Literature Survey on Mobile Adhoc Networks and Routing Protocols

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ABSTRACT: Wireless networks have evolved from network Adhoc concept. A concept where nodes, devices communicate with each other without any standalone system setup facilitating mobile communication. This technique assists in data transmission in hard terrain area and is easy to setup. As such mobile adhoc network have been major research domain with technology deployment numerous challenges arise such as path discovery, routing overhead and security. Routing overhead has been major concern in MANET. Numerous procedures have been implemented in MANET. Protocols like DSR, AODV have been found to satisfy QOS (quality of services) for network. Still major challenge in defining a scalable routing protocol is current research need. This article surveys existing articles on MANET and different routing protocol approaches, for finding a better routing protocol type which help in reducing routing overhead and eliminating path discovery.

KEYWORDS: MANET, Routing Protocol, AODV, Routing overhead.

I. INTRODUCTION

A computer network or a data network is a collection of mobile nodes which are highly interconnected. This interconnection can be wired or wireless. The wireless networks can be categorized into two types based on their system architecture such as the first one is Infrastructure (Figure 1a) and second one is Ad Hoc network (Figure 1b). Mobile devices coupled with wireless network interfaces is an essential part of computing environment that consist of infra-structured and infrastructure-less mobile networks [1]. Wireless Local Area Network (WLAN) is the most prevalent infra-structured mobile network, where a mobile node communicates with a fixed base station, and thus a wireless link is limited to one hop between the node and the base station. Mobile Ad hoc Network (MANET) is an infrastructure-less multi-hop network where each node communicates with each other either directly or indirectly through intermediate nodes [1].
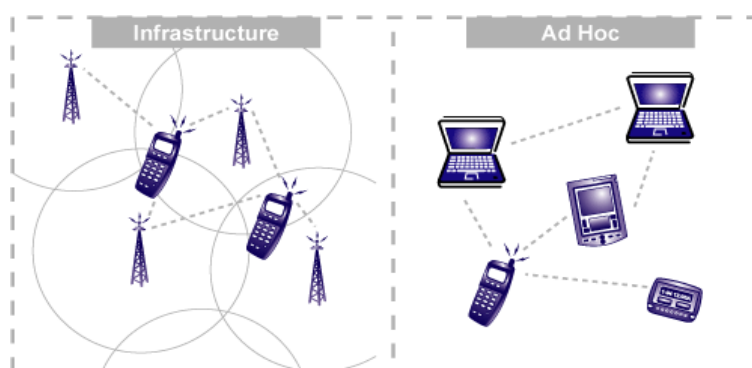

Figure (1): (a) Cellular Network (b) Ad Hoc Network

II. RELATED WORK

Major reason for evolution of wireless network is Adhoc network. This network consists of mobile nodes that communicate over network. Military network deployment is major application area of adhoc network still it's up growth has facilitated commercial network enhancement [2]. (Figure 2) presents mobile adhoc network. Internet Engineering Task Fork (IETF) is group of researchers working on MANET. Layered Architecture is being adopted in Mobile adhoc networks. A well designed MANET involves network layer ranging from physical range to application range. Numerous protocols have been Design and implemented for MANET. MANET is a self-governing accumulation of portable clients that convey over moderately transmission capacity obliged remote connections.
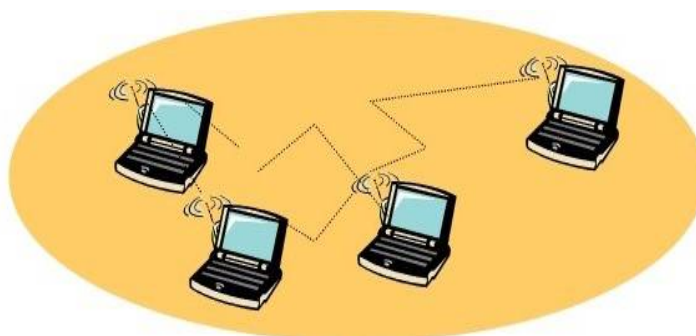

Figure (2): Mobile Adhoc Network

The Mobile Adhoc Network has following characteristics:
1. Decentralize network
2. Autonomous and infrastructure less
3. Dynamic network topology
4. Multihop Routing
5. Network Scalability
6. Self-creation, self-administration and self-organization
7. Short cost of arrangement.

The mobile ad hoc network has the typical features [4] such as the unreliability of wireless links between nodes. There is limited power supply and continuous motion of the nodes; the wireless links between mobile nodes in the ad hoc network are not stable for the communication participants. Another feature is constantly changing topology, due to mobility of nodes, the topology of the mobile ad hoc network changes constantly, the nodes can continuously move across the radio range of each other in the ad hoc network, and because of this movement the routing information will be changing all the time. Lack of incorporation of security features in statically configured wireless routing protocol not meant for ad hoc environments. Since the topology of the ad hoc networks is changing constantly, it is necessary for each pair of adjacent nodes to incorporate in the routing issue so as to prevent some kind of potential attacks that try to make use of vulnerabilities in the statically configured routing protocol. This results in maintenance and discoveries of routes frequently.

A. *Advantage of MANET:*
Having deliberated overall issues in MANET reason behind acceptance benefits from MANET are as following
1. Short cost of arrangement: As the name suggest, requiring no costly framework, for example, copper wires, information links, and so on.

2. Firm positioning: In comparative to WLAN MANET are easy to implement convenient on go require lesser manual intervention as of no infrastructure.

3. Dynamic Arrangement: Ad hoc system setup can change progressively with time, for the numerous situations, for example, information partaking in classrooms, and so forth. This is a valuable component. At the point when contrasted with configurability of LANs, it is anything but difficult to change the system topology.

4. Decentralized and robust: Another advantage of ad hoc networks is that they are inherently very robust [5]. Imagine that for some reason one of the base stations is not working. In this case, all users of that base station will lose connectivity to other networks.

B. *Application Area of MANET:*

Interesting application of MANET is ranging from battle ground to study room. Following are diverse applications of MANET.

1. War ground: Communication between vehicles and soldiers is been done using adhoc network. At such situation troops communicate using hand held devices which are based on MANET. System could be configured with devices working on MANET.

2. Emergency services: In situations, for example, Search and rescue operations, Disaster recovery, Replacement of fixed infrastructure in case of environmental disasters, Policing and firefighting, Supporting doctors and nurses in hospitals. [4]

3. Sensor network: Home applications such as smart sensors and actuators embedded in consumer electronics, Body area networks (BAN), Data tracking of environmental conditions, animal movements, chemical/biological detection.

4. Entertainment: Adhoc network is use in many cases such as Multi-user games, Wireless P2P networking, Outdoor Internet access, Robotic pets, Theme parks.

5. Commercial and civilian environment: MANET provide many applications such as electronic payments anytime and anywhere environments, Vehicular services such as road or accident guidance, transmission of road and weather conditions, taxi cab network, inter-vehicle networks, In Sports stadiums, trade fairs, shopping malls, Networks of visitors at airports MANET is use. [4]

6. E tutor System: In study scenario tutors and teachers can set up an offhand remote framework to share data using convenient workstations.

C. *Common Issues in MANET:*

Common Issue has been summarized in this section. In MANET all node has to cooperate and communicate over facing common issue challenges. Most common issue is routing and path discovery. This article focuses on routing protocols and issue associated to them. Ad-hoc networks have to suffer many challenges at the time of routing [4]. Dynamically changing topology and no centralized infrastructure are the biggest challenges in the designing of an Ad-hoc network. The position of the nodes in an Ad-hoc network continuously varies due to which we can't say that any particular protocol will give the best performance in each and every case topology varies very frequently so we have to select a protocol which dynamically adapts the ever changing topology very easily. Another challenge in MANET is limited bandwidth. If we compare it to the wired network then wireless network has less and more varying bandwidth, so bandwidth efficiency is also a major concern in Ad-hoc network routing protocols. Limited power supply is the biggest challenge of an Ad-hoc network so if we want to increase the network lifetime as well the node lifetime then we must have an efficient energy management protocol. So an Ad-hoc routing protocol must meet all these challenges to give the average performance in every case.

The main challenges in mobile ad-hoc networks are as follows [4,6]:

1. Limited Power Supply
2. Dynamically Changing Topology
3. Limited Bandwidth
4. Lesser Security
5. Mobility-induced packet losses
6. Battery constraints

Some common issue in MANET are [5,7]as follows:

1. Diverse Topology: Because ad hoc networks do not allow the same kinds of aggregation techniques that are available to standard Internet routing protocols, they are vulnerable to scalability problem. Since the MANET's nodes are mobile, the routing changes as the nodes move. Current connectivity Information must to be propagated to all network's participant. Control messages have to send around the network frequently. The increased number of control messages burdens the available bandwidth. Therefore, the ad hoc protocols are typically designed to reduce the number of control messages, such as by keeping the current information.

2. Power consciousness: As working of MANET in critical situation is based on batteries and power supply. As such major requirement in MANET is designing effective routing protocol. As such power awareness is major challenge faced by MANET.

3. Addressing structure: The system topology continues changing progressively and thus the tending to conspire utilized is very huge. A dynamic system topology involves a pervasive tending to plot, which stays away from any copy addresses.

4. Lower data rate: One of biggest Problem of ad hoc networks [5]is reduced data rates. The characteristic of wave, which is used for wireless communication, prevents wireless communication to transmit data better than wired communication. A higher frequency can transmit more data, but then it is more vulnerable to interference and performs well in short range.

5. Node mobility: Due to node mobility in MANETs, [7] frequent link breakages may lead to frequent path failures and route discoveries, which could increase the overhead of routing protocols and reduce the packet delivery ratio and increasing the end-to-end delay.

6. Designing Routing protocol: One of the fundamental challenges [7] of MANETs is the design of dynamic routing protocols with good performance and less overhead. Thus, reducing the routing overhead in route discovery is an essential problem.

III. ROUTING PROTOCOL OVERVIEW

Route are setup and maintain by routing protocol as it is the essential performance factor in the Mobile Ad-hoc Network. Routing protocol specifies the routes between the nodes and disseminating information which choose the routes between any two nodes on a network. [8] Routing protocols can be classified into three types: Proactive, Reactive and Hybrid routing protocols. (Figure 3) demonstrates the classification of MANET protocol. [7]. Basically Proactive is considering as Table driven routing protocol, Reactive is consider as On demand driven routing protocol and Hybrid is combination of both proactive and reactive routing protocol.
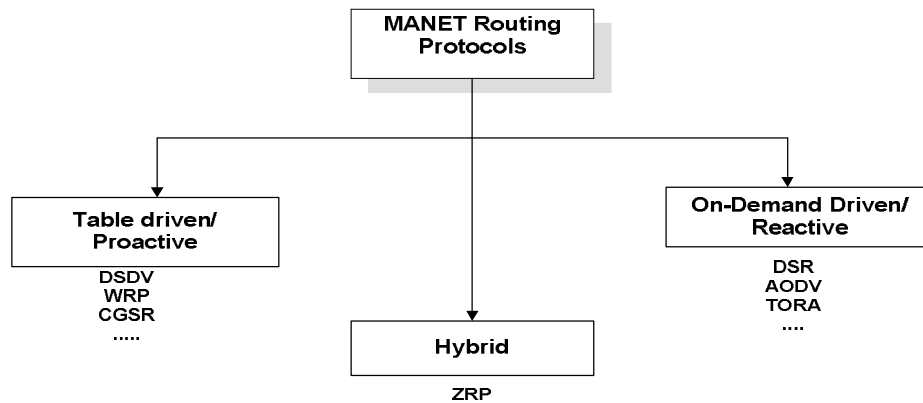
Figure (3): Classification of MANET

A. *Proactive Routing Protocol*

In proactive conventions, routing protocols uses link-state routing algorithms which transmit link information about its neighbours frequently. In proactive routing protocol every node continuously maintains complete routing information of the network through the table. Due to this reason proactive routing protocol also known as Table-Driven routing protocol. In every node keep up the network topology data as tables. These tables are periodically exchange data for the current view of data or updating of data. [10] The examples of proactive routing protocols are DSDV, WRP, etc.

- *Destination Sequenced Distance Vector (DSDV) Routing Protocol-* Destination Sequence Distance Vector Routing (DSDV) is a hop-by-hop distance vector routing protocol. [10] It is a proactive protocol in which each network node keeps up a directing table that contains the separation of next-node and the quantity of jumps to every reachable destination. A periodical broadcast of routing updates keeps the routing table completely updated at all times. To keep up the consistency of directing tables in an evolving topology, each station intermittently transmits refreshes, quickly when critical new data is accessible. DSDV adds a new attribute, sequence number to indicate the freshness of the route. Using this sequence number, the mobile nodes can recognize old route information from the new one and thus prevent the formation of routing loops. Advantages of DSDV include fast reaction to topology changes and guarantees loop freeness. The main disadvantage is that DSDV creates overhead because of the unused routing information.

- *Link State Routing (LSR)***:** LSR [11] is a basic proactive protocol aimed to find route based on current conditions, is made up on Dijkstra's SPF scheme, where each node has a complete topology view over the entire network. All nodes in the network keep a copy of the topology map which is regularly updated and creates a Link State Packet (LSP) with the state of directly connected link and broadcasts this to neighbor nodes. LSR is comparatively fast, provides loop less convergence and builds topological map also helps to have a complete view of network topology. The disadvantages include significant demands on memory, more CPU processing and propagation of routing information is costly in terms of network bandwidth.

B. *Reactive Routing protocol*

In reactive routing conventions, routing protocol discover route to a goal just when it is required. It uses distance-vector routing algorithm which establish the route to particular destination only when a node demands it. In Reactive Routing protocol based on demand so it is also called as the On-demand driven routing protocol. This routing protocol reduce routing overhead which are present in proactive routing protocol.

- *Ad-Hoc On-Demand Distance Vector Routing Protocol(AODV)***:** An Ad Hoc On-Demand Distance Vector (AODV) is a routing protocol designed for wireless and mobile ad hoc networks. This protocol establishes routes to destinations on demand and supports both unicast and multicast routing**.** The AODV protocol builds routes between nodes only if they are requested by source nodes. AODV is therefore considered an on-demand algorithm and does not create any extra traffic for communication along links. The routes are maintained as long as they are required by the sources. They also form trees to connect multicast group members. AODV makes use of sequence numbers to ensure route freshness. The Advantage [1] of AODV is that route discovery and route maintains operations are performed only when there is demand of creating path between two nodes. The Disadvantage is that high latency time in route finding.

- *Dynamic Source Routing (DSR):* It is a routing protocol [12] for wireless mesh networks. It is similar to AODV in that it forms a route on-demand when a transmitting node requests one. DSR [12] allows the network to be completely self-organizing and self-configuring, without the need for any existing network infrastructure or administration. The protocol is composed of the two mechanisms of Route Discovery and Route Maintenance, which work together to allow nodes to discover and maintain source routes to arbitrary destinations in the ad hoc network. The use of routing allows packet routing to be trivially loop-free, avoids the need for up-to-date routing information in the intermediate nodes through which packets are forwarded, and allows nodes forwarding or overhearing packets to cache the routing information in them for their own future use.

C. *Hybrid Routing Protocol*

In Hybrid routing conventions, routing protocol combines the merits of both proactive and reactive routing. The advantage of the hybrid routing is that the routing initially established with some proactively prospected routes and then serves the demand from additionally activated nodes through reactive flooding. The main disadvantage of such routing is that advantage depends on number of other nodes activated and reaction to traffic demand depends on gradient of traffic volume.

- *Zone Routing Protocol(ZRP):* This routing protocols combine the feature of both Proactive and Reactive Protocols. It takes advantage of proactive routing to discover nearby contiguous nodes and Reactive Protocols for routing between these neighbour ZRP (Zone Based Routing) Protocol-Hybrid routing protocols combine the feature of Proactive and Reactive Protocols ring nodes. In ZRP the nodes have routing zone which characterize a range as far as hop that every node is required to keep up network availability [10]. The routing procedures inside the zone are performed by the Intrazone routing protocols (IARP) and to speak with various zone is performed by Interzone routing protocols (IERP).

In the following table1 The comparative study of different routing types such as Proactive routing, Reactive routing and Hybrid routing is provided with respect to Protocol type, Routing Approaches, Routing Acquisition, Latency, Network scalability, Storage requirement, Power requirement, Bandwidth requirement and Routing overhead.

Table1. **Comparison between different Routing Types [8]**

Features	Proactive	Reactive	Hybrid
Route Acquisition	Table driven	On-Demand	Combination of both
Routing Information	Always available	Available when required	Combination of both
Scalability	Low	Not suitable for large network	Designed for large network
Mobility	Periodic update	Route maintain on demand	Combination of both
Latency	Low due to routing tables	High due to flooding	Inside zone low outside high similar to reactive protocol
Storage requirement	High	Low	Medium
Bandwidth requirement	High	Low	Medium
Power requirement	High	Low	Medium
Periodic update	Require when network topology changes	Not needed	Require
Routing overhead	High	Low	Medium

From the above table 1, we found that each routing approach such as proactive, reactive and hybrid has some unique features. The main factor that distinguishes the routing protocols from each other is the way of determining routes from source node to destination node. In general, on demand(Reactive) routing protocols perform better under lower power requirement, bandwidth requirement and exhibit low routing overhead as comparative to other routing types.

IV. CONCLUSION

In this survey paper we discuss about MANET, its applications, advantages and some common issues face by MANET. This paper also presents a comparative study of different routing approaches such as proactive, reactive and hybrid routing. So the major challenge in MANET is designing effective scalable routing protocol. Existing protocol lacks either path discovery or face energy loose, or face routing overhead problem. Thus the research problem definition is to design and develop an effective routing protocol with good performance for reducing routing overhead in MANET. The protocol should be effective for large no of nodes and scalable. Routing protocol should satisfy all QOS. Design and implement System in Simulation based environment and test it.

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