

Analysis of MANET Characteristics, Applications and its routing challenges

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Abstract-In the last few years; we have seen that the field of mobile computing drastically changes due to the economical, widely available wireless devices. However, current devices, applications and protocols are mainly focused on cellular or WLAN, without including the MANET (Mobile Ad-Hoc Network).

Keywords- MANET, Security, Routing, Bandwidth, Power

INTRODUCTION

A MANET is an autonomous collection of mobile devices like laptops, smart phones, wireless sensor, etc) which will communicate with each other over using wireless links and helps in the distributed form to provide the necessary network functionality where the fixed network infrastructure is not available. This type of network, operating as a stand-alone network or more than one points of connection to cellular network or the Internet, provides the way for new and exciting applications. If we talk about application scenarios include, emergency operations like flood, earthquake, etc., in auditorium for a conference, personal network etc. In this paper, we can see the potential of a MANET for different kind of applications using Ad-Hoc Networks and also we will see challenges to face by protocol and network developers. These challenges include network and resource discovery, routing problem, Internet connectivity, Security, Network lifetime, power consumption at node level, temporary network without any established infrastructure or centralized administration, security challenges to provide secure communication, etc.

The growth of wireless communication including mobile communication field is at very much high level during the last few decade. Currently second generation (2G) and third generation cellular systems have been reached probably at saturation level, which enables worldwide mobile connectivity. Now a day, Mobile users are using their smart phones to check email and browse the Internet. Recently, an increasing number of WLAN hot spots is rising, which will allow travelers with portable computers to surf the Internet from any feasible locations like airports, railway stations, hotels, school or college campus as well as other public locations. Presently, third generation (3G) provides higher data rates, location-based or person requirement based services.

Even though, all these networks are usually wireless networks, they required a fixed network infrastructure with centralized administration for their operation, which will consumes a lot of time and money for setup and maintenance. Another thing, wireless interfacing ranges is short in different devices like as laptops, Personal Digital Assistants, Tablet PCs, smart phones, etc. But, these kinds of devices are small in size, economical and more users oriented. This will provides a new concept of wireless network in which mobile devices form a self creating network, self organizing network and self-administering network, called a mobile ad hoc network[1].

Mobile Ad Hoc Networks (MANETs) has become one of the most favorite areas of research now a day because of its challenges related to its protocols. MANET is the new emerging technology which enables users to communicate without any need of any fixed infrastructure, because of this; sometimes it is also called an infrastructure less network. Due to some advance features like cheaper, small and more powerful devices make MANET a fastest growing network. A MANET is self-organizing and adaptive. Device in mobile ad hoc network should be able to find out the presence of other devices in the same network and perform necessary set up to communicate and sharing of data and service with it. MANET allows the devices to maintain connections to the network as well as easily adding and removing devices to and from the network. Opposed to infrastructure wireless networks, where each user directly communicates with an access point or base station, a mobile ad hoc network, or MANET, does not rely on a fixed infrastructure for its operation as shown in the Fig. 1 for peer to peer communication.

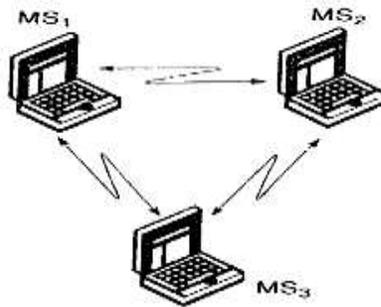


Fig. 1 Peer to peer Mobile Ad-Hoc Network (MS stands for Mobile Station)

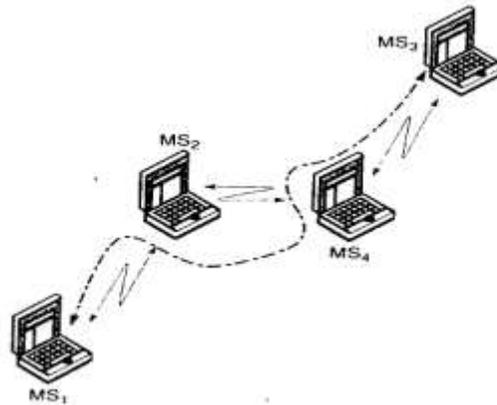


Fig. 2 Multi-hop Mobile Ad-Hoc networks (MS stands for mobile Station)

Fig. 2, shows the multi-hop ad hoc network, where more than one node or device is able to communicate with each other. In addition, in MANET all devices are free to join or leave the network and they may move randomly anywhere within the range of network, which results in continuous change in network topology, which may generate the problem of communication in between every device. In this energy constrained, dynamic network topology, multihop environment, nodes need to organize themselves dynamically in order to provide the necessary network functionality without any fixed infrastructure or central control or we can say administration[7].

CHARACTERISTICS

1) Autonomous network:

In this kind of a network, no centralized administration is available to manage the operation of the different mobile nodes or devices because individually every node is working as a router also.

2) Constrained of Energy for operation:

Few or every node in a MANET may depend on batteries for their energy because of its mobility. For these nodes, a most important condition is optimum power management.

3) No need of fixed Infrastructure:

In this kind of network, all nodes or devices are mobile and able to connect with each other at any moment as per its need.

4) Dynamic network topology:

Nodes are free to move randomly anywhere in the network. So, the dynamic network topology will come in to the picture in which, because of nodes, the topology of the network is randomly changes at unpredictable times.

5) Band-width optimization:

The capacity of a Wireless links in the sense of number of nodes is very much lower as compare to the wired networks. So, in this network, the problem of congestion will arise when an application demands more number of nodes to join the network, results in higher network capacity where the optimum use of bandwidth will come into the picture.

6) Physical Security:

Wireless links mean the risk of security will be higher, like in to a peer to peer communication or a shared wireless medium

is accessible for network users as well as attackers. Firewall for any attacks must be considered into the wireless network [8].

APPLICATIONS

As we have seen the salient characteristics of MANET, we will switch over to the few applications of MANET, where the above characteristics must be considered. Due to many advantages, MANETs are used in many fields like commercial as well as in military.

Application	Used final area of an application
Commercial field	Mobile offices, Vehicular services like way guidance, road and weather conditions, taxi cab network, inter-vehicle networks
Educational field	In college campus or in Universities campus during arrange any kind of meeting or to deliver a lecture to the students/faculties
For Gaming Zone	To play any kind of Multi-user games
Networks based on sensor	Used in different home applications based on sensors which will interfaced with consumer electronics products
Device network	It can establish a wireless communication link between more than one mobile device

ROUTING PROTOCOL to overcome the routing

challenges of MANET, different Protocols are used. With the help of different protocols, many challenges are solved but still many problems arise when in actual manner MANET will be implemented. Let's see few protocols which are used for MANET.

MANET routing protocols are mainly categorized into three:

1. Topology based routing
2. Location based routing
3. Energy awareness based routing

1. TOPOLOGY BASED ROUTING:

Here in topology based routing protocol; it uses the knowledge of instantaneous connectivity of the network with significance condition of the network links. Here, the routing protocols are again classified into three subtypes, which are mainly focused on the time at which the routes are going to be discovered and updated. Different routing protocols are shown in Fig. 3.

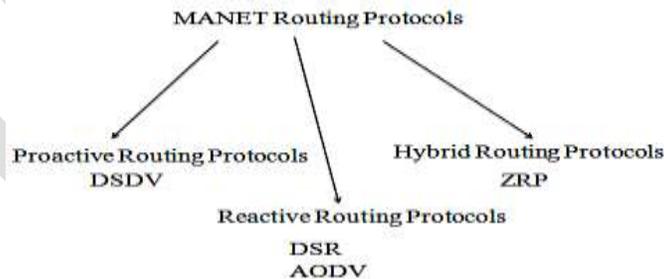


Fig.3 MANET routing protocol

The routing types are as mentioned below:

- 1.1. Proactive Routing Protocol (Table Base)
- 1.2. Reactive Routing Protocol (Demand Base)
- 1.3. Hybrid Routing Protocol

1.1 PROACTIVE ROUTING PROTOCOLS

Proactive routing protocols are maintained consistently and latest routing information between every communicating pair of nodes in the network by circulating, route updates at every fixed time intervals. These protocols are sometimes referred to as table base or table driven protocols because of the every routing information is notified in tables. The main characteristic of proactive protocol is that the each node in the network will maintain a route to every other node available on the same network at any times

continuously. Periodic updates in the table consist of routing information exchanges between each node at a particular time intervals, which is already set. Example of a Proactive Routing Protocol is DSDV.

A) *DSDV (Destination Sequence Distance Vector) :*

In DSDV routing protocol, every node, available, in the network, maintains a routing table, in which all the possible destinations within the network to reach at every destination are notified. Each route entry is marked with a specific sequence number. Nodes are periodically transmitting routing table updates to the network in order to maintain table consistency, throughout. Route updates contains the information in the form of address of few node, the number of path to reach the destination, the sequence number of a destination as well as a sequence number that identifies the update continuously.

1.2 REACTIVE ROUTING PROTOCOLS

As per the requirement of a communication path from one node to another node a query reply dialog does the work. Thus, the latency goes high but here as per need only control messages is used. Example of different Reactive routing protocols are AODV, DSR, etc.,

A) *AODV(Ad-Hoc On Demand Distance Vector):*

AODV is based on DSDV protocol with some improvement in it. AODV protocol minimizes the number of route broadcasting by destination node for create a route on an on-demand basis for communication purpose. Here, route discovery is basis on-demand. So, the route request is forward to the neighbors as per demand, and so on for whole network until either the destination node or an intermediate node with a latest route to the destination is located.

1.3 HYBRID ROUTING PROTOCOLS

This kind of protocols is the combination of proactive and reactive routing protocols. Hence, recently, several hybrid routing protocols are proposed. Out of them one is ZRP.

A) *ZRP(Zone Routing Protocol):*

ZRP topology divided in between zones and searching to utilize different routing protocols for intra-zone and inter-zone, based on the weaknesses and strengths of these protocols. ZRP is routing protocol can be used within same zone and between different zones. The size of the zones is defined by a parameter which is describing the radius in hops. Intra-zone routing is handled by a proactive protocol since these protocols keep an up to date routing information of the zone topology, which results in minimum latency when communicating with nodes available in intra-zone. Whether, inter-zone routing will be under the control of reactive protocol.

2. LOCATION BASED ROUTING:

Location based routing uses the actual position in any area of nodes to make routing decision. Location information can be obtained through some mechanism or by using Global Positioning System (GPS).

A) *Location-Aided Routing (LAR) protocol*

It is an example of Location Based routing. The central point of LAR is working on request zone in which the flooding rate, of routing request packets in a small group of nodes, is less. To create this kind of request zone, the zone should be defined of the destination. The route discovery process in LAR is like the nodes within the request zone forward the message, others discard the message. On receipt of the route request packet, the destination sends back a route reply packet which contains its current location. Then the routing request packet is broadcast within the request zone.

3. ENERGY AWARENESS ROUTING:

Each node maintains multiple entries of routing in routing tables, one for each of the power levels available on the wireless medium. Routing table corresponding to the power level is built and maintained by transferring hello messages in between nodes at power level. So, the number of entries in routing table of nodes is corresponds to the number of nodes reachable by using power level. Thus, the number of entries in routing tables gives the total number of network nodes.

ROUTING CHALLENGES

Even though many routing protocols are available for MANET, still problems are arising related to the following field like[4]:

- a. Security
- b. Bandwidth optimization
- c. Energy limitation
- d. Parties within the network want their communication to be secure.

Out of all these problems, in present scenario all the researchers are focused on power efficient routing protocol.

CONCLUSION

The continuous evolution in the field of communication is driving a new alternative way for wireless communication, in which devices are in mobile condition which creates a self-creating, self-organizing and self-administering wireless network, known as a MANET. Its flexibility, infrastructure less, auto-configuration, low cost applications make it an essential part of wireless environments. Integration of MANET with other wireless networks and fixed infrastructures will be an essential part of the future 4G (fourth-generation) communication networks. Many routing protocol are used for MANET but technically still more number of challenges to be solved related to devices, security, routing protocols, power constraint and services.

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