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# A Review on Mobile AD HOC Networks

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## Abstract:

A MANET is an autonomous group of mobile users that communicate over reasonably slow wireless links. The network topology may vary rapidly and unpredictably over time, because the nodes are mobile. The network is decentralized, where all network activity, including discovering the topology and delivering messages must be executed by the nodes themselves. Hence routing functionality will have to be incorporated into the mobile nodes. MANET is a kind of wireless ad-hoc network and it is a self-configuring network of mobile routers (and associated hosts) connected by wireless links – the union of which forms an arbitrary topology. Such a network may operate in a standalone fashion, or may be connected to the larger Internet Problems in Ad Hoc Networks.

## 1. INTRODUCTION

A Mobile ad hoc network is a group of wireless mobile computers (or nodes). In which nodes collaborate by forwarding packets for each other to allow them to communicate outside range of direct wireless transmission. Ad hoc networks require no centralized administration or fixed network infrastructure such as base stations or access points, and can be quickly and inexpensively set up as needed. A MANET is an autonomous group of mobile users that communicate over reasonably slow wireless links. The network topology may vary rapidly and unpredictably over time, because the nodes are mobile. The network is decentralized, where all network activity, including discovering the topology and delivering messages must be executed by the nodes themselves. Hence routing functionality will have to be incorporated into the mobile nodes.

## 2. HISTORY

We can classified the mobile ad hoc network into first, second and third generation. Present work on the third generation ad hoc network.The first generation of ad hoc network , these are called Packet Radio Network (PRNET) can be traced back to 1970's. In 1970's. The Defence Advanced Research Project Agency (DARPA) initiated research of using packet- switched radio technology that provide reliable communication between computers and urbanized PRNET. Basically PRNET uses the combination of two most popular technology Areal Location of Hazardous Atmospheres (ALOHA) and Carrier Sense Multiple Access (CSMA) for multiple access and distance vector routing. The PRNET is then evolved into the Survivable Adaptive Radio Network (SURAN) that provides some benefits by improving the radio performance through making them smaller, cheaper and power thrifty. United State Department of Defence (DOD) continued work for programs of improve the performance such as technologies Globe Mobile Information System (GloMo) and Near Term Digital Radio (NTDR). GloMo allow use of CSMA/CA and TDMA and provides self-organizing and self-healing network for instance ATM over wireless, Satellite Communication Network. The NTDR make and allow use of clustering and link state

routing that organized an ad hoc network. NTDR is introduced by US Army. This is the only one existing ad hoc network in use.The functioning group of MANET is born in Internet Engineering Task Force (IETF) who worked for routing protocols on MANET and gives rise to the development of various mobile devices like PDA's, palmtops, notebooks, etc.

## 2. CHARACTERISTICS OF MANET

Mobile ad hoc network nodes are furnished with wireless transmitters and receivers using [7] antennas, which may be highly directional (point-to-point), Omni directional (broadcast), probably steer able, At a given point in time, depending on positions of nodes, their transmitter and receiver coverage patterns, communication power levels and co-channel interference levels, a wireless connectivity in the form of a random, multi-hop graph or "ad hoc" network exists among the nodes. This ad hoc topology may modify with time as the nodes move or adjust their transmission and reception parameters.The characteristics of these networks are as follows:

- Communication via wireless means.
- Nodes can perform the roles of both hosts and routers.
- Bandwidth-constrained, variable capacity links.
- Limited Physical Security.
- Dynamic network topology.

## 3. ADVANTAGES OF MANET

The following are the advantages of MANET:

- They provide access to information and services regardless of geographic position.
- These networks can be set up at any place and time [10].

## a. DISADVANTAGES OF MANET

Some of the disadvantages of MANETs are as follows:

- Limited resources and physical security.
- Intrinsic mutual trust vulnerable to attacks.
- Lack of authorization facilities.
- Volatile network topology makes it hard to detect malicious nodes.
- Security protocols for wired networks cannot work for ad hoc networks.

## b. APPLICATIONS OF MANET

Some of the applications of MANETs are as follows:

- Military or police exercises.
- Disaster relief operations.
- Mine cite operations.
- Urgent Business meetings.

## 4. PROPERTIES OF MANET ROUTING PROTOCOLS

The properties that are desirable in MANET Routing protocols are:

**a). Distributed operation:**

The protocol should be distributed. It should not be dependent on a centralized controlling node. This is the case even for stationary networks. The dissimilarity is that the nodes in an ad-hoc network can enter or leave the network very easily and because of mobility the network can be partitioned.

**b). Loop free:**

To improve the overall performance, the routing protocol should assurance that the routes supplied are loop free. This avoids any misuse of bandwidth or CPU consumption.

**c). Demand based operation:**

To minimize the control overhead in the network and thus not misuse the network resources the protocol should be reactive. This means that the protocol should react only when needed and should not periodically broadcast control information.

**d). Unidirectional link support:**
The radio environment can cause the formation of unidirectional links. Utilization of these links and not only the bi-directional links improves the routing protocol performance.

**e). Security:**
The radio environment is especially vulnerable to impersonation attacks so to ensure the wanted behavior of the routing protocol we need some sort of security measures. Authentication and encryption is the way to go and problem here lies within distributing the keys among the nodes in the ad-hoc network.

**f). Power conservation:**
The nodes in the ad-hoc network can be laptops and thin clients such as PDA's that are limited in battery power and therefore uses some standby mode to save the power. It is therefore very important that the routing protocol has support for these sleep modes.

**g). Multiple routes:**
To reduce the number of reactions to topological changes and congestion multiple routes can be used. If one route becomes invalid, it is possible that another stored route could still be valid and thus saving the routing protocol from initiating another route discovery procedure.

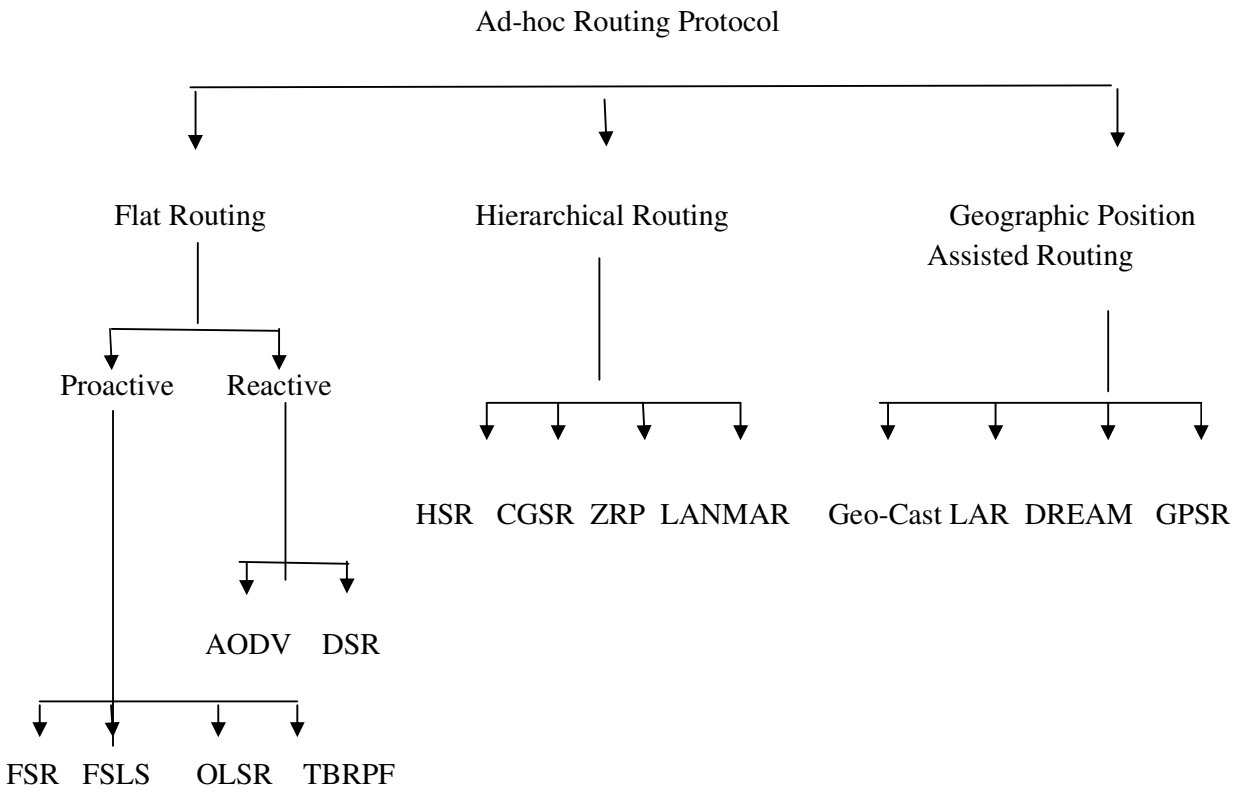
**h). Quality of Service Support:**
Some sort of Quality of service is necessary to incorporate into the routing protocol. This helps to find what these networks will be used for. It could be for instance real time traffic support [12].

## 5. PROBLEMS IN ROUTING ITH MOBILE AD HOC NETWORKS

c. **Asymmetric links:** Most of the wired networks rely on the symmetric links which are always fixed. But this is not a case with ad-hoc networks as the nodes are mobile and constantly changing their position within network
d. **Routing Overhead:** In wireless ad hoc networks, nodes often change their location within network. So, some stale routes are generated in the routing table which leads to unnecessary routing overhead.
e. **Interference:** This is the major problem with mobile ad-hoc networks as links come and go depending on the transmission characteristics, one transmission might interfere with another one and node might overhear transmissions of other nodes and can corrupt the total transmission.
f. **Dynamic Topology:** Since the topology is not constant; so the mobile node might move or medium characteristics might change. In ad-hoc networks, routing tables must somehow reflect these changes in topology and routing algorithms have to be adapted. For example in a fixed network routing table updating takes place for every 30sec. This updating frequency might be very low for ad-hoc networks

## 6. ROUTING PROTOCOLS

Classification of routing protocols in mobile ad hoc network can be done in many ways, but most of these are done depending on routing strategy and network structure.
The routing protocols can be categorized as flat routing, hierarchical routing and geographic position assisted routing while depending on the network structure.
According to the routing strategy routing protocols can be classified as Table-driven and source initiated.




Routing Protocols

### 9.1. Flat Routing Protocols

Flat routing protocols are divided mainly into two classes; the first one is proactive routing (table driven) protocols and other is reactive (on-demand) routing protocols. One thing is general for both protocol classes is that every node participating in routing play an equal role. They have further been classified after their design principles; proactive routing is mostly based on LS (link-state) while on-demand routing is based on DV (distance-vector).

#### 9.1.1. Pro-Active / Table Driven routing Protocols

Proactive MANET protocols are also called as table-driven protocols and will actively determine the layout of the network. Through a regular exchange of network topology packets between the nodes of the network, at every single node an absolute picture of the Network is maintained. There is hence minimal delay in determining the route to be taken.

This is especially important for time-critical traffic .When the routing information becomes worthless quickly, there are many short-lived routes that are being determined and not used before they turn invalid. Therefore, another drawback resulting from the increased mobility is the amount of traffic overhead generated when evaluating these unnecessary routes. This is especially altered when the network size increases. The portion of the total control traffic that consists of actual practical data is further decreased.

Lastly, if the nodes transmit infrequently, most of the routing information is considered redundant. The nodes, however, continue to expend energy by continually updating these unused entries in their routing tables as mentioned,

energy conservation is very important in a MANET system design. Therefore, this excessive expenditure of energy is not desired. Thus, proactive MANET protocols work best in networks that have low node mobility or where the nodes transmit data frequently. Examples of Proactive MANET [4] Protocols include:

- ✓ Optimized Link State Routing (OLSR)
- ✓ Fish-eye State Routing (FSR)
- ✓ Destination-Sequenced Distance Vector (DSDV)
- ✓ Cluster-head Gateway Switch Routing Protocol (CGSR)

#### 9.1.2. Reactive (On Demand) protocols

Portable nodes- Notebooks, palmtops or even mobile phones usually compose wireless ad-hoc networks. This portability also brings a significant issue of mobility. This is a key issue in ad-hoc networks. The mobility of the nodes causes the topology of the network to change constantly. Keeping track of this topology is not an easy task, and too many resources may be consumed in signalling.

Reactive routing protocols were intended for these types of environments.[4] These are based on the design that there is no point on trying to have an image of the entire network topology, since it will be constantly changing. Instead, whenever a node needs a route to a given target, it initiates a route discovery process on the fly, for discovering out a pathway .Reactive protocols start to set up routes on-demand.

The routing protocol will try to establish such a route, whenever any node wants to initiate communication with another node to which it has no route. This kind of protocols is usually based on flooding the network with Route Request (RREQ) and Route reply (RERP) messages .

By the help of Route request message the route is discovered from source to target node; and as the target node gets a RREQ message it send RERP message for the confirmation that the route has been established. This kind of protocol is usually very effective on single-rate networks. It usually minimizes the number of hops of the selected path. However, on multi-rate networks, the number of hops is not as important as the throughput that can be obtained on a given path.

The different types of On Demand driven protocols are:

- ➢ Ad hoc On Demand Distance Vector (AODV)
- ➢ Dynamic Source routing protocol (DSR)
- ➢ Temporally ordered routing algorithm (TORA)
- ➢ Associability Based routing (ABR)
- ➢ Signal Stability-Based Adaptive Routing (SSA)
- ➢ Location-Aided Routing Protocol

### 9.2. Hierarchical Routing Protocols

As the size of the wireless network increases, the flat routing protocols may produce too much overhead for the MANET. In this case a hierarchical solution may be preferable.

- Hierarchical State Routing (HSR)
- Zone Routing Protocol (ZRP)

- Cluster-head Gateway Switch Routing Protocol (CGSR)
- Landmark Ad Hoc Routing Protocol (LANMAR)

### 9.3. Geographical Routing Protocols

There are two approaches to geographic mobile ad hoc networks:

1. Actual geographic coordinates (as obtained through GPS – the Global Positioning System).
2. Reference points in some fixed coordinate system.

An advantage of geographic routing protocols is that they prevent network-wide searches for destinations. If the recent geographical coordinates are known then control and data packets can be sent in the general direction of the destination. This trim downs control overhead in the network. A disadvantage is that all nodes must have access to their geographical coordinates all the time to make the geographical routing protocols useful. The routing updates must be done faster in compare of the network mobility rate to consider the location-based routing effective. This is because locations of nodes may change quickly in a MANET. Examples of geographical routing protocols are:

- Geo-Cast (Geographic Addressing and Routing)
- DREAM (Distance Routing Effect Algorithm for Mobility)
- GPSR (Greedy Perimeter Stateless Routing)

## 10.DESCRIPTION OF REACTIVE PROTOCOLS

Reactive protocol is identified as On-demand protocols because it creates routes only when these routes are needed.. The various Reactive Routing Protocols are discussed below:

### 10.1. Ad-hoc On Demand Distance Vector Routing (AODV)

Ad hoc On-Demand Distance Vector (AODV) routing is a routing protocol for mobile ad-hoc networks and other wireless ad-hoc networks. It is jointly developed in Nokia Research Centre of University of California, Santa Barbara and University of Cincinnati by C. Perkins and S. Das. It is an on-demand and distance-vector routing protocol, meaning that a route is established by AODV from a destination only on demand. AODV is capable of both unicast and multicast routing. It keeps these routes as long as they are desirable by the sources. Additionally, AODV creates trees which connect multicast group members. The trees are composed of the group members and the nodes needed to connect the members. The sequence numbers are used by AODV to ensure the freshness of routes. It is loop-free, self-starting, and scales to large numbers of mobile nodes.

✓ **Characteristics of AODV**

- Unicast, Broadcast, and Multicast communication.
- On-demand route establishment with small delay.
- Multicast trees connecting group members maintained for lifetime of multicast group.
- Link breakages in active routes efficiently repaired and All routes are loop-free through use of sequence numbers.
- Use of Sequence numbers to track accuracy of information.
- Only keeps track of next hop for a route instead of the entire route.

- Use of periodic HELLO messages to track neighbors.

✓ **Advantages and Disadvantages**

The main advantage of AODV protocol is that routes are established on demand and destination sequence numbers are used to find the latest route to the destination. The connection setup delay is less. The HELLO messages supporting the routes maintenance are range-limited, so they do not cause unnecessary overhead in the network.

One of the disadvantages of this protocol is that intermediate nodes can lead to inconsistent routes if the source sequence number is very old and the intermediate nodes have a higher but not the latest destination sequence number, thereby having stale entries. Also multiple Route-Reply packets in response to a single Route-Request packet can lead to heavy control overhead. Another disadvantage of AODV is that the periodic beaconing leads to unnecessary bandwidth consumption.

### 10.2. Dynamic Source Routing (DSR)

Dynamic Source Routing (DSR) is a routing protocol for wireless mesh networks. It is similar to AODV in that it establishes a route on-demand when a transmitting mobile node requests one. However, it uses source routing instead of relying on the routing table at each intermediate device. Dynamic source routing protocol (DSR) is an on-demand, source routing protocol, whereby all the routing information is maintained (continually updated) at mobile nodes. DSR allows the network to be completely self-organizing and self-configuring, without the need for any existing network infrastructure or administration. The protocol is composed of the two main mechanisms of "Route Discovery" and "Route Maintenance", which work together to allow nodes to discover and maintain routes to arbitrary destinations in the ad hoc network.

An optimum path for a communication between a source node and target node is determined by Route Discovery process. Route Maintenance ensures that the communication path remains optimum and loop-free according the change in network conditions, even if this requires altering the route during a transmission. Route Reply would only be generated if the message has reached the projected destination node (route record which is firstly contained in Route Request would be inserted into the Route Reply).

✓ **Advantages and Disadvantages**

DSR uses a reactive approach which eliminates the need to periodically flood the network with table update messages which are required in a table-driven approach. The intermediate nodes also utilize the route cache information efficiently to reduce the control overhead.

The disadvantage of DSR is that the route maintenance mechanism does not locally repair a broken down link. The connection setup delay is higher than in table-driven protocols. Even though the protocol performs well in static and low-mobility environments, the performance degrades rapidly with increasing mobility. Also, considerable routing overhead is involved due to the source-routing mechanism

employed in DSR. This routing overhead is directly proportional to the path length.

## 11.DESCRIPTION OF PROACTIVE PROTOCOL

### 11.1. DSDV Protocol: (Destination Sequenced Distance Vector (DSDV) Protocol)

The destination address

– The number of hops required to reach the destination and

– The new sequence number, originally stamped by the destination

The transmitted routing tables will also contain the hardware address, network address of the mobile host transmitting them. The routing tables will contain the sequence number created by the transmitter and hence the most new destination sequence number is preferred as the basis for making forwarding decisions. This new sequence number is also updated to all the hosts in the network which may decide on how to maintain the routing entry for that originating mobile host. After receiving the route information, receiving node increments the metric and transmits information by broadcasting. Incrementing metric is done before transmission because, incoming packet will have to travel one more hop to reach its destination.

Time between broadcasting the routing information packets is the other important factor to be considered. When the new information is received by the mobile host it will be retransmitted soon effecting the most rapid possible dissemination of routing information among all the cooperating mobile hosts. The mobile host cause broken links as they move from place to place within the network. The broken link may be detected by the layer2 protocol, which may be described as infinity. When the route is broken in a network, then immediately that metric is assigned an infinity metric there by determining that there is no hop and the sequence number is updated. Sequence numbers originating from the mobile hosts are defined to be even number and the sequence numbers generated to indicate infinity metrics are odd numbers.

The broadcasting of the information in the DSDV protocol is of two types namely: full dump and incremental dump. Full dump broadcasting will carry all the routing information while the incremental dump will carry only information that has changed since last full dump. Irrespective of the two types, broadcasting is done in network protocol data units (NPDU). Full dump requires multiple NPDU's while incremental requires only one NPDU to fit in all the information.

When an information packet is received from another node, it compares the sequence number with the available sequence number for that entry. If the sequence number is larger, then it will update the routing information with the new sequence number else if the information arrives with the same sequence number it looks for the metric entry and if the number of hops is less than the previous entry the new information is updated (if information is same or metric is more then it will discard the information).

While the nodes information is being updated the metric is increased by 1 and the sequence number is also increased by 1. Similarly, if a new node enters the network, it will announce itself in the network and the nodes in the network update their routing information with a new entry for the new node.During broadcasting, the mobile hosts will transmit their routing tables periodically but due to the frequent movements by the hosts in the networks, this will lead to continuous burst of new routes transmissions upon every new sequence number from that destination. The solution for this is to delay the advertisement of such routes until it shows up a better metric.

## 12. COMPARISON OF DSDV, AODV, DSR

| DSDV | AODV | DSR |
|---|---|---|
| 1) (DSDV) is a table driven routing scheme for ad hoc mobile networks based on the Bellman-ford algorithm. | 1) AODV is an on –Demand routing protocol which is confluence of DSDV and DSR. | 1) Dynamic Source Routing is a Pure On-Demand routing protocol |
| 2) Each node acts as a router where a routing table is maintained and periodic routing updates are exchange, even if the routes are not needed. | 2) Route is calculated on demand | 2) Route is calculated only when it is required. |
| 3) A sequence number is associated with each route or path to the destination to prevent routing loops. | 3) AODV provides loop free routes while repairing link breakages. but unlike DSDV, it doesn't require global periodic routing advertisements. | 3) It uses no periodic routing messages like AODV |
| 4) (DSDV) is a table driven routing scheme for ad hoc mobile networks. | 4) AODV maintains a routing table where it maintains one entry per destination unlike the DSR that maintains multiple route cache | 4) DSR uses source routing where the whole route is carried as an overhead. |

## CONCLUSION

In this research paper we have discussed about a new technology in information technology: MANET. We have seen the advancement in this field even day by day of internet due to wireless networking technologies. It gives rise to many new applications that work on wireless technology. In the past few decades, we have seen the advancement in wireless networks. The rising capabilities of mobile

devices are giving a new direction to the internet, which decreases the cost and allow us to use infrastructure wireless networks and infrastructure less wireless networks that called as MANET (Mobile Ad hoc Wireless Network). We have also described the architecture, characteristics,apploications, advantages and desadvantages, routing protocols. There is no doubt that MANET is development trend for the future.

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