

Mobile Ad Hoc Networks (MANET)-An Overview

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ABSTRACT

Mobile ad hoc networks (MANETs) are a subclass of wireless ad hoc networks having special characteristics of dynamic network topology and moving nodes. Mobile ad hoc networks (MANETs) are infrastructure-less self-configuring networks designed to support mobility. The main of this paper is to provide an overview of MANET including its concept, features, types, and its applications along with the routing protocols used for communication.

Keywords: Mobile ad hoc networks, Vehicular ad hoc networks, Smart phone ad hoc networks, Flying ad hoc networks

I. INTRODUCTION

Mobile computing is one of the most important technologies supporting pervasive computing. Advances in both hardware and software techniques have enabled the spread of mobile hosts and wireless networking to masses. Generally, there are two modes in which wireless mobile nodes can communicate,

1. **Infrastructured:** In this mode, all the communication among the mobile nodes goes through a base station. A Base station is also known as an access point. These base stations are connected to the fixed infrastructure or wired networks.

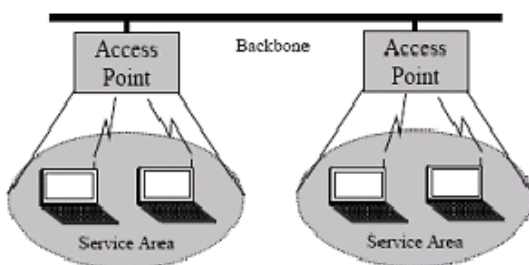


Figure 1. Infrastructure-Based Wireless Network

2. **Infrastructure less:** This mode of communication is known as a mobile ad hoc network. A MANET is a collection of wireless nodes that can dynamically form a network to exchange information without using any pre-existing fixed network infrastructure. This is a very important part of communication technology that supports truly pervasive computing because in many contexts information exchange between mobile units cannot rely on any fixed network infrastructure, but on the rapid configuration of wireless connection on-the-fly. A typical example of this mode of communication is people sitting in the conference room and exchanging data among them without any fixed infrastructure.

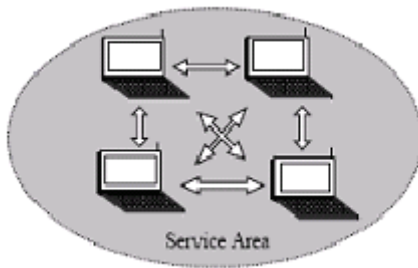


Figure 2. Infrastructure less (Ad Hoc) Wireless Network

II. CONCEPT OF MANET

A mobile ad-hoc network is a collection of wireless nodes that can dynamically be set up anywhere and anytime without using any pre-existing network infrastructure. It is an autonomous system in which mobile hosts connected by wireless links are free to move randomly. In MANET, nodes can be act as both host and routers.

III. FEATURES OF MANET

The features of MANET are given below:

1. **Autonomous terminal:** In MANET, each mobile host is an autonomous node, which may function as both a host and a router. In other words, besides the basic processing ability as a host, the mobile nodes can also perform switching functions as a router. So usually endpoints and switches are indistinguishable in MANET.
2. **Distributed operation:** There is no background network for the central control of the network operations, the control and management of the network is distributed among the terminals. The nodes involved in a MANET should collaborate amongst themselves and each node acts as a relay as needed, to implement functions e.g. security and routing.
3. **Multi-hop routing:** Basic types of ad hoc routing algorithms can be single hop and multi-hop. Single-

hop MANET is simpler than multihop in terms of structure and implementation, with the cost of lesser functionality and applicability. When delivering data packets from a source to its destination out of the direct wireless transmission range, the packets should be forwarded via one or more intermediate nodes.

4. **Dynamic network topology:** Here the nodes are mobile, the network topology may change rapidly and unpredictably and the connectivity among the terminals may vary with time. MANET should adapt to the traffic and propagation conditions as well as the mobility patterns of the mobile network nodes. The mobile nodes in the network dynamically establish routing among themselves as they move about, forming their own network on the fly. Moreover, a user in the MANET may not only operate within the ad hoc network but may require access to a public fixed network.

5. **Fluctuating link capacity:** The nature of high bit-error rates of wireless connection might be more profound in a MANET. One end-to-end path can be shared by several sessions. The channel over which the terminals communicate is subject to noise, fading, and interference, and has less bandwidth than a wired network. In some scenarios, the path between any pair of users can traverse multiple wireless links and the link themselves can be heterogeneous. One effect of the relatively low to moderate capacities is that congestion is typically the norm rather than the exception i.e. aggregate application demand will likely approach or exceed network capacity frequently.

6. **Energy-constrained operation:** Some or all of the nodes in a MANET may rely on batteries or other means for their energy. Such devices need optimized algorithms and mechanisms that implement the computing and communicating functions.

7. **Limited physical security:** MANETs are generally more vulnerable to physical security threats than are

fixed cable networks. The increased possibility of eavesdropping, spoofing and denial-of-service attacks should be carefully considered.

IV. TYPES OF MANET

1. **Vehicular ad hoc networks (VANETs)** are used for communication between vehicles and roadside equipment. Intelligent vehicular ad hoc networks (In VANETs) are a kind of artificial intelligence that helps vehicles to behave in intelligent manners during vehicle-to-vehicle collisions, accidents.
2. **Smart phone ad hoc networks (SPANs)** leverage the existing hardware (primarily Bluetooth and Wi-Fi) in commercially available smart phones to create peer-to-peer networks without relying on cellular carrier networks, wireless access points, or traditional network infrastructure. SPANs differ from traditional hub and spoke networks, such as Wi-Fi Direct, in that they support multi-hop relays and there is no notion of a group leader so peers can join and leave at will without destroying the network.
3. **Internet-based mobile ad-hoc networks (iMANETs)** is a type of wireless ad hoc network that supports Internet protocols such as TCP/UDP and IP. The network uses a network-layer routing protocol to link mobile nodes and establish routes distributedly and automatically.
4. **Flying ad hoc networks (FANETs)** are composed of unmanned aerial vehicle, allowing great mobility and providing connectivity to remote areas.

V. APPLICATIONS OF MANET

Mobile ad-hoc networks are the only choice for mobility support where there is no infrastructure or

it is too expensive. Some application areas of such use of MANET are given below:

1. **Instant Infrastructure:** Unplanned meetings, spontaneous interpersonal communications etc. Cannot rely on any infrastructure, therefore ad-hoc connectivity has to be set up.
2. **Disaster relief:** Disaster break infrastructure and emergency teams have to rely on the infrastructure they set up themselves. Therefore, ad-hoc networks can be the solution.
3. **Military Activities:** Many military activities are confidential and for security reasons it is good to use ad-hoc connectivity for communication.

Remote Area: In sparsely populated and hilly areas it is too expensive to set up an infrastructure. Depending on the communication pattern, ad-hoc networks can be the solution.

VI. CLASSIFICATION OF ROUTING PROTOCOLS IN MANET

Mobility of nodes and rapidly changing topology are such characteristics of the MANET network that make routing decisions more challenging. Several other factors such as power and storage constraints and security makes routing more challenging in VANET. Routing protocols can be classified on various basis such as on the topology of network for routing i.e. proactive and reactive routing protocols, on the basis of communication strategy used for delivery of information from source to destination i.e. unicast, multicast and broadcast. In this paper, classification is done using topology information. Topology-based routing protocol uses topology information which is stored in the routing table as a basis to forward packets from source node to the destination node. They are further divided into three groups as Proactive, Reactive and Hybrid Protocols.

The Classification done using Topology is represented below,

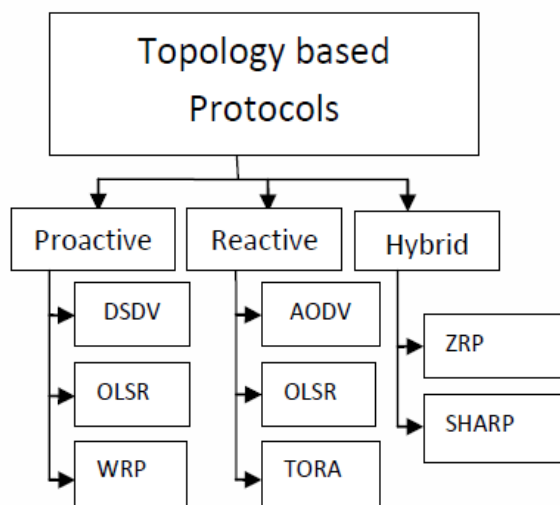


Figure 3. Classification of Routing Protocols of MANET

A. Proactive Routing Protocol

Proactive MANET protocols are table-driven and will actively determine the layout of the network. Through a regular exchange of network topology packets between the nodes of the network, a complete picture of the network is maintained at every single node. There is hence minimal delay in determining the route to be taken. This is especially important for time-critical traffic. However, a drawback to a proactive MANET of protocol is that the life span of a link is significantly short. This phenomenon is brought about by the increased mobility of the nodes, which will render the routing information in the table invalid quickly. When the routing information becomes invalid quickly, there are many short-lived routes that are being determined and not used before they turn void. Hence, another drawback resulting from the increased mobility is the amount of traffic overhead generated when evaluating these unnecessary routes. This is especially aggravated when the network size increases. The fraction of the total control traffic that consists of actual practical data is further decreased.

Example of Proactive Routing Protocol

- Destination-Sequenced Distance Vector (DSDV)
- Optimized Link State Routing (OLSR)
- Wireless Routing Protocol (WRP)

B. Reactive Routing Protocol

On-demand routing is a popular routing category for wireless ad hoc routing. It is a relatively new routing philosophy that provides a scalable solution to relatively large network topologies. The design follows the idea that each node tries to reduce routing overhead by only sending routing packets when communication is requested. Common for most on- demand routing protocols are the route discovery phase where packets are flooded into the network in search of an optimal path to the destination node in the network. There are numerous on-demand routing protocols, but only two of them are more significant. These are Ad Hoc On-Demand Distance Vector Routing (AODV) and Dynamic Source Routing (DSR). These two have been chosen because both have been extensively evaluated in the MANET literature and are being considered by the Internet Engineering Task Force (IETF) MANET Working Group as the leading candidates for standardization. Thus, reactive MANET protocols are most suited for networks with high node mobility or where the node transmits data infrequently.

Example of Reactive Routing Protocol

- Ad Hoc On-Demand Distance Vector (AODV)
- Dynamic Source Routing (DSR)
- Temporally Ordered Routing Algorithm (TORA)

C. Hybrid Routing Protocol

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Since proactive and reactive routing protocols each work best in oppositely different scenarios, there is good reason to develop hybrid routing protocols, which use a mix of both proactive and reactive routing protocols. These hybrid protocols can be used to find a balance between the proactive and reactive protocols. The basic idea behind hybrid routing protocols is to use proactive routing mechanisms in some areas of the network at certain times and reactive routing for the rest of the network. The proactive operations are restricted to a small domain in order to reduce the control overheads and delays. The reactive routing protocols are used for locating nodes outside this domain, as this is more bandwidth-efficient in a constantly changing network.

Example of Hybrid Routing Protocol

- Zone Routing Protocol (ZRP)
- Sharp Hybrid Adaptive Routing Protocol (SHARP)

VII. CONCLUSION

In this paper, an overview on Mobile ad hoc networks (MANETs) is presented including concept of MANETs, its applications and features that distinguish it from other wireless networks. Due to these features, there is need of separate routing protocols for MANET. Classification of routing protocols for MANET has been done on the basis topology of the network i.e. proactive or table- driven and reactive or demand- driven. A summarized overview of routing protocols belonging to each type of classification has also been presented which is very useful when we get to know about an overview of MANET. We concluded that MANET routing protocols are designed based on the application area and environment and it is not possible to design a single protocol, which is suitable for all MANETs.