National Conference on Recent Research in Engineering and Technology (NCRRET-2015)
International Journal of Advance Engineering and Research Development (IJAERD)
e-ISSN: 2348 - 4470 , print-ISSN:2348-6406

A Survey: Routing Protocols in MANETs, Advantages, Problems and Security

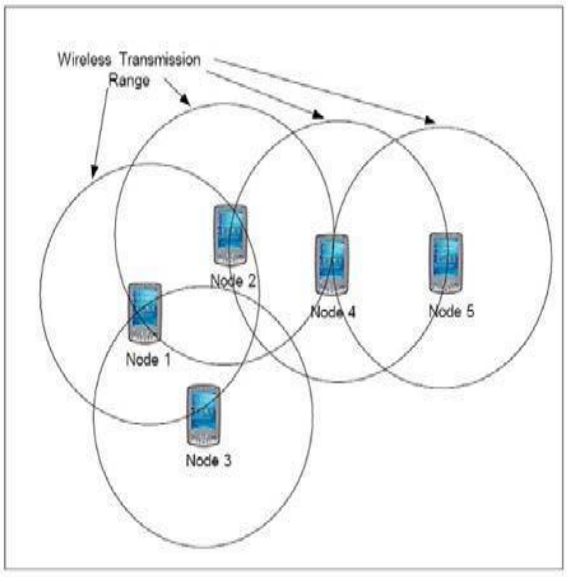
Mamta Parmar[*1]
mamtaparmar32@gmail.com
Mayur Ajmeri #2
mayurajmeri@gmail.com
Assistant Professor in CSE Department, DJMIT, Gujarat, India.

Abstract: *Mobile ad hoc networks (MANETs) are autonomously self-organized networks without infrastructure support. In a mobile ad hoc network, nodes move arbitrarily; therefore the network may experience rapid and unpredictable topology changes. Because nodes in a MANET normally have limited transmission ranges, some nodes cannot communicate directly with each other. Hence, routing paths in mobile ad hoc networks potentially contain multiple hops, and every node in mobile ad hoc networks has the responsibility to act as a router. This paper aims at the advantages and problems of MANET with the issue of improving the future security.*

Keywords:
MANET, Routing Protocols, Ad-hoc network , Wireless network.

I. Introduction

As the importance of computer increases it also build up the connectivity demand. Wired solutions are used from a very long time, but the demands for wireless solution are increasing for connecting to the Internet, exchanging information, send and receive E-mail messages etc. Mobile Ad-hoc network (MANET) becomes one of the most capable fields for research.[1] MANET is a wireless adhoc network. A MANET can be connected to internet or external network and can be a standalone network. MANET is a Latin word which means "for this," or "for this purpose only". Figure 1 shows the structure of MANET.

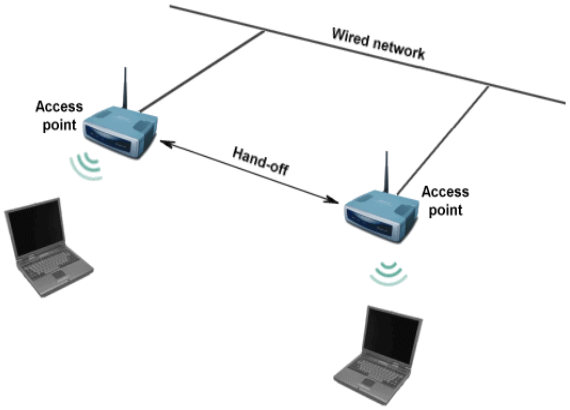


(Figure 1: structure of MANET)

A MANET is a group of self-governing wireless mobile nodes which can interchange data in dynamic manner. Due to the mobile behavior of nodes the network structure is dynamic. The network is self-deploying and decentralized. The nodes in MANET act as both router and as a host and network topology changes rapidly and decision taken in a distributed manner. Due to dynamic behavior of network, routing for MANET is a daring task and wireless link become highly error prone in MANET. Security, reliability, availability, scalability, quality of service is some of the requirements of MANET.

Wireless network is divided into 2 parts:

1).Infrastructure network: An infrastructure network act as a bridge, which connect wired network and wireless network. The base stations are fixed and the mobile network move during communication. If any ode goes out of range from any base station, it goes into the range of other base station. Figure 2 shows infrastructurenetwork.



(Figure 2: Infrastructure Wireless Networks)

2).Infrastructure less network: no fixed base station and mobile nodes can move while communicating. All the nodes present act as routers. Infrastructure less network also called Ad-hoc network which forms temporary networks. In this type of network nodes are portable devices such as mobile phones and laptops. Figure 3 shows an ad-hoc network.

(Figure 3: An ad-hoc network.)

The main goal of routing in MANET is finding end –to-end paths or routes, scaling i.e. minimize overhead and route maintenance. Challenges of MANET routing are (1) flat addressing (2) network-to-network connectivity (3) heterogeneity (4) mobility. The rest of the paper is as follows. Section 2 consists of routing protocols used in MANET with their properties. Section 3 consists of Benefits, limitations and characteristics of MANET. Section 4 consists of security attacks and goals of MANET.

II. Routing Protocols

Routing is the process of transmitting information or packets from source node to destination node. As Ad-Hoc network changes their topology very frequently and thus making packet routing difficult. Routing protocol controls the flow of data in networks and also decides the efficient path to reach the destination. There are 2 types of routing approaches:

a) Topology based: topology based routing protocol perform packet routing by using the information about the nodes existing in the network. Proactive, reactive and hybrid approaches are examples of topology based routing protocol. [2]

b) Position based: position based routing take away few drawbacks of topology based routing by adding some new information. The routing needs additional information about the physical positioning of each node participating. Position based routing doesn't need any maintenance of routers. The nodes neither keep the routing table up to date by transmitting message nor store the routing table.

Topology based routing protocols are mainly divided into 3categories:

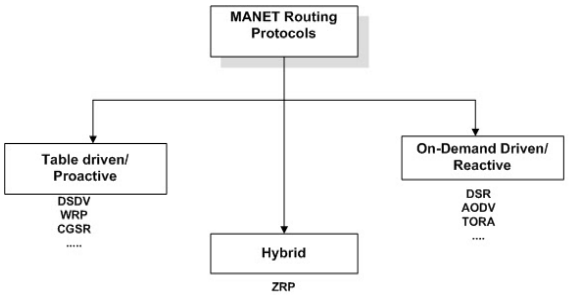
a) Table driven or Proactive protocols

b) On demand or Reactive protocols
c) Hybrid protocol

Proactive protocols: *Proactive* protocol, try to maintain up-to-date routes between all pairs of nodes in the network at all times [2].Some of the proactive routing protocols are Destination Sequenced Distance Vector (DSDV), Wireless Routing Protocol (WRP), hierarchical source Routing (HSR), Global state Routing (GSR).

Reactive Protocol: *Reactive* protocol, only maintain routing information that is strictly necessary, they set up routes on demand when a new communication session is started, or when a running communication session falls without route Some examples of reactive protocol are Ad-hoc On Demand Routing (ADOV), Dynamic Source Routing (DSR), and Location Aided Routing (LAR), temporally ordered Routing Algorithm (TORA).

Hybrid Protocol: hybrid algorithms use both proactive and reactive elements, trying to combine the best of both.[2] Some examples of Hybrid routing are Zone Routing Protocol (ZRP), Zone Based Hierarchical Link State (ZHLS). ZRP divide the network into zones. The Reactive routing is used to route the packet b/w various zones.[13] Hybrid routing is an appropriate way for routing in large networks. Figure 4 shows the classification of Routing protocols in MANET.



(Figure 4: Routing Protocols in MANET)

Some of the advantage and disadvantage of Proactive, Reactive and hybrid are as follows:

	Advantages	Disadvantages
Proactive	-Up to date routing information -Quick establishment of routes -Small delay -A route to every other node in the network is always available	-Slow convergence -Tendency of creating loops -Large amount of resource are needed -Routing information is not fully used
Reactive	-Reduction of routing loads -Saving of resources -Loop-free	-Not always up-to-date routes -Large Delay -Control traffic and overhead cost
Hybrid	-Scalability -Limited search cost -Up-to-date routing information with zones	-Arbitrary proactive scheme with zones -Inter-zone routing latencies -More resources for large size zones

Now we further study one protocol from each of the routing protocol category:

1) Destination Sequenced Distance Vector (DSDV): DSDV is a proactive routing

protocol based on Bellman-Ford algorithm which evaluates the minimum number of hopes to reach the destination.[3] Each mobile node present in the network retains a routing table which contain all feasible destinations and numbers of hopes to each destination in the network are recorded. DSDV uses the approach of sequence number assigned by destination hopes to determine the originality of route [3] .Upgrades of periodic transmissions of the routing table helps in retaining the topology information of the network. If any new remarkable amendments for the routing information are found, the updates are transmitted immediately.[7] The routing upgrades are sent through two ways i.e. Full dump and incremental dump. In full dump the complete routing table is forwarded to the neighbours, where as in matter of incremental dump only the entries that require alteration are conveyed.

2) Ad Hoc on-Demand Distance Vector Routing (AODV): AODV is a reactive routing protocol applies for mobile adhoc network. AODV is efficient for unicast, multicast and broadcast communication. In AODV each mobile node retains a table accommodate information about the efficient path for packet to reach the destination[8].When source node wants to transmit information to destination node and does not have any route to destination, route discovery process starts. Route request (RREQ) is broadcast if any source node desire to send packets to destination node. The adjacent nodes broadcast the packet to their adjacent nodes and this action persists till the destination is achieved by the packet. During this process, all the transitional nodes store the address of the adjacent node from which the initial copy of the broadcast packet is accepted. These records are stored in routing tables, which ease in demonstrating the reserve path.[5] The extra or duplicate copies of the same RREQ are eliminated. This procedure extends till termination warning achieved source node.
The difference b/w DSDV and AODV are shown below:

DSDV	AODV
DSDV broadcasts every change in the network to every node	In AODV such broadcasts are not necessary
When two neighbors enter communication range of each other ❍ This results in a network wide broadcast	If a link breakage does not affect on going transmission -> no global broadcast occurs
Similarly when two nodes drift apart from each other's range –> link breakage ❍ Also results in a network wide broadcast	Only affected nodes are informed
Local movements have global effects	Local movements of nodes have local effects

3*) Zone Routing Protocol (ZRP):* To gain the advantage ZRP uses both proactive and reactive routing protocol. It takes benefit of proactive protocol to find local adjacent nodes and reactive protocol for routing between these adjacent nodes. All the communication in MANET takes place between the nodes close to each other. In ZRP the whole network is divided into different size overlapping zones. Each mobile node related to variable overlapping zone.[9] Every zone consists of 2 types of nodes i.e. peripheral nodes and interior nodes. Peripheral nodes are situated at extreme or boundary and interior nodes are situated in the radius zone except the extreme node.

Some of the challenges of routing protocol in MANET are:

1) Bandwidth Constraints in routing protocol rely on the number of nodes and the traffic handle by them.

2) Mobility is a serious Challenge. Mobility in routing protocols outputs in the frequent collision of packets, path breaks, difficulty in routing information and resource reservation.

3) Constraints on Resources such as Computing power, buffer storage and battery power **restrict the ability of a routing protocol**.

4) More number of collision results in high **contention** for channel. Network load is distributed uniformly in a good routing protocol.

III. Benefits and Limitations

Firstly we have to know some of the characteristics and features of MANET.

Characteristics and features

1) Autonomous Behaviour: Each mobile node in MANET acts as both router and host. In other words, mobile nodes can also achieve switching task as a router. So generally terminals and switches are identical in MANET.

2) **Dynamic topologies:** As al the nodes in the network are mobile they are free keep move with dissimilar speed, which consequence in the variation of network. The topology in the network may change arbitrarily at uncertain time. All the mobile nodes present in the network establish routing among themselves dynamically, creating their own network.

3) Multi-hop routing: When any nodes wants to build up communication with other nodes which are out of range, then the packet is transmitted through one or more intermediate nodes. Two types of ad-hoc routing i.e. single-hop and multi-hop routing. Single-hop is simpler than multi-hop regarding cost, structure and implementation.

4) Distributed operation: The control of the network is distributed among the mobile nodes of the network as there is no background network for the main control of the network operation.

5) Light weight terminal: In most of the cases, the MANET is mobile nodes with less memory size, low power storage and low CPU capability. Optimized algorithm and process that perform computing and communication functions.

6) Energy constrained and limited Bandwidth: today in the modern electronic world all the devices completely depend on the batteries. The purpose of the network is to be optimised to preserve the energy utilize of the mobiles. Wireless network has a very limited bandwidth and the network is to be optimized to accomplish with the utmost efficiency with in the limited bandwidth.

Some of the advantages of the Mobile ad-hoc network include following:

1) MANET can be succeeded where there is less telecommunication infrastructure.

2) Minimum cost estimation.

3) Enhanced flexibility.

4) MANET gives access to information and facilities regardless to geographic location.

5) These networks can be arranged at any time and Place. .

6)Powerfuldueto decentralised management.

7) MANET has independent behaviour with dynamic network topology and multi-hop network.

8) Scalable- holds the addition of more nodes.

9) Self-organizing network, nodes can also act as routers.

Some of the disadvantages of MANET are:

1) Lack of physical security.

2) Inherent Resources are limited.

3)Mutual trust unsafe to attack.In sufficiency of authorization services.
4) Dynamic network topology makes it difficult to identify malicious attack.

IV.Security Goals and Attacks

Security Goals

Security is a crucial aspect of MANET. Security involves a set of speculations that are sufficiently funded. In MANET all the network functions such as routing and packet forwarding are implemented by themselves in a self-organizing way [15].That is why securing a MANET is a challenging task. Some goals to assess whether a MANET is secure or not are as follows:

1) Confidentiality: confidentiality protects that computer associated benefits are acquired by authorized parties only. It means only those who have right to access should really obtain that access[15].To keep the information secret from all organisation that do not have right to access them we have to retain confidentiality. Privacy and secrecy are synonyms of confidentiality.

2) Availability: Availability means the benefits are attainable to authorized parties at suitable time. Availability relates to both services and data. It ensures the survivability of the network facilities despite contradiction of service attack.

3) Authentication: Authentication sanction a node to protect the originality of peer node it is communicating with. Authenticity is ensured because only the genuine sender can create a message that will decrypt correctly with the shared key. [10]Authentication is vital affirmation that participants in communication are validated and not imitate.

4) Integrity: Integrity means the assets can be adapted only by authorized parties in an authorized way. Adaption includes deleting, creating, writing and changing status. Integrity convinces that the information being transmitted is never corrupted.

5) Non-repudiation: It protects that the sender and the receiver of the message does not disclaim that they have ever sent or received such a message. This is accommodating when we need to differentiate if a node with some undesired function is undermine or not.

Security Attacks

Securing and designing an efficient routing protocol for wireless ad-hoc network is one of the most challenging tasks. Due to dynamic nature and no infrastructure of MANET demands a new set of networking strategies to be processed in order to provide effective and protected overhead free end-to-end communication. Because of lack of predefined centralized administration for route discovery procedure, results in the decrease in the performance of network. MANET is more vulnerable to cyber/digital attacks as compare to wired networks. There are several types of attack that affect the MANET and its security. These attacks can be divided into two types:

1) Passive attack
2) Active attack

Passive attack: In passive attack, an unauthorized node controls and goals to search out information about the network.[6] Attackers do not damage data in the network in place of it he examines traffic like recognizing communicating nodes, control data which is changed between them and steal important information. Passive attackers do not shatter the operation of routing protocols but try to discover the important information from routed traffic. Passive attack is used to achieve the information for future harmful effects. They do not examine to adjust or change the data packets. Some of the examples of passive attack include:

1) Traffic monitoring

2) Snooping
3) Eavesdropping
4) Traffic analysis
5) Release of message contents

Active attack: Active attack can alter or change the state of the data in the network such as message modification, denial of services, message fabrications, congestion etc. it shatter the normal functionality of the network and launched by the nodes with authorization to process with in a network. Active attacks are divided into four groups i.e. *dropping, modification, timing attacks and fabrication.* Active can be of two types may be internal or external. An external active attack can be brought out by any outside source that do not belong to the network.[11] An internal active attack is malicious nodes that are part of a network. They are hard to find out as compare to external attack. Some of the active attack includes:

1) Spoofing
2) Modification
3) Denial of service
4) Masquerade
5) Network Jamming
6) Impersonating
7) Message reply

V. Conclusion

This paper give account of fundamental issues and examine main research problem of MANET. MANET due to their dynamic behavior, limited resources (power, bandwidth etc.), and distributed operation is more vulnerable to many attacks. In this research paper an attempt has been done to focus on comparative study and performance of different routing protocol mainly reactive, proactive and hybrid like DSDV, AODV, and ZRP etc. The main aim of routing protocol is to provide efficient energy aware and secure routing schemes to MANET. In this research paper we summarize characteristics, features, advantage and disadvantage of MANET. After that we discuss the most complex and challenging issue in MANET i.e. Security with their goals and Attacks. Mainly two types of security attacks passive and Active. MANET is a rapidly developing and changing field with a huge scope of research work in this field.

References

1. Priyanka Goyal, Vinti Parmar, Rahul Rishi, "*MANET: Vulnerabilities, Challenges, Attacks, Application*", IJCEM International Journal of Computational Engineering & Management, Vol. 11, January 2011, ISSN (Online): 2230-7893, www.IJCEM.org, IJCEM.

2. Sunil Taneja and Ashwani Kush, "*A Survey of Routing Protocols in Mobile Ad Hoc Networks"*, International Journal of Innovation, Management and Technology, Vol. 1, No. 3, August 2010, ISSN: 2010-0248.

3. Alex Hinds, Michael Ngulube, Shaoying Zhu, and Hussain Al-Aqrabi, *"Review of Routing Protocols for Mobile Ad-Hoc NETworks (MANET),*" International Journal of Information and Education Technology, Vol. 3, No. 1, February 2013, DOI: 10.7763/.

4. Luo Junhai, Xue Liu, Ye Danxia, "*Research on multicast routing protocols for mobile ad-hoc networks*," Computer Networks 52 (2008) 988–997.

5. Geetha Jayakumar and Gopinath Ganapathy, "*Performance Comparison of Mobile Ad-hoc Network Routing Protocol*," IJCSNS International Journal of Computer Science and Network Security, VOL.7 No.11, November 2007.

6. Aarti Department of Computer Science & Engineering , MRIU Faridabad, Haryana, India and Dr. S. S. Tyagi, Professor and Head, Department of computer science & Engineering, MRIU, Faridabad, India, "*Study of MANET: Characteristics, Challenges, Application and Security Attacks*," International Journal of Advanced Research in Computer Science and Software Engineering, Volume 3, Issue 5, May 2013, ISSN: 2277 128X.

7. Sridhar Iyer IIT Bombay, "*Mobile Ad Hoc Networks*," Tutorial at CIT'2000 Bhubaneshwar, Dec 2023, http://www.it.iitb.ernet.in.in/sri,sri@it.iitb.ernet.in

8. By Donatas Sumyla, 03/20/2006," *Mobile Ad-hoc Networks (manets),*"

9. Simardeep Kaur, 2Anuj K. Gupta, RIMT IET, Punjab, India, Dept. of CSE, RIMT IET, Punjab, India," *Position Based Routing in Mobile Ad-Hoc Networks: An Overview*,"

IJCST Vol. 3, Issue 4, Oct - Dec 2012, ISSN : 0976-8491 (Online) | ISSN : 2229-4333 (Print).

10. Deepa.S, Senior Lecturer,SRN Adarsh College,Bangalore, Dr. D.M Kadhar Nawaz, Professor, Sona College of Technology, Salem," *A Study on the Behaviour of MANET Routing Protocols with Varying Densities and Dynamic Mobility Patterns*," cIJCA Special Issue on "Mobile Ad-hoc Networks" MANETs, 2010.

11. Gurpinder Singh, Asst. Prof. Jaswinder Singh University College Of Engineering, Punjabi University Patiala (PB.), India," *MANET: Issues and Behavior Analysis of Routing Protocols*," International Journal of Advanced Research in Computer Science and Software Engineering, Volume 2, Issue 4, April 2012, ISSN: 2277 128X.

12. Dr.S.S.Dhenakaran Assistant Professor, Department of Computer Science and Engineering, Alagappa University, Karaikudi, Tamilnadu, India, A.Parvathavarthini Research Assistant, Department of Women's Studies ,Alagappa University,Karaikudi Tamilnadu, India," *An Overview of Routing Protocols in Mobile Ad-Hoc Network,"* International Journal of Advanced Research in Computer Science and Software Engineering, Volume 3, Issue 2, February 2013, ISSN: 2277 128X.

13. Meenakshi Yadav1, Nisha Uparosiya *"Survey on MANET: Routing Protocols, Advantages, Problems and Security"* International Journal of Innovative Computer Science & Engineering ISSN: 2393-8528,Volume 1 Issue 2

14. Jun-Zhao Sun, MediaTeam, Machine Vision and Media Processing Unit, Infotech Oulu, P.O.Box 4500, FIN-90014 University of Oulu, Finland," *e Ad Hoc Networking: An Essential Technology for Pervasive Computing*,"

15. Sevil Şen, John A. Clark, Juan E. Tapiador, Department of Computer Science,University of York, YO10 5DD, UK," *Security Threats in Mobile Ad Hoc Networks*,"