A Broad Review of Routing Protocols in Mobile Ad-hoc Networking

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ABSTRACT – ***MANET (Mobile Adhoc-Network), is a self-configured wireless infrastructure-less network. Different traditional mobile wireless networks, ad-hoc networks do not depend on any permanent infrastructure. As an,option hosts rely on each other to keep the network connected. It represents intricate distributed systems that include wireless mobile nodes that can freely and dynamically Self-organize addicted to arbitrary and temporary, ''ad-hoc'' network topologies. This paper attempts to provide a complete overview of this routing protocol in MANET. It first explains the vital role that mobile ad hoc networks took part in the evolution of future wireless technologies and then it reviews the latest research activities in the areas of mobile ad-hoc network applications.***

Keywords – MANET,Routing.

1. INTRODUCTION

Wireless networking is the cheapest way to connect our homes, office, enterprise installations by avoiding costly process of cables. Wireless networks use radio waves to connect devices such as laptops to the to the Internet, the business network and other applications. Many types of wireless communication devices exist. These devices include personal dig ital assistants (PDAs), laptops, personal computers (PCs), servers, and printers having a way of interfacing with a particular type of network. The wireless network can be classified into two types: Infra-structured or Infra-structure less. In Infra-structured wireless networks, the mobile node can move while communicating, the base stations are fixed and as the node goes away from the range of a base station, it gets into the range of another base station. In Infrastructure-less or Ad-Hoc wireless network, the mobile node can shift while communicating, there are no fixed base stations and all the nodes in the network act as routers[1]. The mobile nodes in the Ad Hoc network dynamically set up routing among themselves to form their own network 'on the fly'. An Ad-hoc network is a collection of wireless mobile nodes which dynamically forming a temporary mobile nodes which dynamically forming a temporary network without the support of any established infrastructure or centralized administration.

Mobile users can utilize their cellular phone to check e-mail, browse internet; travellers with portable computers can surf the internet from airports, railway stations, Starbucks and other public locations; tourists can employ Global Positioning System (GPS) terminals installed inside rental cars to situate driving maps and tourist attractions, researchers can replace files and other information by linking portable computers via wireless LANs while attending conferences; at home, users can coordinate data and transfer files between portable devices and desktops.[2]Not only are mobile devices getting smaller, cheaper, more convenient, and more powerful, they also run more applications and network services, commonly fuelling the explosive growth of mobile computing equipment market

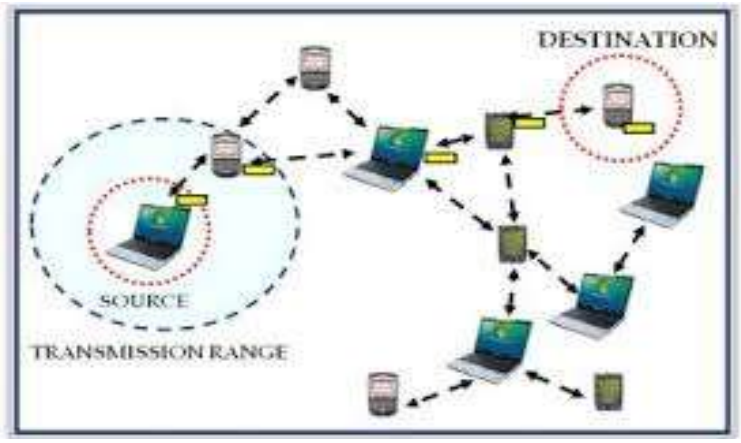

Figure 1:.Mobile Adhoc networking.

This paper demonstrates the impetus behind mobile ad hoc-networks, and presents a representative collection of routing protocol used at the different layers of the network.

1.1 Evolution of MANET

- In 1970, Normanl Abramson and his fellow researchers at the University of Hawaii invented ALOHA net.
- In 1972 DARPA Packet Radio Network (PRNet)
- In 1980 Survivable Radio Networks (SURAN)[3].
- During 1980 emergence of Internet Emerging Taskforce (IETF), termed the mobile ad-hoc networking group.
- In 1994 emergence of Bluetooth by Ericsson.

1.2 Challenges in MANET

- Unicast routing
- Multicast routing
- Dynamic network topology
- Speed
- Frequency of updates or Network overhead
- Scalability
- Mobile mediator based routing
- Quality of Service
- Energy efficient/Power aware routing
- Secure routing

2. APPLICATIONS OF MANET

2.1 Military battlefield:

Military equipment now routinely contains some sort of computer equipment. Ad-hoc networking would allow the military to take advantage of usual network technology to maintain an information network between the soldiers, vehicles, and military information head quarters. The basic techniques of ad hoc network came from this field.

2.2 Commercial sector:

Ad-hoc can be second-hand in emergency/rescue operations for disaster relief efforts, e.g. in fire ,flood, or earthquake. Emergency rescue operations must take place where non-existing or broken communications infrastructure and rapid deployment of a communication network is needed. Information is relayed from one rescue team member to another over a small handheld. Other commercial scenarios consist of e.g. ship-to-ship ad hoc mobile communication, law enforcement, etc.

2.3 Local level:

Ad hoc networks can autonomously link an instant and temporary multimedia network by means of notebook computers or palmtop computers to spread and share information among participants at a e.g. conference or classroom. Another appropriate local level application might be in home networks where devices be able to communicate directly to

exchange information. Similarly in other civilian environments like taxicab, sports stadium, boat and small aircraft, mobile ad hoc communications will have a lot of applications.

2.4 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). Monotonous 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.

3. PROS OF AD HOC NETWORKS

3.1 No infrastructure and lower cost

There are situations, with which a user of a communication system cannot rely on an infrastructure. Using a service from a infrastructure can be expensive for specific applications. In an area with very low density, like desert, mountain, or isolated area it is not impossible to establish an Infrastructure. But if we compare how often the people there are using service of infrastructure and how many data per day transmitted with cost of installation, maintenance, and repair, it is maybe too expensive. Almost the same problem with military network. It is obviously very useless to build an infrastructure in a battlefield. Aside from cost of installation, the enemy can destroy the infrastructure in short time. An independent from infrastructure network is needed for both cases.

3.2 Mobility (MANET only)

In the next generation of wireless communication systems, there will be a need for the rapid deployment of independent mobile users. The most popular examples include military networks, emergency / rescue operations, disaster effort. In these scenarios we can't rely on centralized connectivity. MANETs support nodes' mobility. We can still communicate with our mobile devices as long as the destination is reachable.

3.3 Decentralized and robust

Another advantage of ad hoc networks is that they are inherently very robust. 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. In the ad hoc networks you can avoid such problem. If one node leaves the network or is not working, you can still have connectivity to other nodes and maybe you can use these nodes to multi-hop your message to the destination nodes, as long as there is at least one way to desired node.

3.4 Easy to build and spontaneous infrastructure:

Malfunction of a network infrastructure is sometimes not avoidable. It is obviously difficult to repair or replace the malfunction infrastructure in short time, while the network's existence must be maintained all-time. Establishing an ad hoc is a good deal in such situation. The network participants can act as ad hoc nodes and hop the messages

4. FACTORS INFLUENCING MANET

4.1 Bandwidth-constrained, variable capacity links:

A very normal trait in wireless networks is congestion because of multiple access, fading, noise and interference conditions thus leading to application demands (of resources) more than the limit of the network capacity. As the mobile network is an extension of the fixed network infrastructure, mobile adhoc users face similar problems.

4.2 Energy-constrained operation:

Nodes are battery operated with limited life in MANETs. Thus energy conservation is of utmost importance.

4.3 Limited physical security:

MANETs are additional level to physical security threats like - eavesdropping, spoofing, denial-of-service etc. For relief to some extent, MANETs have been provided with the decentralization of network control.

5. ROUTING PROTOCOLS

A routing protocol is needed whenever a packet wants to be transmitted to a destination via number of nodes and numerous routing protocols have been proposed for such kind of ad-hoc networks. These protocols locate a route for

packet delivery and deliver the packet to the correct destination. The studies on various aspects of routing protocols have been an active area of research for many years.

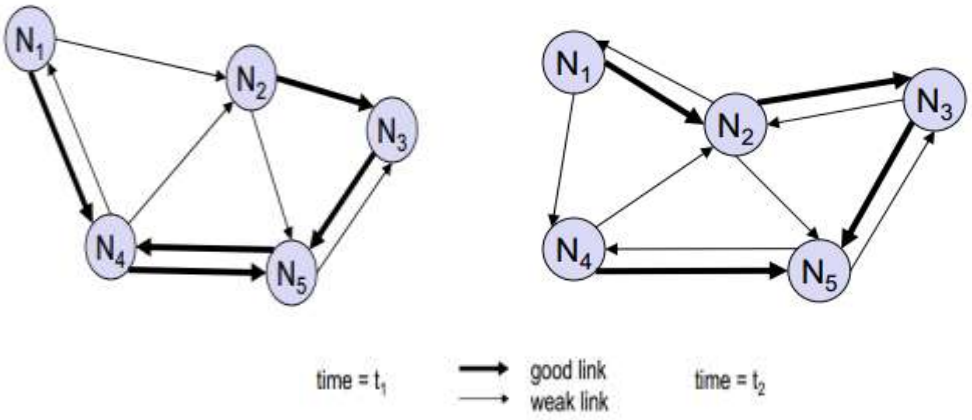

Figure 2: Routing Example for MANET

5.1 Classification of Routing Protocol:

"Routing is the process of information exchange from one host to the other host in a network. Routing is the method of forwarding packet towards its destination using most efficient path. Efficiency of the path is measured in various metrics like, Number of hops, traffic, security. In Ad-hoc network each host node acts as specialized router itself. Routing protocol for ad-hoc network can be categorized in three strategies.

a) Flat against Hierarchical architecture.
b) Pro- active against Re- active routing protocol.
c) Hybrid protocols.

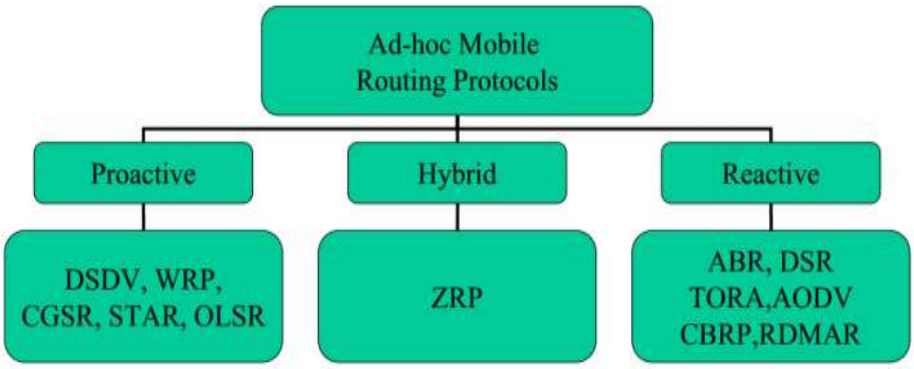

Figure 3 Classification of routing protocols

5.1.1 Flat Vs. Hierarchical architecture

Hierarchical network architecture topology consists of several layers where top layers are more seen as master of their lower layer nodes. There are cluster of nodes and one gateway node along with all clusters has a duty to communicate with the gateway node in other cluster[3]. In this schema there is a clear distribution of task. Burden of storage of network topology is on gateway nodes, where communicating dissimilar control message is dependent on cluster nodes. But this architecture breaks down when there is single node failure (Gateway node). Gateway nodes become very critical for successful operation of network. For an example Zone-based Hierarchical Link State (ZHLS) routing protocol . Where in flat architecture there is no layering of responsibility. Each and every node follows the same routing algorithm as any other node in the network.

5.1.2 Proactive Vs Reactive routing protocol in MANET

5.1.2.1 Proactive routing protocol

In proactive routing scheme every node endlessly maintains complete routing information of the network. This is achieved by flooding network periodically with network status information to find out any possible change in network topology[4].Current routing protocol like Link State Routing (LSR) protocol (open shortest path first) and the Distance Vector Routing Protocol (Bellman-Ford algorithm) are not appropriate to be used in mobile environment. Destination Sequenced Distance Vector Routing protocol (DSDV) and Wireless routing protocols were proposed to eliminate counting to infinity as well as looping problems of the distributed Bellman-Ford Algorithm. Some of the Examples of Proactive Routing Protocols are Global State Routing (GSR),Hierarchical State Routing (HSR),Destination Sequenced Distance Vector Routing (DSDV).

5.1.2.2 Reactive routing protocol

Each node in this routing protocol maintains in sequence of only active paths to the destination nodes. A route search is needed for every new destination as a result the communication overhead is reduced at the expense of delay to search the route[5].Rapidly changing wireless network topology may break active route and cause successive route search. Some Examples of reactive protocols are Ad hoc On-demand Distance Vector Routing (AODV), Dynamic Source Routing (DSR).

5.1.3 Hybrid routing protocols in MANET

There survive a number of routing protocols of globally reactive and locally proactive states. Hybrid routing algorithm is ideal for Zone Based Routing Protocol (ZRP).

5.1.3.1 Benefits of Pro-active Routing Protocol:

Proactive protocols: Routes are readily available when there is any requirement to send packet to any other mobile node in the network. Quick response to Application program.

6. PERFORMANCE METRICS

There are number of qualitative and quantitative metrics that can be used to compare reactive routing protocols.

6.1. Routing overhead:

This metric describes how many routing packets intended for route discovery and route maintenance require to be sent so as to spread the data packets.

6.2. Average Delay:

This metric represents average end-to-end delay and indicates how it extended took for a packet to travel from the source to the application layer of the destination. It is measured in seconds.

6.3. Throughput:

This metric represents the total quantity of bits forwarded to higher layers per second. It is measured in bps. It can also be defined as the total amount of data a receiver actually receives from sender separated by the time taken by the receiver to obtain the last packet.

6.4. Media Access Delay:

The time a node takes to access media for starting the packet transmission is called as media access delay. The delay is recorded for every packet when it is sent to the physical layer for the first time.

6.5. Packet Delivery Ratio:

The ratio between the amount of next data packets and actually received data packets.

6.6 Path optimality:

This metric can be defined as the differentiation between the path actually taken and the best possible path for a packet to reach its destination.

Table 1: Parameter on routing protocol

Parameters	**Table Driven(Pro-active)**	**On-Demand(Reactive)**	**Hybrid**
Storage Requirements	Higher	Dependent on no. of routes maintained or needed	Depends on size of each zone or cluster
Route Availability	Constantly available	Computed as per need	Depends on location of destination
Periodic Route Updates	Required Always	Not Required	Used inside each zone
Delay	Low	High	Low for local destinations and high for Inter-zone
Scalability	100 nodes	>100	>1000
Control Traffic	High	Low	Lower than other two types
Routing Information	Keep stored in Table	Does not store	Depends on requirement
Routing Philosophy	Mostly Flat	Flat	Hierarchical

7. CONCLUSION

MANETs is an emerging technological field and as a result is an active area of research. Because of ease of deployment and defined infrastructure less feature these networks find applications in a range of scenarios ranging from emergency operations and disaster relief to military service and task forces. Routing is an essential component of communication protocols in mobile ad hoc networks. The design of the protocols are determined by specific goals and requirements based on respective assumptions about the network properties or application area.

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