

# A Survey on MANETs: Mobile Ad-hoc Networks and Its Routing Protocols

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**Abstract**— A collection of wireless mobile hosts forming a temporary network without the aid of any centralized administration or standard support services. Network topology is dynamic, nodes enters and leaves the network dynamically. No centralized control or fixed infrastructure to support network configuration and reconfiguration. The main objectives of this paper are to address the characteristics of MANET, Various Routing Protocols, Applications and Issues and Challenges of MANET.

**Keywords**- Mobile Networks, Routing Protocol, Applications, Challenges of MANET.

## I. INTRODUCTION

Wireless Networks are classified into two categories: Infrastructure networks and ad-hoc networks. These classifications are shown in Figure1

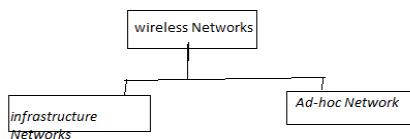


Fig1: Classification of wireless Networks

### A. Infrastructure Network

An access point (AP) represents a central coordinator for all nodes. Any node can enter into the network through AP. In addition, AP organizes the connection between the Basic Set Services (BSSs that the route is ready when it is needed. However, one drawback of using an infrastructure network is the large overhead of maintaining the routing tables.

### B. Ad-hoc Network

The term tends to “different forms” and can be mobile, stand alone. A wireless network is a decentralized type of wireless network. The network is because it does not rely on a pre-existing infrastructure such as routers in wired network or access point in wireless network. Network has various types such as VANETs (Vehicular Networks), SPANs (Smart Phone Ad-hoc Networks), IMANETs (Internet-Based Mobile Ad- hoc Networks), FANETs (Flying

Ad- hoc Networks), and MANETs (Mobile Ad- hoc Networks).

### VANETs

Vehicular Networks are used for communication between Vehicles and road side equipment. Intelligent Vehicular Networks (IVANETs), are a kind of artificial intelligence that helps Vehicles to behave in intelligent manner during Vehicles to Vehicles Collisions, Accidents.

### SPANETs

Smart Phone Ad hoc Networks leverage the existing hardware (Primarily Bluetooth and Wi-Fi) in commercially available Smart Phones to create Peer-to-Peer network without relying any network infrastructure.

### IMANETs

Internet-based ad hoc Network is a type of wireless ad hoc Network that supports Internet Protocols such as TCP/UDP and IP.

### FANETs

Flying Ad-hoc Network is composed of unmanned aerial Vehicle, allowing great mobility and providing connectivity.

In this paper, we discussed about one of the types of wireless ad hoc Network in brief that is MANETs (Mobile Ad- hoc Network).MANET (Mobile Network) is an autonomous system of mobile hosts connected by wireless links. There is no static infrastructure such as base stations.

Each node in the network act as a router: forwarding data packets for other nodes. It is a temporary network with no wires and no administrator intervention required. MANET is a self configuring network of mobile hosts connected by an arbitrary topology. The routers are free to move randomly, Networks wireless topology change rapidly and unpredictably. MANET nodes are Laptops, PDAs, Pocket PCs, Cellular Phones, Internet mobile Phones, Palmtops or any mobile or any other mobile wireless devices. These devices are typically lightweight and battery operated.

This paper is organized as follows Section I contains the introduction of MANETs, Section II contain the characteristics of MANETs, Section III contain the classification of routing protocols, Section IV contain the applications of MANETs, Section V contain the issues and challenges of MANETs, Section VI concludes the work with future directions.

## II. CHARACTERISTICS OF MANETS

The main Characteristics of MANETs are the computed lack of centralized control, lack of association among nodes, rapid mobility of host, frequent dynamically varying network topology, shared broadcast radio channel, insecure operating environment, physical vulnerability and limited availability of resources, such as CPU Processing Capacity, memory power, battery power and bandwidth.

### A. Dynamic Network Topology

The nodes in MANETs are free to move independently in any direction. The Network's wireless topology may change frequently and randomly at unpredictable times and primarily consisting of bidirectional links.

### B. Low Bandwidth:

These Networks have lower capacity and shorter transmission range than fixed infrastructure networks. The throughput of wireless communication is lesser than wired communication because of the effect of the multiple access, fading noise and interference conditions.

### C. Limited battery Power

The nodes of the hosts operate on small batteries and other exhaustible means of energy, so energy conservation is the most important design optimization criteria.

### D. Decentralized control

Due to unreliable links, the working of MANET depends upon cooperation of participating nodes. Thus, implementation of any protocol that involves a centralized authority or administrator becomes difficult.

### E. Unreliable communications

The Shared medium nature and unstable channel quality of wireless links may result in high packet loss rate and re-routing instability, which is a common phenomenon that leads to throughput drops in multi-hops networks. This implies that the security solution in wireless ad hoc networks cannot rely on reliable communication.

### F. Weak Physical Protection

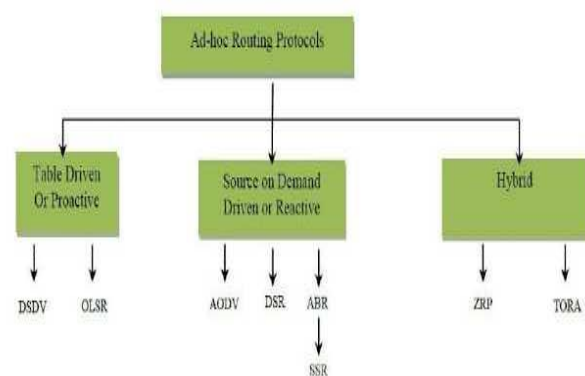
MANETs are more prone to physical security threats than fixed- cable nets. Mobile nodes are usually compact, soft and hand-held in nature. Today, Portable devices are getting smaller. They could get damaged or lost or stolen easily and misused by an adversary. The increased Possibility of different types of attacks should be carefully considered.

### G. Scalability

Due to the limited memory and processing power on mobile devices, the scalability is the key problem when we consider a large network size. Networks of 10,000 even 100,000 nodes are envisioned and scalability is one of the major design concerns.

## III. CLASSIFICATION OF ROUTING PROTOCOLS

Routing Protocols define a set of rules which governs the journey of message packets from source to destination in Networks. In MANET, there are different types of routing protocols each of them is applied according to the network circumstances. Basic classification of the routing protocols in MANET (shown in Figure 4)



**Classification of Routing Protocol**

### A. Proactive Routing Protocols

These protocols are also called as table driven routing protocols. In this every node maintain routing table which contain information about network topology even without requiring it. The routing table are updated periodically whenever the network topology changes. The

various proactive Routing protocols are DSDV, WRP, and CGSR.

#### 1). DSDV: Destination Sequence –Distance Vector

It is a table-driven routing for mobile networks based on the Bellman-Ford algorithm. It was developed by C. Perkins and P. Bhagwat in 1994. The main contribution of the algorithm was to solve routing loop problem. Each entry in routing table contains a sequence numbers, the sequence numbers are generally even if a link is present; else an odd number is used. The number is generated by the destination and the emitter needs to send out the next update with this number. For example, the routing table for node 4 in this network is

Destination	NextHop	Number of hops	Sequence Number	Install Time
A	A	0	A48	002000
B	B	1	B36	002200
C	B	2	C28	002500

The table contains all possible paths reachable by node A, along with the next hop, number of hops and sequence number.

#### 2). Wireless Routing Protocol:

WRP is enhanced version of the DSDV. It introduces mechanisms which reduce route loops and ensures reliable message exchange. DSDV maintains only one topology table. WRP uses a set of tables to maintain more accurate information. The tables that are maintained by a node are the following: Distance Table (DT), Routing Table(RT), Link Cost table (LCT), and a message retransmission List (MRL).

#### 3). CGSR: Cluster Head Gateway Switch Routing Protocol

The mobile nodes are grouped into Cluster and a Cluster-head is selected. All nodes in the range of the Cluster-head belongs its cluster. A gateway node is node that is the communication of two or more cluster-heads CSGR uses a least cluster range (LCC) algorithm the source node sends packet to its cluster-head. From this cluster-head, the packet is send to the gateway node that connects this cluster-head and the next cluster-head along the route to the destination.

#### B. Reactive Protocol

Reactive Protocol is also known as on-demand Routing Protocol. Each node needs to discover the route from source to destination. The Protocol consists of two main components namely: route discovery and route maintenance.

#### 1). Route Discovery

Source node sends a route request(RREQ) packet to its neighbours, which then forwards the request to its neighbour and so on. It records the address of the neighbour from which first packet of the broadcast is received, thereby establishing a reverse path. It replies by Uni-casting the route reply (URREP) towards source node.

#### 2). Route Maintenance

A route between source and destination pair is maintained as long as needed by the source. If destination or some intermediate node moves, the node remove the routing entry and send route error. The various Reactive Routing Protocols are: AODV, DSR, TORA.

#### 1) On-Demand Distance Vector.

AODV provides loop free routes while repairing link breakages.

#### 2). Dynamic Source Routing

Similar to AODV but entire route maintained within packet header Intermediate nodes propagating a “route request” append their ID to the “route record” in the packet header. When the packet reaches destination or node with valid cached route to destination, “route reply” returned. Like AODV, DSR also maintain the route information. It works user in large networks where route change frequently and mobility of route is higher.

#### 3) Temporally Ordered Routing Algorithm:

The TORA attempts to achieve a high degree of scalability using a “flat”, non-hierarchical routing algorithm. It builds and maintain a directed Acyclic graph (DAG) rooted at a destination. It does not use a shortest path selection.

The key design concepts of TORA is localization of control messages to a very small set of nodes near the occurrence of topological change, The protocol performs three basic functions: Route creation, Route maintenance Route erasure`

## IV. APPLICATIONS

With the increase of portable devices and progress in wireless communication, there are number of applications in MANETs. The set of applications is for MANET is diverse, range from large-scale, mobile, high dynamic networks to small, static networks having limited power resources. MANETs Network is a decentralized and devices are mobile, that is no fixed infrastructure. They provide numerous applications in different areas such as Military Tactical Operation, Search and Rescue Operation, Disaster Relief Operation, Law Enforcement and Commercial use.

#### A) Military Tactical Operation

For fast and possibly short term establishment of Military communications and Troop developments in hostile and for unknown environments.

#### B) Search and Rescue Operation

Search and Rescue Operation is for communication areas with little or no wireless infrastructure support.

#### C) Disaster Relief Operation

MANET is for Communication in environments where the existing infrastructure is destroyed or left inoperable.

#### D) Law Enforcement

MANET is for Secure and fast communication during Law Enforcement Operation.

#### E) Commercial use

To enable communications in Exhibitions, Conference and Large Gatherings. In Business Scenarios, the need for collaborative computing might be more important outside office environments than inside a building. After all, it is often the case where people do need to have outside meetings to cooperate and exchange information on a given project.

### V. ISSUES AND CHALLENGES OF MANET

#### Limited Bandwidth

Wireless network have limited bandwidth, lower capacity as compared to infrastructure networks. The effect of fading, multiple accesses, interference addition is varying in ad-hoc networks in comparison with maximum radio transmission rate.

#### Dynamic topology

A node has less trust between them, due to dynamic topology some settlement are node between the nodes in trust level.

#### High Routing

Due to dynamic topology node changes their position frequency which affects the routing table.

#### Transmission Error and Packet loss

By increasing in collision, hidden terminal, interference, and unidirectional links and by the mobility of nodes frequent path breaks a higher packet loss has been faced by ad-hoc networks.

#### Mobility

Dynamic nature of network topology is due to movement of the nodes. Ad hoc networks face path breaks and it also changes in the route frequently.

#### Security Threats

New security challenges bring by this networks due to wireless behaviour. The trust management between nodes leads the numerous security attacks. The two types of attacks are Active Attacks And Passive Attacks.

### VI. CONCLUSION

MANETs requires a reliable, efficient, scalable, and most importantly a secure protocol as they are highly insecure, self-organizing, rapidly deployed and they use dynamic routing. We have seen a great development in the field of wireless networks and in the field of mobile network. The number of Routing protocols for MANET, which are broadly categorized as proactive, reactive protocol and hybrid protocol. These Networks are going to have widespread use in future; there are various challenges that need to be met. Designing MANET protocol and applications is a very complicated task. Applications in our paper will give the new way for researchers to new innovations in future.

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