

Study of Mobile Ad-hoc Network (MAGNET)

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ABSTRACT

Mobile Ad-hoc Network (MANET) is a collection of wireless mobile nodes dynamically forming a temporary network without the aid of any established infrastructure or centralized administration. The mobility of nodes in MANETs changes frequently which results in changing network topology, due to changing network topology routing in MANETs is a challenging task.

Keywords: Basics of MANET, Self Organizing network, Mobile Communications

INTRODUCTION

A **mobile ad hoc network (MANET)** is a self-configuring infrastructureless network of mobile devices connected by wireless. *Ad hoc* is Latin and means "for this purpose".

Each device in a MANET is free to move independently in any direction, and will therefore change its links to other devices frequently. Each must forward traffic unrelated to its own use, and therefore be a router. The primary challenge in building a MANET is equipping each device to continuously maintain the information required to properly route traffic. Such networks may operate by themselves or may be connected to the larger Internet.

Mobile Ad hoc networking will play an important role in the future of mobile communication. Mobile networking is one of the most important technologies, devices like Personal Digital Assistants (PDAs), mobiles and computers enhance information processing with mobility [1]. Mobile ad hoc network aims to provide a pervasive computing environment that supports users in accomplishing their tasks. The unique characteristics possess the great demand of MANETs when mobile devices are connected through wireless links [2]. Nodes can directly communicate with each other that are in range of a mobile ad hoc network, whereas nodes which are out of range are connected by intermediate nodes [6]. Due to the movement of nodes, routing in these networks is complex and many protocols have been derived. Mobile ad hoc networks are very vulnerable and thus possess many challenges and security issues to improve the performance.

MANETs are a kind of wireless ad hoc network that usually has a routable networking environment on top of a Link Layer ad hoc network.

The growth of laptops and 802.11/Wi-Fi wireless networking has made MANETs a popular research topic since the mid-1990s. Many academic papers evaluate protocols and their abilities, assuming varying degrees of mobility within a bounded space, usually with all nodes within a few hops of each other. Different protocols are then evaluated based on measures such as the packet drop rate, the overhead introduced by the routing protocol, end-to-end packet delays, network throughput etc.

These networks are a decentralized system. Here nodes communicate with each other without any centralized access points or base stations. In this type of network, each node acts both as a router and as a host at the same time. Due to the limited transmission range, multiple hops are needed for the data exchange in the network. Mobile Ad hoc Network is the rapidly growing technology from the past 20 years. The gain in their popularity is because of the ease of deployment, infrastructure less and their dynamic nature. MANETs created a new set of demands to be implemented and to provide efficient better end-to-end communication. MANETs work on TCP/IP structure in order to provide the

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communication between the work stations. Work stations are mobile, that is why the traditional TCP/IP model needs to be modified, in order to compensate the MANETs mobility to provide efficient functionality of the network. That is why the key research areas Routing. Routing protocols in MANETs is a challenging task, researchers are giving their attention to this area [1].

Types

- Vehicular Ad hoc Networks (VANETs) are used for communication among vehicles and between vehicles and roadside equipment
- Internet based mobile ad hoc networks (iMANETs) are ad hoc networks that link mobile nodes and fixed Internet-gateway nodes. In such type of networks normal adhoc routing algorithms don't apply directly.
- Intelligent vehicular ad hoc networks (InVANETs) are a kind of artificial intelligence that helps vehicles to behave in intelligent manners during vehicle-to-vehicle collisions, accidents, drunken driving etc.

BASICS OF MANET

The basics of MANETS are discussed in this section. Firstly the basic MANET concept is illustrated. After this the features and applications of MANETS are discussed.

Manet Concept

A Mobile Ad hoc network is formed of collection of wireless nodes that can be set up anywhere and anytime without the intervention of existing network [1]. In this system mobile system are free to move and often act as routers as well as hosts connected by wireless links. A mobile Ad hoc network forms the communication that is cost effective among many mobile hosts [2]. Ad hoc networks are highly effective in numerous situations such as emergency and rescue situations where team's members need to be communicated while others are not allowed to intervene. Further, using mobile ad hoc networking in convention centers, online conferences and classrooms without routing them to the available infrastructure and provide cost effective and cheaper communication to share information[2] . Mobile hosting traffic in infrastructure less mobile ad hoc networking is different from those in infrastructured wireless networks, including:

Peer-to-Peer

Communication is between two nodes with in one hop and it results in good connectivity [1] .

Remote-to-Remote

Communication maintains a stable route between two nodes beyond single hop. This may be outcome of many nodes in communication range with each other over respective are[1] .

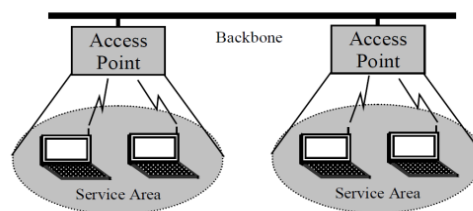


Fig1. Infrastructure-based wireless network

Dynamic Traffic

Nodes are constantly moving around and dynamic in nature. Communication does not maintain stable route between nodes and routes may be reconstructed. This results in poor connectivity [1]. The figure of infrastructure based wireless network is shown below:

A basic arrangement of a Mobile Ad-hoc Network is shown below in figure:

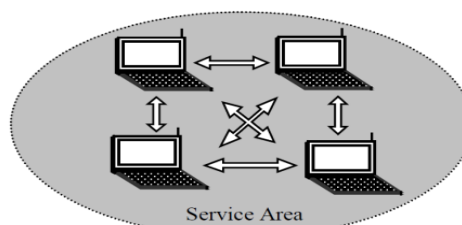


Fig2. Ad hoc wireless network

Features in Manet

Features of MANETS are illustrated below:

Autonomous Terminal

Nodes in MANET can serve the function of host as well as perform functions as router [4].

Distributed Operation

As there exists no central control system in background, the control and management operation of networks are distributed among terminals only. All nodes are collaborated and work themselves and each node acts as needed [1].

Multihop Routing

Single hop and multihop are the basic types of ad hoc routing algorithms. In terms of structure and implementation single hop MANET simpler than multihop. Delivering packets in mutihop are transmitted though more than one node to the destination [4].

Dynamic Network Topology

Network topology may change rapidly and unpredictably as nodes are mobile. Nodes that lie within each other's range can communicate directly and are responsible for dynamically discovering each other[1].

Self-Creation, Self-Organization and Self Administration

Mobile Ad hoc network can be rapidly deployed as there is no need for detailed plane of installation or wiring[4].

Manets Application

Mobile ad hoc networks are gaining importance with increasing number of application, some are as follow[4]:

SYSTEM CHALLENGES IN MANETS

Beside number of applications there are certain challenges which depict the inefficiencies and limitations of mobile ad hoc networking. Few challenges are as following [5]:

Limited Transmission Range

Data rates and radio bands are limited in wireless networks compare to what wired networks offer. Thus wireless networks must use bandwidth always in optimal manner [5].

Routing

Routing packets between pair of nodes is a challenging task as topology of network is changing constantly. Also multicast tree is not static as random movement of nodes is throughout the network [4].

Security

Radio channels in particular Ad hoc network are shared by all nodes. The attacker can easily snoop the data from transmitted from the node that is in its range. This originates the concept of authentication and key management in mobile ad hoc networks to protect data from attackers[1].

Quality of Services (QOS)

Quality of service is difficult in mobile ad hoc network as it is not possible to provide same grade of quality to each and every device in particular network. It depends on many factors such as the mobility of nodes and traffic in the network. The quality of service in constantly changing environment is a challenge [8].

Battery Constrains

Devices in wireless networks has limited power source in order to maintain portability, weight and size of the device. There must be optimal utilization of power and routing must be undertaken for conservation of power [6].

SECURITY ISSUES

Following are the key security issues in MANETs:

Lack of Secure Boundaries

In mobile ad hoc networks once the adversary is in radio range it accesses the network and there is need to gain physical access. It joins the network automatically by accessing the nodes in its range. Unsecure boundaries make the network easy targets for attackers[6].

Threats from Compromised Nodes inside the Network

Since mobile nodes can join and leave the network freely, the compromised node could change its attack target frequently and performs malicious behavior through different nodes. Thus it's very difficult to track down the behavior performed by the compromised node and thus these attacks are much harder to detect[6].

Lack of Centralized Management Facility

Due to the absence of centralized management facility it's very difficult to detect the attacks as it is very difficult to monitor the traffic. The decision making ability is sometime decentralized as there is no central authority. Thus lack of centralized management facility can influence several aspects in mobile ad hoc networks [6].

Power Restricted

While a node of mobile ad hoc network relies on batteries they have limited source of power for the operation. Attackers could easily access the node and can run out the node from power supply by trapping it in time consuming computation. Thus the battery will be exhausted and node will run out of service and no longer available in ad hoc network [6].

Scalability

The scale keeps on changing due to the mobility of nodes in mobile ad hoc network and it is difficult to predict how many nodes will there be in future. Thus routing protocols and key management services are compatible to manage the continuously changing scale of the network [6].

CONCLUSION

In this paper MANET concept is discussed along with its features, application, challenges and security issues. Mobile ad hoc networks have flexibility, ease of deployment, less cost and potential applications which make them essential part of future computing environment. Before implementing the security issues that can cause problems should be taken care. MANETs give an alternative solution for communication during emergency situations when traditional network infrastructure is not available. Discussion in this paper gives the vision that mobile ad hoc networks still possess large number of challenges related to devices, application and services to be solved.

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