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## A STUDY ON PROBLEMS AND CHALLENGES IN MOBILE AD HOC NETWORKS

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### Abstract :

*Mobile Ad Hoc Networks (MANETs) are infrastructure-less wireless networks composed of mobile nodes that operate without centralized control or fixed switching devices. Each node is capable of movement and can dynamically establish connections with other nodes through wireless communication. This paper presents an analytical study of Mobile Ad Hoc Networks, including their classification, characteristics, and operational features. In addition, the major issues and challenges associated with MANETs—such as routing, security, and quality of service—are discussed in detail to highlight the complexities involved in their deployment and management.*

**Keywords :** MANET, Wireless LAN, VANET, QoS, DoS, Router

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### Introduction :

Wireless networks have gained significant importance in the computing domain since their emergence in the 1970s. Over the past decade, their adoption has increased rapidly due to advancements that support mobility. Currently, mobile wireless networks can be broadly classified into two categories.

The first category consists of infrastructure-based networks, which rely on fixed and wired gateways known as base stations. In such networks, a mobile node communicates with the nearest base station within its transmission range. When the node moves out of one base station's coverage area and enters another, a seamless handoff process ensures uninterrupted communication. Wireless Local Area Networks (WLANs) are common examples of this type of network.

The second category includes infrastructure-less mobile networks, commonly referred to as Mobile Ad Hoc Networks (MANETs). These networks do not depend on fixed routers or centralized administration. Instead, all nodes are mobile and can dynamically form network topologies in an unpredictable manner. Each node functions not only as an end device but also as a router, discovering and maintaining routes to other nodes. MANETs are widely used in scenarios such as disaster recovery operations, emergency rescue missions, conferences, and data collection in hostile or remote environments where conventional



infrastructure is unavailable.[1]

## 1. Classification :

Mobile Ad Hoc Networks can be classified into the following types:

### A. Vehicular Ad Hoc Networks (VANETs) :

These networks enable communication among vehicles and between vehicles and roadside infrastructure to support intelligent transportation systems.

### B. Internet-based Mobile Ad Hoc Networks (iMANETs) :

iMANETs integrate mobile ad hoc networks with fixed Internet gateway nodes, allowing mobile nodes to access Internet services. Traditional ad hoc routing protocols may not be directly applicable in such environments.

### C. Intelligent Vehicular Ad Hoc Networks (InVANETs) :

These networks incorporate artificial intelligence techniques to enable smart vehicular behavior, particularly in scenarios involving collision avoidance, accident management, and detection of unsafe driving conditions.

## 2. Features :

Mobile Ad Hoc Networks exhibit the following key characteristics:

- Absence of fixed infrastructure, resulting in a flat network architecture
- Wireless communication using a shared radio medium
- Each node operates both as a host and a router
- Nodes function autonomously without centralized control
- Dynamic topology due to node mobility
- Limited energy, processing power, and memory resources
- Unreliable wireless links prone to interference and signal degradation
- Lack of built-in security mechanisms in traditional routing protocols
- Routing protocols not originally designed for highly dynamic ad hoc environments[2]

## Issues In Mobile Ad-Hoc Networks :

Several issues make MANETs complex to integrate with existing global networks.

### A. Routing :

Routing is one of the most challenging aspects of MANETs due to the continuously changing network topology. Since there is no predefined routing path, nodes must dynamically discover and maintain routes. Each node acts as a router, forwarding packets for other nodes to enable multi-hop communication.

### B. Security :



Wireless communication is inherently more vulnerable than wired communication. The open nature of radio channels makes MANETs susceptible to eavesdropping, interception, and cryptographic attacks, especially when encryption mechanisms are weak or improperly implemented.[3]

### **C. Quality of Service (QoS) :**

Providing Quality of Service in MANETs is difficult because of node mobility, fluctuating bandwidth, and limited resources. Maintaining consistent performance levels in such a dynamic environment remains a significant challenge.

### **Challenges In Mobile Ad- Hoc Networks :**

MANETs face numerous operational challenges, including:

- Nodes acting as both end systems and intermediate routers
- Frequently changing network topology
- Potential network partitions
- High node mobility
- Limited battery power
- Restricted wireless bandwidth
- Variable channel quality
- Absence of centralized management
- Efficient routing and channel access mechanisms
- Mobility management
- Energy conservation
- Optimal utilization of available bandwidth [4]

### **Review Of Literature :**

Mobile ad hoc networks (MANETs) are perplexing circulated frameworks that contain remote portable hubs that can unreservedly and progressively arrange themselves into erratic and brief, 'specially appointed' network geographies, permitting individuals and gadgets to consistently internetwork in regions with no previous correspondence foundation, as in the event of calamity recuperation conditions. Ad hoc networking systems administration idea is definitely not another one, having been around in different structures for more than 30 Years. Generally, strategic organizations have been the main correspondence organizing application that followed the specially appointed worldview. With the presentation of new innovations, for example, the Bluetooth, IEEE 802.11, possible business MANET organizations have been made external the tactical space. These new advancements have been creating a reestablished and developing interest in the innovative work of MANET [5].

As of late, the famous development of versatile registering gadgets, which principally incorporate workstations, individual advanced partners (PDAs) and handheld advanced gadgets, has caused a progressive change in the processing scene: figuring won't just depend



on the capacity given by the PCs, and the idea of universal processing arises and becomes one of the exploration areas of interest in the software engineering society [6].

In the omnipresent figuring climate, individual clients at the same time use a few electronic stages through which they can get to all the expected data at whatever point and any place they might be [7].

The pervasive idea of figuring has made it obligatory to embrace remote organization as the interconnection strategy: it isn't workable for the universal gadgets to get wired network interface at whatever point and any place they need to interface with other omnipresent gadgets. The Portable Impromptu Organization is one of the remote organizations that have drawn in significant pushed from numerous scientists.

A Mobile Ad hoc NETwork35 (MANET) is an arrangement of remote portable hubs that progressively put together themselves in erratic and transitory organization geographies. Individuals and vehicles can accordingly be internetworked in regions without an as of now correspondence framework or when the utilization of such foundation requires remote augmentation. Maybe the most broadly acknowledged and recognized thought of a versatile impromptu organization is an organization framed with next to no focal organization, comprising of portable hubs that utilization a remote connection point to send bundle information. As the hubs in an organization of this sort can act as switches and has, they can advance bundles for the benefit of different hubs and run client applications [8].

Portable Mobile ad hoc networks are frameworks that are independent, included various versatile hubs that convey through remote method for correspondence. They are self-coordinated, self-arranged and self- controlled framework less organizations. These organizations can be set up and sent rapidly on the grounds that it has a basic foundation set-up and no focal organization.

Mobile ad hoc networks (MANET's) are self- designing and framework less organizations that are contained versatile hubs which impart over remote connections with no focal control and on a shared premise. These singular hubs go about as switches to advance both their own information and furthermore their neighbor's information by sending and getting parcels to and from different hubs in the organization. The self-arrangement and the speedy sending make impromptu organizations reasonable for crisis circumstances (like human or cataclysmic events) and for military activities [9].

One situation is laying out correspondence between various specialists in a catastrophe recuperation activity where for example firemen need to associate with nearby ambulances and traffic light, in conditions where the typical correspondence foundation is obliterated or generally delivered unusable. In such circumstances an assortment of versatile hubs with remote organization connection point can shape a short lived network.

Mobile ad hoc networks (MANET's) are independent frameworks of versatile hubs associated by remote connections. These hubs are in this manner allowed to randomly move. The geography of these organizations changes powerfully and unusually. MANETs have



numerous attributes that make them unique in relation to other remote and wired networks that are generally perceived [10, 11, 12, 13, and 14]:

#### **A. Multi-hop correspondences :**

The correspondence between any two distant Hubs in MANET is performed by various go-between hubs whose capabilities are to hand-off information parcels starting with one point then onto the next. Accordingly, specially appointed networks need the help of multi-bounce interchanges.

#### **B. Compelled Assets :**

For the most part, MANET gadgets are little hand-held gadgets going from individual advanced associates (PDAs) and workstations down to phones. These gadgets to be sure have impediments due to their confined nature; they are many times battery- worked, with little handling and storage spaces. [10]

#### **C. Infrastructure less :**

MANETs are framed in light of the joint effort between independent hubs, shared hubs that need to speak with one another for particular reason, with no pre-arranged framework or base station.

#### **D. Dynamic Geography :**

MANET hubs are allowed to move, subsequently the availability between hubs in MANET can change with time, since tributes can move randomly; hence the hubs can be powerfully inside and outside the organization, continually changing their connections and geography, Prompting change in the steering data all the time because of the development of the hubs. Consequently, the imparted joins between hubs in MANET can be bi-directional or unidirectional.

#### **E. Restricted Gadget Security :**

MANET gadgets are normally little and can be moved starting with one spot then onto the next, and afterward they are not obliged by area. Sadly, thus these gadgets could be handily lost, taken or harmed.

#### **F. Restricted Actual Security :**

For the most part, MANETs are more vulnerable to actual layer assaults than wired network; the chance of ridiculing, snooping, sticking and refusal of administration (DoS) assaults ought to be painstakingly thought of. By contrast the decentralized idea of MANET improves them safeguarded against single disappointment focuses.

#### **G. Short Reach Availability :**

MANETs depend on radio recurrence (RF) innovation to associate, which is overall viewed as short reach correspondence. Consequently, the hubs that need to impart



straightforwardly should be in the nearby recurrence scope of one another. To manage this impediment, multi-jump directing systems have hence to be utilized to interface far off hubs through delegate ones that work as switches.

### **Characteristic Issues of Mobile Ad Hoc Networks :**

Unreliable wireless communication between hubs: Versatile hubs don't predictably partake in correspondence, since their energy asset is very restricted.

### **Non-disavowal :**

The powerlessness of any hub inside a MANET to invalidate the way that it is a source of a message. This prerequisite is given by delivering a mark to each message. In a typical encryption system by the public key technique, each hub in a MANET signs a message by utilization of a confidential key. Any remaining hubs confirm the marked message with this hub's public key, subsequently he can't nullify that his mark is connected to the message.

Availability represents the availability of all network services and resources to legitimate network users, which is essential for preserving the network structure during the attacks. Access control is a strategy for counteraction of unapproved access and utilization of organization frameworks and assets Difficulties in Versatile impromptu organizations the primary test of MANETs is their weakness to security assaults and how to work safely and effectively while saving its own assets [10, 11].

MANET hubs are normally recognized by their restricted power, handling, and memory assets as well as serious level of portability. In such organizations, the remote portable hubs may powerfully enter the organization as well as leave the organization. Because of the restricted transmission scope of remote organization hubs, various bounces are normally required for a hub to trade data with some other hub in the organization.

The difficulties of supporting Nature of Administration in specially appointed networks are the means by which to save transmission capacity and how to ensure the predefined delay for constant application information streams. For remote transmissions, the channel is divided between neighbors. In this way, the accessible transmission capacity relies upon the adjoining traffic status, as does the postponement. Because of this trademark, supporting QoS isn't possible by the actual host, yet participation from the hosts inside a hub's impedance range is required. This requires an imaginative plan to facilitate the correspondence among the neighbors to help QoS in MANETs. Besides, the conveyed association of MANETs carries extra difficulties to coordinated effort for supporting QoS .

There are circumstances where client required systems administration associations are not accessible in a given geographic region, and giving the required network and organization administrations in these circumstances turns into a genuine test. All the more as of late, new elective ways of conveying the administrations have been arising. These are engaged around having the cell phones associate with one another in the transmission range through programmed arrangement, setting up a specially appointed versatile organization that is both



adaptable and strong. Along these lines, in addition to the fact that versatile hubs speak with each other, yet can likewise get Internet providers through Web door hub, really stretching out Internet providers to the non- framework region. As the remote organization keeps on advancing, these specially appointed capacities are supposed to turn out to be more significant, the innovation arrangements used to help more basic and critical future innovative work endeavors can be anticipated in industry and foundation [12].

Since security is a fundamental part in MANET, the striking elements of portable impromptu organizations raise the two difficulties and open doors in accomplishing these security objectives, In contrast to other conventional organizations (wired) where hubs should have actual admittance to the organization or convey through a few guard edges like firewalls and passages, MANET utilizes the remote medium so goes after on a remote organization can emerge out of all headings and focus on any hub. This gives a bigger surface of assault going from inactive assaults, for example, "tapping" to dynamic assaults, for example, message replay, message spillage, tainting and mutilation. This implies that a MANET doesn't have a reasonable line of protection, and each hub should be ready to safeguard against the different sort of assaults[13].

### **Conclusion And Future Scope :**

This paper presented a comprehensive overview of Mobile Ad Hoc Networks, including their classification, characteristics, issues, and challenges. A detailed literature review highlighted the evolving research landscape and the key technical problems associated with MANETs. Future research efforts should focus on improving routing efficiency, security mechanisms, and Quality of Service to enhance the reliability and scalability of Mobile Ad Hoc Networks in real-world applications.

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