

## Survey on MANET: Routing Protocols, Advantages, Problems and Security

Meenakshi Yadav<sup>1</sup>, Nisha Uparosiya<sup>2</sup>

<sup>1</sup>Department of Computer Science & Engineering, Jayoti Vidhyapeeth Women's University, Jaipur, India

[mymeenumy@gmail.com](mailto:mymeenumy@gmail.com)

<sup>2</sup>Department of Computer Science & Engineering, Jayoti vidhyapeeth Women's University, Jaipur, India

[nishauparosiya@gmail.com](mailto:nishauparosiya@gmail.com)

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#### Corresponding Author:

#### Meenakshi Yadav

1 Department of Computer Science & Engineering, Jayoti Vidhyapeeth Women's University, z Jaipur, India  
E-mail: [mymeenumy@gmail.com](mailto:mymeenumy@gmail.com)

### ABSTRACT

Mobile Ad-hoc Network (MANET) is a very powerful field in the progress of Wireless network. Over the past years Wireless ad-hoc network become most stimulating and vital field due to the popularity of mobile devices and wireless network. MANET is a network with many autonomous nodes i.e. mobile devices. MANET uses dynamic topology, wireless links, decentralized network and doesn't need any cellular infrastructure. The main usage area of MANET is Military scenarios, Sensor Networks, Rescue operations, Student on campus, Conferences etc. MANET is rapidly deployable and self-configuring. Due to highly dynamic environment routing in MANET is a very critical task. This paper shows an overview of routing protocols in MANET. This paper aims at the advantages and problems of MANET with the issue of improving the future security.

**KEYWORDS-**: MANET, Routing Protocols, Ad-hoc network, Wireless network.

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### 1. INTRODUCTION

As the importance of computer increases it also build up the connectivity demand. Wired solutions are used from a very long time, but the demands for wireless solution are increasing for connecting to the Internet, exchanging information, send and receive E-mail messages etc. Mobile Ad-hoc network (MANET) becomes one of the most capable fields for research. MANET is a wireless adhoc network. A MANET can be connected to internet or external network and can be a standalone network. MANET is a Latin word which means "for this," or "for this purpose only". Figure 1 shows the structure of MANET.

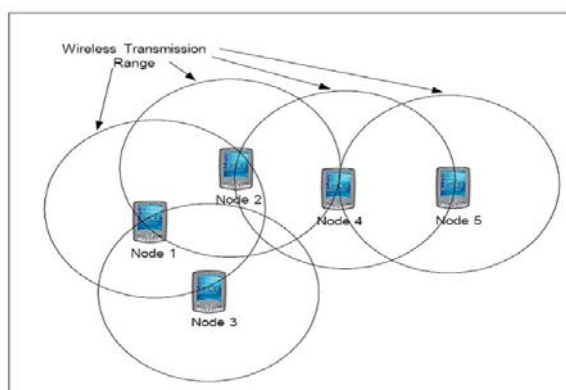


Figure 1: structure of MANET

A MANET is a group of self-governing wireless mobile nodes which can interchange data in dynamic manner. Due to the mobile behavior of nodes the network structure is dynamic. The network is self-deploying and decentralized. The nodes in MANET act as both router and as a host and network topology changes rapidly and decision taken in a distributed manner. Due to dynamic behavior of network, routing for MANET is a daring task and wireless link become highly error prone in MANET. Security, reliability, availability, scalability, quality of service is some of the requirements of MANET.

Wireless network is divided into 2 parts:

**1).Infrastructure network:** An infrastructure network act as a bridge, which connect wired network and wireless network. The base stations are fixed and the mobile network move during communication. If any ode goes out of range from any base station, it goes into the range of other base station. Figure 2 shows infrastructure network.

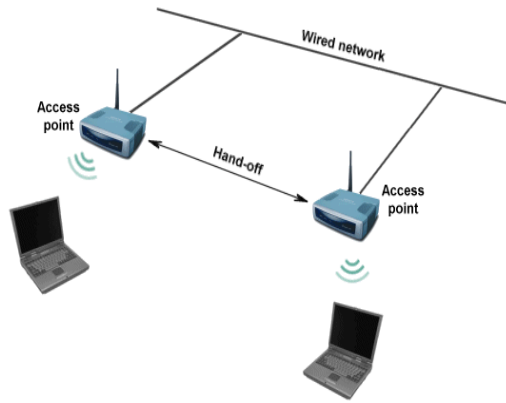


Figure 2: Infrastructure Wireless Networks

**2).Infrastructureless network:** no fixed base station and mobile nodes can move while communicating. All the nodes present act as routers. Infrastructureless network also called Ad-hoc network which forms temporary networks. In this type of network nodes are portable devices such as mobile phones and laptops. Figure 3 shows an ad-hoc network.



Figure 3: An ad-hoc network.

The main goal of routing in MANET is finding end-to-end paths or routes, scaling i.e. minimize overhead and route maintenance. Challenges of MANET routing are (1) flat addressing (2) network-to-network connectivity (3) heterogeneity (4) mobility. The rest of the paper is as follows. Section 2 consists of routing protocols used in MANET with their properties. Section 3 consists of Benefits, limitations and characteristics of MANET. Section 4 consists of security attacks and goals of MANET.

## 2. Routing Protocols

Routing is the process of transmitting information or packets from source node to destination node. As Ad-Hoc network changes their topology very frequently and thus making packet routing difficult. Routing protocol controls the flow of data in networks and also decides the efficient path to reach the destination. There are 2 types of routing approaches:

**a) Topology based:** topology based routing protocol perform packet routing by using the information about the nodes existing in the network. Proactive, reactive and hybrid approaches are examples of topology based routing protocol.

**b) Position based:** position based routing take away few drawbacks of topology based routing by adding some new information. The routing needs additional information about the physical positioning of each node participating. Position based routing doesn't need any maintenance of routers. The nodes neither keep the routing table up to date by transmitting message nor store the routing table.

Topology based routing protocols are mainly divided into 3categories:

- a) Table driven or Proactive protocols
- b) On demand or Reactive protocols
- c) Hybrid protocol

**Proactive protocols:** In proactive protocol, each node has to continuously maintain the routing table in the network. The routing information is up to date to preserve the modern view of network. Proactive protocol lowers the amount of traffic overhead because packets are forwarded only to known routers. This is inappropriate for high dynamic networks because routing table are continuously updating with change in topology, this tends in increasing the packet overhead which lower the network performance. Proactive protocol uses the shortest path protocol. Some of the proactive routing protocols are Destination Sequenced Distance Vector (DSDV), Wireless Routing Protocol (WRP), hierarchical source Routing (HSR), Global state Routing (GSR).

**Reactive Protocol:** Reactive protocol builds up routes only when required by source node. The major benefit of this protocol is that it requires minor routing information. When a communication occurs from source to destination, it includes the route discovery process. The route rest justifiable till the destination is attained or the route is no more required or expired. The route discovery happens by flooding the route request packet through the network. When reactive protocol querying for routes there is more network overhead in flooding process. Requires bandwidth only when needed. Some examples of reactive protocol are Ad-hoc On Demand Routing (ADOV), Dynamic Source Routing (DSR), and Location Aided Routing (LAR), temporally ordered Routing Algorithm (TORA).

**Hybrid Protocol:** The Hybrid protocol is the combination of both proactive routing protocol and reactive routing protocol. They have higher latency than proactive routing protocols. Some examples of Hybrid routing are Zone Routing Protocol (ZRP), Zone Based Hierarchical Link State (ZHLS). ZRP divide the network into zones. The Reactive routing is used to route the packet b/w various zones. Hybrid routing is an appropriate way for routing in large networks. Figure 4 shows the classification of Routing protocols in MANET.

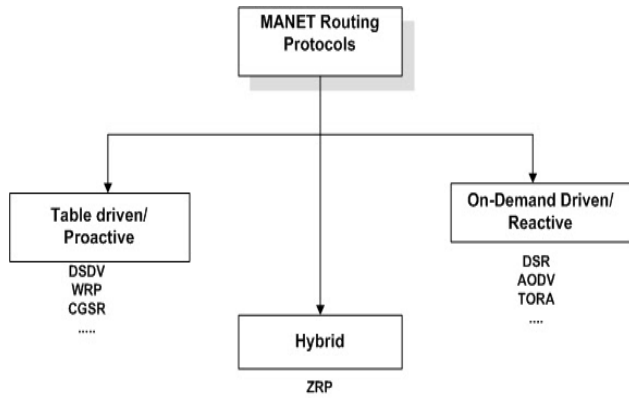


Figure 3: Routing Protocols in MANET

Some of the advantage and disadvantage of Proactive, Reactive and hybrid are as follows:

	Advantages	Disadvantages
<b>Proactive</b>	<ul style="list-style-type: none"> <li>-Up-to-date routing information</li> <li>-Quick establishment of routes</li> <li>-Small delay</li> <li>-A route to every other node in the network is always available</li> </ul>	<ul style="list-style-type: none"> <li>-Slow convergence</li> <li>-Tendency of creating loops</li> <li>-Large amount of resources are needed</li> <li>-Routing information is not fully used</li> </ul>
<b>Reactive</b>	<ul style="list-style-type: none"> <li>-Reduction of routing load</li> <li>-Saving of resources</li> <li>-Loop-free</li> </ul>	<ul style="list-style-type: none"> <li>-Not always up-to-date routes</li> <li>-Large delay</li> <li>-Control traffic and overhead cost</li> </ul>
<b>Hybrid</b>	<ul style="list-style-type: none"> <li>-Scalability</li> <li>-Limited search cost</li> <li>-Up-to-date routing information within zones</li> </ul>	<ul style="list-style-type: none"> <li>-Arbitrary proactive scheme within zones</li> <li>-Inter-zone routing latencies</li> <li>-More resources for large size zones</li> </ul>

Now we further study one protocol from each of the routing protocol category:

**1) Destination Sequenced Distance Vector (DSDV):**

DSDV is a proactive routing protocol based on Bellman-Ford algorithm which evaluates the minimum number of hops to reach the destination. Each mobile node present in the network retains a routing table which contain all feasible destinations and numbers of hops to each destination in the network are recorded. DSDV uses the approach of sequence number assigned by destination hops to determine the originality of route. Upgrades of periodic transmissions of the routing table helps in retaining the topology information of the network. If any new remarkable amendments for the routing information are found, the updates are transmitted immediately. The routing upgrades are sent through two ways i.e. Full dump and incremental dump. In full dump the complete routing table is forwarded to the neighbours, where as in matter of incremental dump only the entries that require alteration are conveyed.

**2) Ad Hoc on-Demand Distance Vector Routing (AODV):**

AODV is a reactive routing protocol applies for mobile adhoc network. AODV is efficient for unicast, multicast and broadcast communication. In AODV each mobile node retains a table accommodate information about the efficient path for packet to reach the destination. When source node wants to transmit information to destination node and does not have any route to destination, route discovery process starts.

Route request (RREQ) is broadcast if any source node desire to send packets to destination node. The adjacent nodes broadcast the packet to their adjacent nodes and this action persists till the destination is achieved by the packet. During this process, all the transitional nodes store the address of the adjacent node from which the initial copy of the broadcast packet is accepted. These records are stored in routing tables, which ease in demonstrating the reserve path. The extra or duplicate copies of the same RREQ are eliminated. This procedure extends till termination warning achieved source node.

The difference b/w DSDV and AODV are shown below:

DSDV	AODV
It always discovers the route to all available destinations	A route discovery is initiated, only when it is required
The routing table retains the route to all destination table	Only the path with the least hop count value is maintained in the routing table
The routing information is propagated periodically, irrespective of the network topology dynamics	The routing information is not propagated unless, the network topology changes
Frequent route discovery requires more control packets for high scalable networks	Requirement of control packets is less, when compared to DSDV
Link breakage due to node mobility does not interrupts the data communication because it has alternative path to the same destination	The link failure interrupts the data communications until an alternative route is discovered
The increased size of the routing table in a large scale network results in high routing overhead	There is no additional overhead due to the maintenance of a fresh route
Frequently changed network topology affects the data packet latency	Scalability and mobility effect on data packet latency is lower than the DSDV
The increased rate of link failure, achieves poor packet delivery ratio	Packet delivery ratio is higher than DSDV
High scalable MANET incurs high bandwidth and power consumption owing to the frequent route discovery	Power consumption is less than DSDV since, it demands route only when it is required

**1) Zone Routing Protocol (ZRP):** To gain the advantage ZRP uses both proactive and reactive routing protocol. It takes benefit of proactive protocol to find local adjacent nodes and reactive protocol for routing between these adjacent nodes. All the communication in MANET takes place between the nodes close to each other. In ZRP the whole network is divided into different size overlapping zones. Each mobile node related to variable overlapping zone. Every zone consists of 2 types of nodes i.e. peripheral nodes and interior nodes. Peripheral nodes are situated at extreme or boundary and interior nodes are situated in the radius zone except the extreme node.

Some of the challenges of routing protocol in MANET are:

**1) Bandwidth Constraints** in routing protocol rely on the number of nodes and the traffic handle by them.

**2) Mobility** is a serious Challenge. Mobility in routing protocols outputs in the frequent collision of packets, path breaks, difficulty in routing information and resource reservation.

**3) Constraints** on Resources such as Computing power, buffer storage and battery power **restrict the ability of a routing protocol.**

4) More number of collision results in high **contention** for channel. Network load is distributed uniformly in a good routing protocol.

### 3. Benefits and Limitations

Firstly we have to know some of the characteristics and features of MANET.

#### Characteristics and features

**1) Autonomous Behaviour:** Each mobile node in MANET acts as both router and host. In other words, mobile nodes can also achieve switching task as a router. So generally terminals and switches are identical in MANET.

**2) Dynamic topologies:** As all the nodes in the network are mobile they are free to keep moving with dissimilar speed, which consequently results in the variation of network. The topology in the network may change arbitrarily at uncertain times. All the mobile nodes present in the network establish routing among themselves dynamically, creating their own network.

**3) Multi-hop routing:** When any node wants to build up communication with other nodes which are out of range, then the packet is transmitted through one or more intermediate nodes. Two types of ad-hoc routing, i.e. single-hop and multi-hop routing. Single-hop is simpler than multi-hop regarding cost, structure and implementation.

**4) Distributed operation:** The control of the network is distributed among the mobile nodes of the network as there is no background network for the main control of the network operation.

**5) Light weight terminal:** In most of the cases, the MANET is mobile nodes with less memory size, low power storage and low CPU capability. Optimized algorithms and processes that perform computing and communication functions.

**6) Energy constrained and limited Bandwidth:** Today in the modern electronic world all the devices completely depend on the batteries. The purpose of the network is to be optimized to preserve the energy utilization of the mobiles. Wireless network has a very limited bandwidth and the network is to be optimized to accomplish with the utmost efficiency within the limited bandwidth.

Some of the advantages of the Mobile ad-hoc network include following:

- 1) MANET can be succeeded where there is less telecommunication infrastructure.
- 2) Minimum cost estimation.
- 3) Enhanced flexibility.
- 4) MANET gives access to information and facilities regardless to geographic location.
- 5) These networks can be arranged at any time and Place.
- 6) Powerful due to decentralised management.
- 7) MANET has independent behaviour with dynamic network topology and multi-hop network.
- 8) Scalable- holds the addition of more nodes.
- 9) Self-organizing network, nodes can also act as routers.

Some of the disadvantages of MANET are:

- 1) Lack of physical security.
- 2) Inherent Resources are limited.
- 3) Mutual trust unsafe to attack. Insufficiency of authorization services.
- 4) Dynamic network topology makes it difficult to identify malicious attack.

#### 4. Security Goals and Attacks

##### Security Goals

Security is a crucial aspect of MANET. Security involves a set of specifications that are sufficiently funded. In MANET all the network functions such as routing and packet forwarding are implemented by themselves in a self-organizing way. That is why securing a MANET is a challenging task. Some goals to assess whether a MANET is secure or not are as follows:

**1) Confidentiality:** Confidentiality protects that computer associated benefits are acquired by authorized parties only. It means only those who have right to access should really obtain that access. To keep the information secret from all organisations that do not have right to access them we have to retain confidentiality. Privacy and secrecy are synonyms of confidentiality.

**2) Availability:** Availability means the benefits are attainable to authorized parties at suitable time. Availability relates to both services and data. It ensures the survivability of the network facilities despite contradiction of service attack.

**3) Authentication:** Authentication sanctions a node to protect the originality of peer node it is communicating with. Authenticity is ensured because only the genuine sender can create a message that will decrypt correctly with the shared key. Authentication is vital affirmation that participants in communication are validated and not imitate.

**4) Integrity:** Integrity means the assets can be adapted only by authorized parties in an authorized way. Adaptation includes deleting, creating, writing and changing status. Integrity convinces that the information being transmitted is never corrupted.

**5) Non-repudiation:** It protects that the sender and the receiver of the message does not disclaim that they have ever sent or received such a message. This is accommodating when we need to differentiate if a node with some undesired function is undermining or not.

##### Security Attacks

Securing and designing an efficient routing protocol for wireless ad-hoc network is one of the most challenging tasks. Due to dynamic nature and no infrastructure of MANET demands a new set of networking strategies to be processed in order to provide effective and protected overhead free end-to-end communication. Because of lack of predefined centralized administration for route discovery procedure, results in the decrease in the performance of network. MANET is

more vulnerable to cyber/digital attacks as compare to wired networks. There are several types of attack that affect the MANET and its security. These attacks can be divided into two types:

- 1) Passive attack
- 2) Active attack

**Passive attack:** In passive attack, an unauthorized node controls and goals to search out information about the network. Attackers do not damage data in the network in place of it he examines traffic like recognizing communicating nodes, control data which is changed between them and steal important information. Passive attackers do not shatter the operation of routing protocols but try to discover the important information from routed traffic. Passive attack is used to achieve the information for future harmful effects. They do not examine to adjust or change the data packets. Some of the examples of passive attack include:

- Traffic monitoring
- Snooping
- Eavesdropping
- Traffic analysis
- Release of message contents

**Active attack:** Active attack can alter or change the state of the data in the network such as message modification, denial of services, message fabrications, congestion etc. it shatter the normal functionality of the network and launched by the nodes with authorization to process with in a network. Active attacks are divided into four groups i.e. *dropping, modification, timing attacks and fabrication*. Active can be of two types may be internal or external. An external active attack can be brought out by any outside source that do not belong to the network. An internal active attack is malicious nodes that are part of a network. They are hard to find out as compare to external attack. Some of the active attack includes:

- Spoofing
- Modification
- Denial of service
- Masquerade
- Network Jamming
- Impersonating
- Message reply

#### 4. CONCLUSION

This paper give account of fundamental issues and examine main research problem of MANET. MANET due to their dynamic behavior, limited resources (power, bandwidth etc.), and distributed operation is more vulnerable to many attacks. In this research paper an attempt has been done to focus on comparative study and performance of different routing protocol mainly reactive, proactive and hybrid like DSDV, AODV, and ZRP etc. The main aim of routing protocol is to provide efficient energy aware and secure routing schemes to MANET. In this research paper we summarize

characteristics, features, advantage and disadvantage of MANET. After that we discuss the most complex and challenging issue in MANET i.e. Security with their goals and Attacks. Mainly two types of security attacks passive and Active. MANET is a rapidly developing and changing field with a huge scope of research work in this field.

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