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# A Survey on Reactive Protocols in Mobile Ad Hoc Networks

**M.Chandrika**
M.Tech student, Dept.of CSE,
Sree Vidyanikethan Engg.College
Tirupati.AP,INDIA.

**N.Papanna**
Assistant Professor, Dept.of CSE,
Sree Vidyanikethan Engg. College
Tirupati.AP,INDIA

***Abstract- Mobile Ad Hoc Networks (MANETs) are self-organizing and self-configuring multihop wireless networks, and the topology of the network changes dynamically. This is mainly due to the mobility of the nodes. Most existing Proactive routing protocols should maintain a routing information in the network at all times all nodes. It may achieved by table driven routing information distribution and regular distribution of updated routing information. These are well suited for a small-scale with high mobility. Here the problem is high routing overhead in mobile ad hoc networks. We driven this issues, propose the reactive routing protocols. Reactive routing protocols are well suited for a large-scale with moderate or low mobility. This paper provides an overview of reactive protocols (E.g.: AODV, DSR, TORA, LAR).***

***Keyword-*** ***MANETS, routing protocol, AODV, DSR, TORA, LAR, unicast routing.***

## 1. INTRODUCTION

"Wireless networking is a technology that enables two or more computers to communicate using standard network protocols, but without network cabling". And now there exist network protocols that are developed just for the purpose of Wireless networks. wireless network can be classified into two types: Infrastructured or Infrastructure less. One was **Infrastructured wireless** networks**,** the mobile node can move while communicating, the base stations are fixed and as the node goes out of the range of a base station.

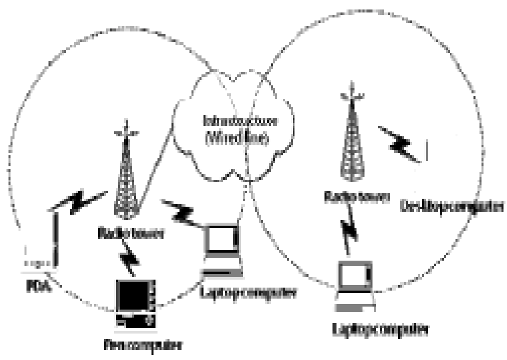


Fig.1. Infrastructured wireless networks.

It gets into the range of another base station. depicts the Infra structured wireless network as shown in fig.1.second as **Infrastructure less or Ad Hoc wireless network**, the mobile node can move while communicating, there are no fixed base stations and all the nodes in the network act as routers. Infrastructure less networks are shown in fig.2. Mobile users are provided with access to real-time information even when they are away from their home or office.

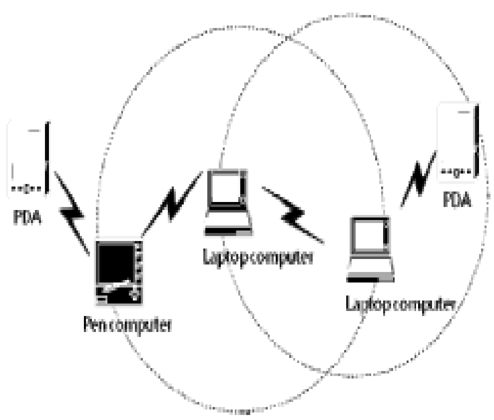


Fig.2. Infrastructureless Wireless Networks.

 

## 2. MOBILE AD-HOC NETWORK (MANET)

A Mobile Ad-hoc Network (MANET) is a temporary wireless network composed of mobile nodes, in which an infrastructure is absent. Nodes in these networks utilize the same random access wireless channel, cooperating in a friendly manner to engaging themselves in multihop forwarding. The nodes in the network not only acts as hosts but also as routers that route data to/from other nodes in network [2].

The main features of MANET are listed some as below [3]:

a. MANET can be formed without any preexisting infrastructure.
b. It follows dynamic topology where nodes may join and leave the network at any time and the multi-hop routing may keep changing as nodes join and depart from the network. It does have very limited physical security, and thus increasing security is a major concern.
c. Every node in the MANET can assist in routing of packets in the network.
d. Limited Bandwidth & Limited Power.

Routing protocols can be divided into fallowing categories:

(1) Unicast routing protocols
  a. Topology-based routing protocols
    • Proactive routing protocols
    • Reactive routing protocols
    • Hybrid routing protocols
b. Geographical-based routing protocols
(2) Multicast routing protocols
(3) Broadcast algorithms

Here, in this many kinds of routing protocols competing for unicast, multicast and broadcast communication for the MANET, for example proactive and reactive routing protocols. If the mobile nodes in the MANET move too quickly, they have to resort to broadcast to achieve peer-to-peer communication. In a summary, every routing protocol has its strengths and drawbacks, and aims at a specific application. As a result, the prospective standard for routing protocols in the MANET is very likely to combine some of the most competitive schemes. This survey studies most of typical routing protocols for MANETs. We present an overview of the application scope, procedures, advantages, and disadvantages of different unicast routing schemes for reactive protocols in section3, respectively. Section4 performance metric and section5 concludes the survey.

## 3. UNICAST ROUTING PROTOCOLS

Most applications in the MANET are depends upon unicast communication. Thus, the most basic operation in the IP layer of the MANET is to successfully transmit data packets from source to destination. The forwarding procedure is very simple in itself: with the routing table, the relay node just uses the destination address in the data packet to look it up in the routing table. If the longest matching destination address is found in the table, the packet is sent to the corresponding next hop. The problem that arises is how the routing table is built in the nodes in the MANET. Many routing protocols have been proposed that utilize all kinds of mechanisms to offset the impact introduced by mobility.

### *3.1. Reactive unicast routing protocols*

The dynamic topology of the MANET, the global topology information stored at each node needs to be updated frequently, which consumes much bandwidth. However sometimes is a waste of bandwidth, because the link state updates received expire before the route between itself and another node is needed. The concept reactive routing protocol is proposed[4].This approach is different from table driven routing process is completed once a route is found or all possible route permutations have been examined. Once a route has discovers and established. It can be maintained by some form of route maintenance procedures until either destination becomes in accessible along every path from the source. If a node wants to send a packet to another node then this protocol searches for the route in an on-demand manner and establishes the connection in order to transmit and receive the packet [5]. The route discovery usually occurs by flooding the route request packets throughout the network.

Examples of reactive protocols are:

1) Ad hoc On-demand Distance Vector Routing (AODV).
2) Dynamic Source Routing (DSR).
3) Location Aided Routing (LAR).
4)Temporally Ordered Routing Algorithm (TORA).

#### *3.1.1. Ad hoc On-demand Distance Vector Routing (AODV)[6][7]*

AODV described in build on the DSDV algorithm. AODV is improvement on DSDV. It is typically minimizes the number of required broadcasts by creating routes on on-demand basis as DSDV opposed to maintaining a complete list of routing. It aims to minimize the requirement of system-wide broadcasts to its extreme. It does not maintain routes from every node to every other node in the network rather they are discovered as and when needed and are maintained only as long as they are required. AODV for establishment of unicast routes are explained below.

#### *A. Route Discovery*

AODV nodes that are not on a selected path do not maintain routing information or participate in routing table exchanges. Here source node wants to send a message to some destination node and does not already have valid route to that destination. Node can initiates a path discovery process to locate the other node and broadcast a route request packet to its neighbors, forward the request to their neighbors and so on. Until either the destination is located. AODV uses destination sequence number to ensure that all routes are loop-free and contain the most recent route information. Each node maintains its own sequence number and broadcast id. The broadcast id is incremented for every RREQ. The node initiates and without interruption the node IP address uniquely identifies an RREQ. During the process of forwarding the RREQ, intermediate nodes record in their route tables. The address of neighbors from which the first copy of the broadcast packet was received, to establish a reverse path. If additional copies of the same RREQ are later received. These packets are silently discarded. The destination node responds by unicasting a routing a route reply packet to the neighbor from which received the RREQ node along this path setup forward route entries in their route tables that point to the node from RREP. RREP is forward along the path establish by an RREQ.

***B. Route Maintenance***

A route discovered between a source node and destination node is maintained as long as needed by the source node. Since there is movement of nodes in mobile ad hoc network and if the source node moves during an active session, it can reinitiate route discovery mechanism to establish a new route to destination. Conversely, if the destination node or some intermediate node moves, the node upstream of the break initiates Route Error (RERR) message to the affected active upstream neighbors/nodes. Consequently, these nodes propagate the RERR to their predecessor nodes. This process continues until the source node is reached. When RERR is received by the source node, it can either stop sending the data or reinitiate the route discovery mechanism by sending a new RREQ message if the route is still required.

***C. Benefits and Limitations of AODV***

The benefits of AODV protocol responds very quickly to the topological changes that affects the active routes. AODV does not put any additional overheads on data packets as it does not make use of source routing. And it favors the least congested route instead of the shortest route and it also supports both unicast and multicast packet transmissions even for nodes in constant movement. The limitation of AODV protocol is that it expects/requires that the nodes in the broadcast medium can detect each others' broadcasts. It is also possible that a valid route is expired and the determination of a reasonable expiry time is difficult. The reason behind this is that the nodes are mobile and their sending rates may differ widely and can change dynamically from node to node. In addition, as the size of network grows, various performance metrics begin decreasing.

***3.1.2. Dynamic Source Routing (DSR) [8]***

This is an On-demand source routing protocol. In DSR the route paths are discovered after source sends a packet to a destination node in the ad-hoc network. The source node initially does not have a path to the destination when the first packet is sent. The mobile nodes are required to maintain route caches the source routes of which the mobiles entries in the route cache are continually updated. which store the complete list of IP addresses of the nodes along the path towards the destination.
The basic procedure of DSR is:

***A. Route discovery:***

If the source route entry towards a destination is not present in the route cache, a Route Request packet is broadcast throughout the MANET. Before the intermediate node forwards the packet, it appends its own IP address in a list in the request packet. When the destination receives the packet, the request packet has accumulated the path from the source to the destination. Then the destination performs another route discovery to find the route towards the source if the underlying MAC layer supports unidirectional links; otherwise, it just reverses the source route recorded in the request packet. In either way, a Route Reply packet which contains the route from the source to destination is sent back to the source. After the procedure of route discovery, both the source and destination have the source route towards each other.

***B. Route maintenance:***

Unlike proactive routing protocols and AODV mentioned below, no periodic HELLO message is introduced in DSR. Every node along the path is responsible for the validity of the downstream link connecting itself and the next hop in the source route, which could be detected by MAC layer or DSR specific software acknowledgement. If link breakage is found, the source of the route will be notified with a Route Error packet. The source then re-initiate a route discovery procedure. Route cache is widely adopted in DSR. For example, the intermediate nodes cache the route towards the destination and backward to the source.

***C. Benefits and Limitations of DSR***

The main benefit of DSR protocol is that there is no need to keep routing table so as to route a given data packet as the entire route is contained in the packet header. The limitations of DSR protocol is that this is not scalable to large networks and even requires significantly more processing resources than most other protocols. Basically, In order to obtain the routing information, each node must spend lot of time to process any control data it receives, even if it is not the intended recipient.

***3.1.3.Temporary Ordered Routing Protocol (TORA)[9]***

The TORA attempts to achieve a high degree of scalability using a "flat", non-hierarchical routing algorithm. In its operation the algorithm attempts to suppress, to the greatest extent possible, the generation of far-reaching control message propagation. In order to achieve this, the TORA does not use a shortest path solution, an approach which is unusual for routing algorithms of this protocol.

 

The key design concepts of TORA is localization of control messages to a very small set of nodes near the occurrence of a topological change. To accomplish this, nodes need to maintain the routing information about adjacent (one hop) nodes.

The protocol performs three basic functions:
a. Route creation
b. Route maintenance
c. Route erasure
route creation and maintenance phases, nodes use a "height" metric to establish a DAG(acyclic graph)rooted at the destination the links are assigned to direction based on the relative height metric of neighboring nodes. This process of establishing a DAG is similar to the query process protocol proposed light weight mobile routing. Route maintenance is necessary to re-establish a DAG rooted at the same destination a node generates a new reference level, the result in the propagation of reference level by neighboring nodes.

TORA metric is quintuple comprising five elements namely:
1. Logical time of link failure
2. Unique ID of the node that defined the new reference level.
3. Replication indicator bit
4. Propagation ordering parameter
5. Unique ID of the nodes

The first three elements collectively represent the reference level. A new reference level is defined each node loses its last downstream link due to a link failure. Finally erasure phase essentially involves the flooding a broadcast "clear packet". Throughout the network to erase invalid routes.

### *A. Benefits and Limitations of TORA*

The multiple routes between any source destination pair are supported by this protocol. Therefore, failure or removal of any of the nodes is quickly resolved without source intervention by switching to an alternate route. TORA is also not free from limitations. One of them is that it depends on synchronized clocks among nodes in the ad hoc network. The dependence of this protocol on intermediate lower layers for certain functionality presumes that the link status sensing, neighbor discovery, in order packet delivery and address resolution are all readily available. The solution is to run the Internet MANET Encapsulation Protocol at the layer immediately below TORA.

### *3.1.4.Location aided routing(LAR)[10]*

LAR uses the basic flooding algorithm that is defined in DSR with the exception that it uses location information of a particular node to limit the flooding in the network. The location information can be gathered using the Global Positioning System (GPS).Sometimes the GPS might only give the approximate location of a node. LAR calculates the expected zone of a particular node.

### *A. Expected Zone*

In a MANET, the nodes will be moving. So, the expected zone is the zone in which a particular node is expected to be at that particular instance of time. For example, if node D is at a location L at time t0 and node D is moving with a speed v. The speed can be the average speed, maximum speed or any other measure related to the speed.

### *B. Request Zone*

LAR limits flooding using the request zone i.e., in LAR, a node forwards a packet if it is in the request zone and discards the packet if it is not in the request zone. For example if node S needs to find a route to node D. Then node S calculates the request zone and broadcasts the values of the zone along with the packet.[10]. There are two schemes proposed in LAR to determine if a node is in the request zone or not i.e. LAR schema1[10] node S first calculates the request zone for the node D and broadcasts the co-ordinates of the request zone along with the route request packet., and LAR schema2[10] doesn't include the co-ordinates of the request zone but it rather includes two other pieces of the information.
The procedure of route discovery in LAR is:
(1) The source puts the location information of itself and the destination in the routing request packet;
(2) The routing request packet is broadcast within the request zone. In other words, the nodes within the request zone forward the message, others discard the message;
(3) On receipt of the route request packet, the destination sends back a route reply packet which contains its current location;
(4) If LAR fails to find the route to the destination due to estimation error or other reasons, the routing protocol resorts to flooding of routing message throughout the MANET[11].

### *C. Benefits and Limitations of LAR*

The LAR protocol utilizes location information to minimize the search space for route discovery towards the destination node. LAR aims to reduce the routing overhead for the route discovery and it uses the Global Positioning System (GPS) to obtain the location information of a node. LAR essentially describes how location information such as GPS can be used to reduce the routing overhead in an ad hoc network and ensure maximum connectivity.

 

## 4. PERFORMANCE METRICS

There are number of qualitative and quantitative metrics that can be used to compare reactive routing protocols. Most of the existing routing protocols ensure the qualitative metrics. Therefore, the following different quantitative metrics have been considered to make the comparative study of these routing protocols through simulation.

1) **Routing overhead:** This metric describes how many routing packets for route discovery and route maintenance need to be sent so as to propagate the data packets.

2) **Average Delay:** This metric represents average end-to-end delay and indicates how long it took for a packet to travel from the source to the application layer of the destination. It is measured in seconds.

3) **Throughput:** This metric represents the total number of bits forwarded to higher layers per second. It is measured in bps. It can also be defined as the total amount of data a receiver actually receives from sender divided by the time taken by the receiver to obtain the last packet.

4) **Media Access Delay:** The time a node takes to access media for starting the packet transmission is called as media access delay. The delay is recorded for each packet when it is sent to the physical layer for the first time.

5) **Packet Delivery Ratio:** The ratio between the amount of incoming data packets and actually received data packets.

6) **Path optimality:** This metric can be defined as the difference between the path actually taken and the best possible path for a packet to reach its destination.

## 5. CONCLUSION

In this survey we have reported on the reactive routing protocols for routing protocols in MANETS. We have discussed some reactive protocols and overview of reactive protocols ( AODV,DSR,TORA and LAR). It has been further concluded that due to the dynamically changing topology infrastructure less, decentralized characteristics, security and power awareness is hard to achieve in mobile ad hoc networks. Hence, security and power awareness mechanisms should be built-in features for all sorts of applications based on ad hoc network. The focus of the study is on these issues in our future research work and effort will be made to propose a solution for routing in Ad Hoc networks by tackling these core issues of secure and power aware/energy efficient routing.

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