IJARCCE

ISSN (Online) 2278-1021
ISSN (Print) 2319 5940

International Journal of Advanced Research in Computer and Communication Engineering
Vol. 5, Issue 4, April 2016

Manet - A Review

Gurpreet Singh[1], Nishan Singh[2]

Guru Nanak Dev University Regional Campus Fattu Dhinga, Kapurthala, India [1, 2]

Abstract: MANET (Mobile Ad-hoc Network) is a new technology which has taken enormous attention in the recent years. It has some unique characteristics which make it different from other ad hoc network as well as difficult to define any exact mobility model and routing protocols because of their high mobility and changing mobility pattern. This paper covers functionality, characteristics, applications, advantages, types and various routing protocol of mobile ad-hoc network.

Keywords: MANET, AODV, DSR, ZRP.

I. INTRODUCTION

A mobile ad-hoc network (MANET) is a self-configuring infrastructure fewer networks of mobile devices connected by wireless ad hoc. Each device in a MANET is free to move independently in any direction and it will change its links to other devices frequently. Primary challenge of building a Mobile ad hoc network 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 [1]. MANET is a type of ad-hoc network that can change locations and configure itself on the fly. Because Manet are mobile, they use wireless connections to connect to various networks. This can be a standard Wi-Fi connection, or another medium, such as a cellular or satellite transmission. Some MANETs are restricted to a local area of wireless devices (such as a group of laptop computers), while others may be connected to the Internet. For example, A VANET (Vehicular Ad Hoc Network) is a type of MANET that allows vehicles to communicate with roadside equipment. While the vehicles may not have a direct Internet connection, the wireless roadside equipment may be connected to the Internet, allowing data from the vehicles to be sent over the Internet [2].The vehicle data may be used to measure traffic conditions or keep track of trucking fleets. Because of the dynamic nature of MANETs, they are typically not very secure, so it is important to be cautious what data is sent over a MANET. Therefore, the environment includes a wide range of devices, applications, and networks.MANET is an autonomous collection of mobile users that communicate over relatively bandwidth-constrained wireless links. Because the nodes are mobile, the network topology may change rapidly and unpredictably over time. The network is decentralized; all network activity, including discovering the topology and delivering messages, must be executed by the nodes themselves; that is, routing functionality will be incorporated into mobile nodes. In many commercial and industrial applications, we often need to monitor the environment and collect the information about the environment. In some of these applications, it would be difficult or expensive to monitor using wired sensors [3]. MANET is a kind of network that has a routable networking environment on top of a Link Layer ad-hoc network. The laptops are widely used from 1990s and IEEE 802.11/Wi-Fi wireless networking has made MANET a popular research topic since the mid of 1990s. Many academic papers evaluated protocols and their abilities, assuming varying degrees of mobility within a bounded space using different simulators [4]. Different protocols are evaluated based on measures using various performance metrics such as packet loss, end-to end delay, throughput, packet drop rate etc. They may contain different transceivers between nodes. This results in a highly dynamic and autonomous topology.

II. TYPES OF MANET

Vehicular Ad-hoc Networks (VANETs) are used for communication among vehicles and between vehicle and roadside equipment. Vehicular ad-hoc networks are responsible for the communication between moving vehicles in a certain environment. A vehicle can communicate with another vehicle directly which is called Vehicle to Vehicle (V2V) communication, or a vehicle can communicate to an infrastructure such as a Road Side Unit (RSU), known as Vehicle-to-Infrastructure (V2I)[5].VANET is a technology that uses moving cars as nodes in a network to create a mobile network. VANET turns every participating car into a wireless router or node, allowing cars approximately 100 to 300 meters of each other to connect and, in turn, create a network with a wide range. As cars fall out of the signal range and drop out of the network, other cars can join in, connecting vehicles to one another so that a mobile Internet is created. Fixed equipment can belong to the government or private network operators or service providers, It is estimated that the first system that will integrate this technology are police and fire vehicles to communicate with each other for safety purposes. Advancing trends in ad hoc network scenarios allow a number of deployment architectures for nearby vehicles and between vehicles and nearby fixed roadside equipment. Vehicular Ad-hoc Networks are expected to implement a variety of wireless technologies such as Dedicated Short Range Communications (DSRC)

IJARCCE
ISSN (Online) 2278-1021
ISSN (Print) 2319 5940
International Journal of Advanced Research in Computer and Communication Engineering
Vol. 5, Issue 4, April 2016

which is a type of Wi-Fi. Other Wireless Technologies are Cellular, Satellite and Wi-max. Vehicular Ad-hoc Networks can be viewed as component of the Intelligent Transportation Systems (ITS).

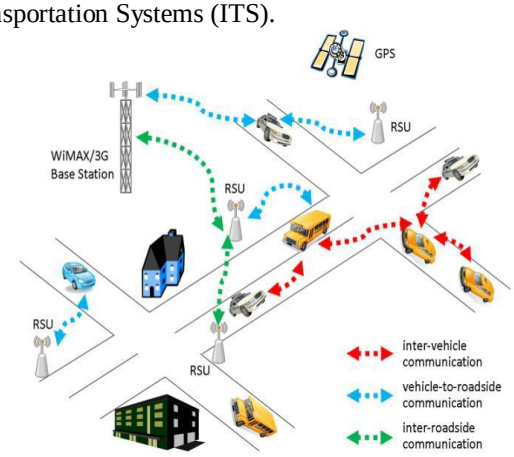

Fig. 1. Vanet

In Figure 1, it consists of vehicles and roadside base stations that exchange primarily safety messages to give the drivers the time to react to life-endangering event.

- 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, drunken driving etc. [6].
- Internet Based Mobile Ad-hoc Networks (i MANET) are ad-hoc networks that link mobile nodes and fixed Internet-gateway nodes. In such type of networks normal ad-hoc routing algorithms don't apply directly.

III. APPLICATIONS OF MANET

There are many applications of MANETs.With the increase of portable devices as well as progress in wireless communication, ad-hoc networking is gaining importance with the increasing number of widespread applications.The domain of applications for MANETs is diverse, ranging from small, static networks that are constrained by power sources to large-scale, mobile, highly dynamic networks. A lot of applications may be thought of using ad hoc networking. It is especially useful in areas where the current fixed, infrastructure based solutions seem inflexible and over-scaled. The feasible applications may also include issues where ad hoc networking technology could supersede the fixed architecture but I think that there will be primarily cooperation instead of competition since the mobile and dynamic ad hoc architecture has huge disadvantages - that are security, bandwidth and scalability [7].

A. Military

For fast and possibly short term establishment of military communications and troop deployments in hostile and/or unknown environments. Probably one of the first hardest, and largest application is utilized in military environments. The way wars are being fought today has changed drastically. When you consider the US operations in Iraq in 2003, you have probably heard that gathering and providing information about what your own and enemy forces are currently doing has been one of the most important improvements in the last years. As you can imagine there is no fixed infrastructure when operating in a foreign country. And even if you are defending your own country these infrastructures being the first targets of enemy forces are most likely to be damaged or destroyed. The US forces used a lot GPS based technology for coordinating their troops. But they are probably the only country that has such an infrastructure at its hand. Adding all this up, you may imagine that there is a really huge area of applications for ad hoc technology. The major challenges in the military field are that reliability, performance, security etc. are even more critical than in civilian applications. A lot of publications in the field of ad hoc networking are actually published by US military organizations.

B. Commercial Sector

For some 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. Other commercial scenarios include e.g. ship-to-ship ad hoc mobile communication, law enforcement, etc

C. Disaster Relief Operations

For communication in environments where the existing infrastructure is destroyed or left inoperable Ad hoc can be used in emergency/rescue operations for disaster relief effort, e.g. in fire, flood, earthquake [8].

D. Local Level

Ad hoc networks can autonomously link an instant and temporary multimedia network using notebook computers or palmtop computers to spread and share information among participants at e.g. conference or classroom. Another appropriate local level application might be in home networks where devices can communicate directly to exchange information. Similarly in other civilian environments like taxicab, sports stadium, boat and small aircraft, mobile ad hoc communications will have many applications.

D. Mercury Wideband Network Radio (WNR)

Among other things, ITT Industries builds networking technology especially designed for military use. One of these technologies is called Mercury Wideband Network Radio. It is the technology chosen by the U.S. Army as the backbone for its first two digitized divisions and is also the United Kingdom's first choice for their Bowman digitization program. That technology comes from ITT Industries' Mercury family of Wideband Digital Radios (WNR). As a wireless plug-and-play system, the WNR serves the U.S. as the Near Term Digital Radio and the U.K. as the High Capacity Data Radio. Other Mercury WNR applications have found service in Canada, Croatia, Holland, Germany, Italy, and Sweden. The Mercury Wideband Network Radio (WNR) does this by building on

DOI 10.17148/IJARCCE.2016.54225

IJARCCE
ISSN (Online) 2278-1021
ISSN (Print) 2319 5940
International Journal of Advanced Research in Computer and Communication Engineering
Vol. 5, Issue 4, April 2016

cellular telephone technology to create a self-organizing network that eliminates the need for fixed base stations. The WNR is the world only field tactical backbone radio system using ad-hoc networking technology.

E. Emergency Services

Another huge public application may be in the area of emergency services. Firefighters, Police and others sometimes have to operate in areas where no information infrastructure is present and operations still need to be coordinated. Another scenario would be a situation after a great natural disaster, atomic reactor melt down or other catastrophes where an existing infrastructure is destroyed. Mobile units could help to build up emergency information structures.

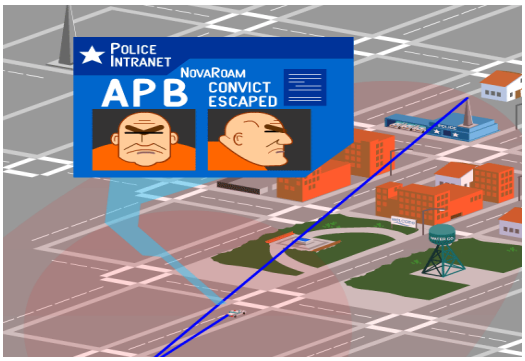

Fig. 2. Emergency Services

F. Personal Area Network (PAN)

Short-range MANET can simplify the intercommunication between various mobile devices (such as a PDA, a laptop, and a cellular phone). Tedious wired cables are replaced with wireless connections. Such an ad hoc network can also extend the access to the Internet or other networks by mechanisms e.g. Wireless LAN (WLAN), GPRS, and UMTS. The PAN is potentially a promising application field of MANET in the future pervasive computing context.

IV. CHARACTERISTICS OF MANET

Mobile ad hoc network nodes are furnished with wireless transmitters and receivers using antennas, which may be highly directional (point-to-point), omnidirectional, probably steerable, or some combination. At a given point in time, depending on positions of nodes, their transmitter and receiver coverage patterns, communication power levels and co-channel interference levels, a wireless connectivity in the form of a random, multihop graph or "ad hoc" network exists among the nodes. This ad hoc topology may modify with time as the nodes move or adjust their transmission and reception parameters. The characteristics of these networks are summarized as follows:

A. Distributed operation

There is no background network for the central control of the network operations. The nodes control over the network is distributed. The nodes should cooperate with each other and communicate among themselves also each node acts as a router if required it also includes specific functions such as routing as well as security.

B. Multi hop routing

When a node tries to send information to other nodes which is out of its communication range, then the packet should be forwarded via relay of intermediate nodes.

C. Autonomous and infrastructure-less

MANET does not rely on any established infrastructure or centralized administration. Each node operates in distributed peer-to-peer mode, acts as an independent router and generates independent data. Network management has to be distributed across different nodes, which brings difficulty in fault detection and management.

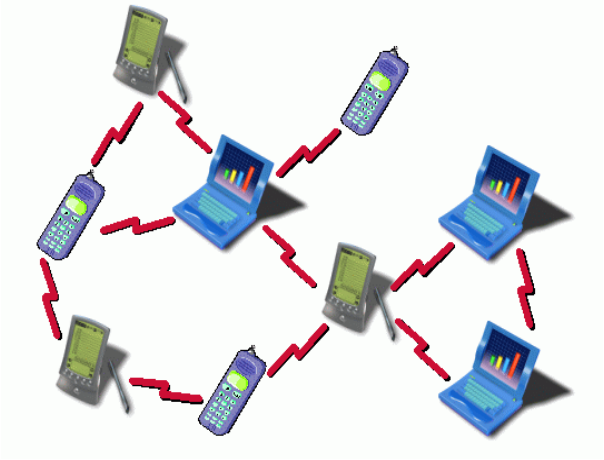

Fig. 3. Manet

D. Dynamic topologies

Nodes are free to move arbitrarily thus, the network topology-which is typically multihop -may change randomly and rapidly at unpredictable times, and may consist of both bidirectional and unidirectional links.

V. ADVANTAGES OF MANET

The advantages of Mobile Ad-Hoc networks are as following [9]:

- Regardless of geographic position MANETs provide access to information as well as services.
- Because of Self-configuring networks, MANETs are independent from central network administration. Nodes are also act as routers. They are less expensive than wired network.
- Scalability feature provides accommodation for addition of more nodes.
- They have highly improved Flexibility.
- They are robust due to decentralized administration.
- The network can easily be set up at any of the place and time.

VI. MANET PROTOCOL

Routing protocol is needed whenever a packet needs to be transmitted to a destination via number of nodes and

IJARCCE
ISSN (Online) 2278-1021
ISSN (Print) 2319 5940
International Journal of Advanced Research in Computer and Communication Engineering
Vol. 5, Issue 4, April 2016

numerous routing protocols have been proposed for such kind of ad hoc networks. These protocols find a route for packet delivery and deliver the packet to the correct destination [10]. The studies on various aspects of routing protocols have been an active area of research for many years. Many protocols have been suggested keeping applications and type of network in view. Basically, routing protocols can be broadly classified into three types:

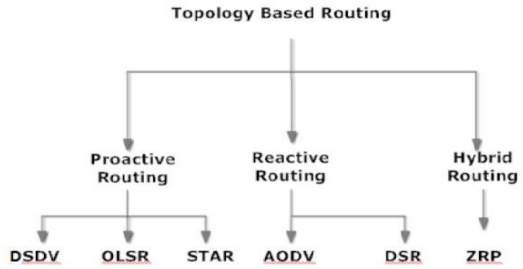

Fig. 4. Topology Based Routing

A. Proactive Routing protocol

In Proactive (Table-driven) routing protocols, each node maintains a table of routes to all destination nodes in the network at all times. This requires periodic exchange of control messages between nodes. Since the route to every destination already exists, there is little or no initial delay when first sending data. DSDV and OLSR are examples of Proactive Routing Protocols.

1) Destination-Sequenced Distance Vector Routing Protocol (DSDV): DSDV is a proactive table-driven routing protocol based on the classical Bellman-Ford algorithm. A routing table is maintained in every mobile node in the network. The routing table records all of the possible destinations within the network and the number of hops to each destination. Each entry is marked with a sequence number assigned by the destination node. The sequence numbers enable the mobile nodes to distinguish routes from new ones. They avoid the formation of routing loops. Routing table updates are periodically transmitted throughout the network in order to maintain table consistency.

In DSDV, each route is tagged with a sequence number, indicating how old the route is. Each node manages its own sequence number by assigning it two greater number than the old one (call an even sequence number) every time. When a route update with a higher sequence number is received, the old route is replaced. In case of different routes with the same sequence number, the route with better metric is used. Updates are transmitted periodically or immediately when any significant topology change is detected.

2) Optimized Link State Routing (OLSR): OLSR is a proactive link state routing protocol based on the following three mechanisms:

- Neighbor sensing using HELLO messages,
- Efficient control traffic flooding using multipoint relays (MPRs), and
- Optimal path calculation using shortest path algorithm.

As a proactive protocol, OLSR constructs and constantly maintains information about network topology by means of exchange link state information. Each OLSR node sends HELLO messages in predefined time intervals for constructing its 1-hop and 2-hop neighbor sets and a TC (topology control) message for completing link state information, so routing table can be calculated. Link failures in OLSR are detected this way. OLSR introduces multipoint relays (MPRs) in order to reduce message overhead in network. The MPR set of a given OLSR node is a subset of its neighbors which can forward its control messages. The neighbors which a given node A selects as MPR are called MPR nodes of A. When all neighbors are MPR nodes of a given router, OLSR diffuses control messages similarly to classical flooding mechanism. On the other hand, MPR mechanism described in can decrease network performance due to overhead introduced for constructing and repairing MPR set.

B. Reactive Routing Protocol

In reactive routing protocols, the route is calculated only when a node needs to send data to an unknown destination. Thus, route discovery is initiated only when needed. This saves overhead in maintaining unused routes. However, this may lead to larger initial delays. During route discovery, the query is flooded into the entire network and the reply from the destination (or intermediate nodes) sets up the path between the source and destination. AODV and DSR are examples of Reactive Routing Protocols.

1) Dynamic Source Routing (DSR): DSR is a reactive (On demand) source routing protocol. The protocol consists of two major phases: route discovery and route maintenance. Route Discovery process is based on flooding the network with route request (RREQ) packets. Every mobile host that receives a RREQ packet checks the contents of its route cache, and if it is the destination it replies to the RREQ with a route reply (RREP) packet that is routed back to the original source; the RREQ is propagated till the destination. DSR protocol is based on the concept of source routing. When a node wants to send data and there is no route to the destination currently available in its route cache, it broadcasts a route request packet, which contains the destination address and a route record. The route record records the passed nodes address. When the request is received by the destination or an intermediate node that knows the route to the destination, a route reply is sent back to the source node via the recorded route.

2) Ad hoc On-Demand Distance Vector (AODV): AODV is a Reactive (On demand) routing protocol, it establishes a route to a destination only on demand. AODV has two important phases: route discovery and route maintenance. It combines DSR and DSDV mechanisms for routing, by using the on-demand mechanism of routing discovery and route maintenance from DSR and the hop-by-hop routing

DOI 10.17148/IJARCCE.2016.54225

and sequence number from DSDV. For each destination, AODV creates a routing table like DSDV, while DSR uses node cache to maintain routing information AODV minimizes the number of required broadcasts, making it suitable for large MANETs. In the route discovery phase, nodes exchange periodic HELLO messages with their neighbors, which are used to establish a list of neighbors at each node. If a valid route exists between two nodes, AODV route discovery is not initiated (e.g. in single hop flows). This process of forwarding RREQs continues till the destination node or a node with a valid route to the destination is discovered.

The benefits of AODV protocol are that it favors the least congested route instead of the shortest route and it also supports both unicast and multicast packet transmissions even for nodes in constant movement. It also responds very quickly to the topological changes that affects the active routes. AODV does not put any additional overheads on data packets as it does not make use of source routing.

C. Hybrid routing protocols
Based on proactive and reactive routing protocols, some hybrid routing protocols are proposed to combine their advantages. The most typical hybrid one is Zone Routing Protocol [11].

1) Zone Routing Protocol: In ZRP the nodes have a routing zone, which defines a range (in hops) that each node is required to maintain network connectivity proactively. Therefore, for nodes within the routing zone, routes are immediately available. For nodes that lie outside the routing zone, routes are determined on-demand, and it can use any on-demand routing protocol to determine a route to the required destination. The advantage of this protocol is that it has significantly reduced the amount of communication overhead when compared to pure proactive protocols. It also has reduced the delays associated with pure reactive protocols such as DSR, by allowing routes to be discovered faster. This is because, to determine a route to a node outside the routing zone, the routing only has to travel to a node which lies on the boundaries (edge of the routing zone) of the required destination. Since the boundary node would proactively maintain routes to the destination. The disadvantage of ZRP is that for large values of routing zone the protocol can behave like a pure proactive protocol, while for small values it behaves like a reactive protocol.

VII. CONCLUSION

Proactive routing protocols tend to provide lower latency than that of the on-demand protocols, because they try to maintain routes to all the nodes in the network all the time. But the drawback for such protocols is the excessive routing overhead transmitted, which is periodic in nature without much consideration for the network mobility or load. On the other hand, though reactive protocols discover routes only when they are needed, they may still generate a huge amount of traffic when the network changes frequently. Depending on the amount of network traffic and number of flows, the routing protocols could be chosen. When there is congestion in the network due to heavy traffic, in general case, a reactive protocol is preferable. Sometimes the size of the network might be a major considerable point. For example, AODV, DSR, OLSR are some of the protocols suitable for relatively smaller networks, while the routing protocols like LANMAR, ZRP are suitable for larger networks. Network mobility is another factor that can degrade the performance of certain protocols. When the network is relatively static, proactive routing protocols can be used, as storing the topology information in such case is more efficient. On the other hand, as the mobility of nodes in the network increases, reactive protocols perform better. Overall, the answer to the debating point might be that the mobility and traffic pattern of the network must play the key role for choosing an appropriate routing strategy for a particular network. It is quite natural that one particular solution cannot be applied for all sorts of situations and, even if applied, might not be optimal in all cases. Often it is more appropriate to apply a hybrid protocol rather than a strictly proactive or reactive protocol as hybrid protocols often possess the advantages of both types of protocols.

ACKNOWLEDGMENT

First I am grateful to God for giving me a chance to complete this work. This work is supported by **Er.Gurpreet Singh** (Assistant Professor, CSE) of GNDU Regional Campus Fattu Dhinga, Kapurthala. I am thankful to him and GNDU Regional Campus Fattu Dhinga, Kapurthala for giving me great support.

REFERENCES

[1]. T. Krag and S. Buettrich, Wireless Mesh Networking, O'Reilly Wireless Dev Center: 2009.
[2]. (2015) the TechTerms Website. [Online]. Available: http://techterms.com/definition/manet
[3]. X. Y. Li, Wireless Ad Hoc and Sensor Networks, Theory and Applications, Illinois Institute of Technology
[4]. Wikipedia. (March 2015) Manet [Online]. Available: https://en.wikipedia.org/wiki/Mobile_ad_hoc_network
[5]. S. U. Rehman, M. A. Khan, T. A. Zia and L. Zheng,"Vehicular Ad-Hoc Networks (VANETs) - An Overview and Challenges" journal of wireless networking and communications 2013, 3(3):29-38 , DOI: 10.5923/j.jwnc.20130303.02
[6]. Types of Manet(2009) Wireless Network. [Online]. Available: http//wirnet.blogspot.ae/2009/09/types-of-manet.htm
[7]. Applications. [Online]. Available: http://www.iwi.unihannover.de/lv/seminar_ss04/www/Jan_Gacnik/xhtml/section4.html
[8]. (2013) Homepage on computer science.[Online]. Available: https://www.ukessays.com/essays/computer-science/the-characteristics-and-applications-of-manets-computer-science-essay.php?cref=1
[9]. Aarti, "Study of MANET: Characteristics, Challenges, Application and Security Attacks", IJARCSSE, Volume 3, Issue 5, pp. 252-257,May – 2013
[10]. S. Taneja, A. Kush,"A Survey of Routing Protocols in Mobile Adhoc networks" International Journal of Innovation, Management and Technology, Vol. 1, No. 3, August 2010
[11]. Z. J. Hass, R. Pearlman, Zone routing protocol for ad-hoc networks, Internet Draft, draft-ietf-Manet-zrp-02.txt, working progress, 1999

ISSN (Online) 2278-1021
ISSN (Print) 2319 5940

International Journal of Advanced Research in Computer and Communication Engineering
Vol. 5, Issue 4, April 2016

BIOGRAPHIES

Gurpreet Singh received his B.Tech. degree in Information Technology from DAV Institute of Engineering & Technology, Jalandhar, Punjab, India in 2009 and M.Tech. degree in Computer Engineering from University College of Engineering, Punjabi University, Patiala, India in 2011. He was teaching as a Lecturer at Rayat Bahra College of Engineering and Bio-Technology for Women, Mohali, Punjab, India. Presently, he is teaching as Assistant Professor at Guru Nanak Dev University, Regional Campus Sultanpur Lodhi. He has more than 20 research publications in International, National Conferences and Journals. His research interest includes Wireless Communication, Network Security, Computer Networks and Data Communication.

Nishan Singh is pursuing his B.Tech. in Computer Science & Engineering from Guru Nanak Dev University Regional Campus, Fattu Dhinga, Kapurthala, India. His research interests include computer and wireless networks.

DOI 10.17148/IJARCCE.2016.54225