocol combines two completely different routing methods into one protocol that is proactive and reactive.ZRP combines the advantages of the proactive and reactive approaches by maintaining an up-to-date topological map of a zone that is each node maintains a current view of a surrounding region that is referred to as a routing zone. Routes are immediately available within the zone. For destinations outside the zone, ZRP employs a route discovery procedure, which can benefit from the local routing information of the zones.

By adopting the idea of Fisheye State Routing in ZRP, a more efficient protocol called Fisheye Zone Routing Protocol (FZRP) was proposed by Chun-Chuan and Li-Pin Tsang .FZRP provides the advantage of a larger zone with only a little increase of the maintenance cost. Two levels of the routing zone are defined in FZRP:

Basic zone : the inner level of the routing zone

Extended zone : the outer extension of the basic zone

Figure 2 shows the case of a basic zone with 2-hop radius and an extended zone with 4-hop radius.

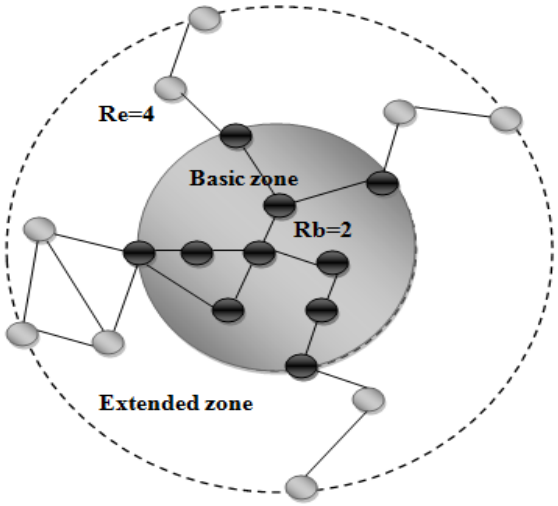

Fig : 2 Two-level routing zone in FZRP

4.2.1 Zone maintenance

Various updating frequencies of changes of link connectivity are associated with the basic zone and extended zone .Basic zone is maintained by transmitting the timely updates of link state to all the nodes in the basic zone by each and every node. A Reduction factor F ($0 < F < 1$, e.g. $F = 1/4$) is defined in FZRP to reduce the frequency of transmitting updates in the extended zone and F is same for basic zone as well .Figure 3 shows the idea of using different updating frequencies for different levels of zone. The radius of the basic zone is RB and the radius of the extended zone is RE in Figure 2.

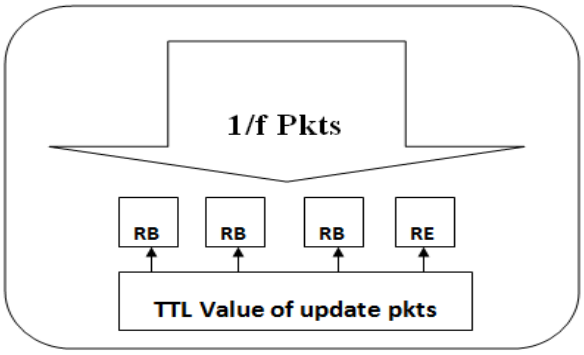

Fig: 3 TTL value in update packets of FZRP

To limit the spreading of the packets TTL(Time-to-Live) field is used in FZRP. A mobile node broadcasts an update packet with a proper TTL value on detecting a change of link connectivity The value of TTL is usually set to *RB* to cover the basic zone.

4.2.2 Table maintenance

Each node maintains the routing table/information in FZRP includes two types of entries:

1) Entries for those nodes (hop count <= *RB*) in the basic zone, and

2) Entries for those nodes (*RB* < hop count <= *RE*) in the extended zone.

4.2.3 Route Acquisition

A source node sends out a route query packet to find an end-to-end route and waits for the reply from the destination. Rather than just simply flooding the queries from a node to all

its neighbors knowledge about routing zone topology can be used to direct the route queries from a node to its peripheral nodes. This kind of packet delivery mechanism is called *bordercasting*

Now in FZRP same mechanism is followed .A source mobile node sends out a route finding request. Until the destination node is reached the intermediate nodes in the MANET forward(bordercast) route requests to other nodes .The destination node sends a reply back to the source node after receiving the route request and an end-to-end route is established. In FZRP, each intermediate node bordercasts the route query to the peripheral nodes(The most distant (in hops) nodes of each routing Zone) of its extended Zone .the bordercasting mechanism explained earlier needs to be changed to support the FZRP in following ways :

1) When the destination node of the route query is not found in the routing table Bordercasting is performed Each node on the path of bordercasting must also check whether the destination node is within its zone (including basic and extended zone). If it is present, the bordercasting process stops, and the route query is forwarded to the destination node directly.

2) There are cases that before the bordercast packet reaches the peripheral node, the TTL value of this packet becomes zero In such cases, the final mobile node receiving the query packet substitutes the peripheral node and continues the bordercasting.

4.3 SLURP

Scalable Location Update based Routing Protocol(SLURP)[6] was proposed by Seung-Chul M.Woo and Suresh Sing to overcome the problem of scalable routing in ad hoc networks. In large networks where nodes travel at high speeds, the fresh routing information for source–destination pairs seems to become stale or old because longer paths have a shorter time to failure (a path fails when any link on it breaks). Similarly, the time to path failure is shorter in networks where nodes travel at higher speeds. In both of above said case, caches (for routing information) lifetime's have also shortened which implies that finding or maintaining accurate routing information can be costly So the approach behind developing this scalable routing protocol was to constantly maintain the *approximate* location information about nodes present in the network and to only find the accurate routes to specific nodes when there are packets to be sent to them

Basic approach of SLURP

When a source node needs to send a packet to some destination, it first determines the destination's approximate location and after that uses a simple geographic routing protocol to send the packet to the destination. This two-phase approach in SLURP reduces the cost of maintaining the routing information while, simultaneously providing the ability to find the good routes inexpensively when required.

Thus, This algorithm, SLURP is based on a combination of:

(1) *Location management*

- *Simple static mapping*
- *Location tracking algorithm*

(2) Approximate geographical routing

4.3.1 Location Management

In SLUR ,geographic location of a node is found out first by using a Location tracking algorithm and keep it maintained

Static mapping

In ad hoc network the geographical area is divided into rectangular regions of dimension $a \times b$ for SLURP to work. All of these home regions are supposed to have well-defined IDs that are concatinated with x and y coordinates. It is assumed that there exists a *static mapping* f that maps a node's ID into a specific region (called its *home region*)

$$f(\text{Node ID}) \rightarrow \text{Region ID}.$$

F is a many-to-one mapping that is static and known to all nodes of the ad hoc network.

Location tracking algorithm

Step 1.*Mobility triggered updates.* A mobile node always informs its neighbors or the nodes currently present in its home region about its location. When the node moves out of its current region into a new one only then this information is updated.

Step 2.*Update in home region.*

When a node moves out of one region to another it sends location update message to it home region and then that location update message is broadcast to all nodes in the home region.

Step 3.*Locating a node.*

Suppose a node S needs to send packets to D. It needs to determine D's current location first. So, S uses f to find the home region of D and sends a message to the region in which D resides enquiring about D's current location. The first node that region receiving this message responds with D's current location.

4.3.2 Approximate Geographical routing

This is a geographic location management strategy to keep the knowledge about the approximate geographic location of the nodes present in the network and it keeps the overhead of routing packets relatively small. Nodes are assigned home regions and all nodes within a home region supposed to know the approximate location of the registered nodes. Nodes send location update messages to their home regions as they travel from one region to another and this information is used to route data packets.

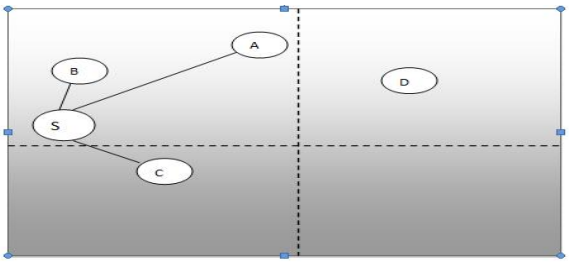

Fig : 4 an example of MFR

Figure 4 shows the working of MFR suppose there are 5 nodes present in 4 regions say nodes are S,A,B,C and D .Nodes S,A,B are present in one region and C in different and D in other one respectively .here is a example how MFR works suppose node S needs to send a packet to D. It has three neighbors, A, B and C. Out Of these three neighbors it selects

A as its next hop because A is closest (in physical distance) to D.

5. CONCLUSION

In this paper, we have described the infrastructure less Mobile Ad-hoc networks(MANET) and discussed the characteristics or features and applications of MANET have discussed that help us to understand more about MANET. The paper also provides a review of the the classification of routing protocols according to the routing strategy the i.e. proactiv ,reactive or hybrid including their advantages and disadvantages. we have presented a brief comparison of the three routing protocols i.e. AODV,FZRP and SLURP .AODV is found to have suited for the small networks with the on-demand scheme but with more latency in finding accurate routes . Fisheye Zone Routing Protocol (FZRP) combines the zone routing protocol with the idea of Fisheye state Routing . in which two levels of routing is defined ,the basis zone and the extended zone FZRP is found to be more efficient than ZRP in route finding with only a little increase of the maintenance overhead. SLURP is suitable for larger zone The specific properties that make SLURP so well-behaved is the use of location tracking to maintain approximate location information for nodes in the network.

defined.

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