Survey on Routing in MANET

Shyamily P V
Scholar
Dept.of CSE
Vimal Jyothi Engineering College,Chemperi, Kannur

Abstract : MANET is a self organized and self configurable network without existing infrastructure. Due to limited resources in MANETs, to design an efficient and reliable routing strategy is still a challenge. A number of protocols have been proposed for efficient routing in MANET. It is quite difficult to determine which protocol is suitable for different network conditions. In this paper concentrate wide range of existing routing protocols and provide comparison between them. Here also discuss Opportunistic data forwarding. One of the reasons why opportunistic data forwarding has not been widely utilized in mobile ad hoc networks (MANETs) is the lack of an efficient, light-weight proactive routing scheme with strong source routing capability. A new routing protocol named PSR for ODF in mobile ad-hoc networks.

Index Terms—Mobile ad hoc networks, Routing Protocols comparison. Opportunistic data forwarding

1. INTRODUCTION

An Ad-Hoc network is a network without any base stations, infrastructure-less or multi-hop. A collection of two or more devices equipped with wireless communications and networking capability. It supports anytime and anywhere computing. A mobile ad hoc network (MANET) is a continuously self-configuring, infrastructure-less network of mobile devices connected without wires.

A Mobile Ad-hoc Network is a collection of independent mobile nodes that can communicate to each other via radio waves. The mobile nodes that are in radio range of each other can directly communicate, whereas others need the aid of intermediate nodes to route their packets. Each of the nodes has a wireless interface to communicate with each other. These networks are fully distributed, and can work at any place without the help of any fixed infrastructure as access points or base stations.

Nodes in the MANET share the wireless medium and the topology of the network changes erratically and dynamically. In MANET, breaking of communication link is very frequent, as nodes are free to move to anywhere. The density of nodes and the number of nodes are depends on the applications in which using MANET.

Fig 1: Mobile Ad-Hoc Network

1.1 APPLICATIONS OF MANET

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. Ad-hoc networking can be applied anywhere where there is little or no communication infrastructure or the existing infrastructure is expensive or inconvenient to use. Ad hoc networking allows the devices to maintain connections to the network as well as easily adding and removing devices to and from the network. The set of applications for MANET is diverse, ranging from large-scale, mobile, highly dynamic networks, to small, static networks that are constrained by power sources. Besides the legacy applications that move from traditional infra structured environment into the ad hoc context, a great deal of new services can and will be generated for the new environment.

Applications are:

1. Military Battlefield: Military equipment now routinely contains some sort of computer equipment. Ad-hoc networking would allow the military to take advantage of commonplace network technology to maintain an information network between the soldiers, vehicles, and military information headquarters. The basic techniques of ad hoc network came from this field.
2. Commercial Sector: Ad hoc can be used 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 damaged communications infrastructure and rapid deployment of a communication network is needed. Information is relayed from one rescue team member to another over a small hand held. Other commercial scenarios include e.g. ship-to ship ad hoc mobile communication, law enforcement, etc.
3. 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.
4. Personal Area Network (PAN): Short-range MANET can simplify 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.
5. MANET-VoVoN: A MANET enabled version of JXTA peer-to-peer, modular, open platform is used to support user location and audio streaming over the JXTA virtual overlay network. Using MANET-JXTA, a client can search asynchronously for a user and a call setup until a path is available to reach the user. The application uses a private signaling protocol based on the exchange of XML messages over MANET-JXTA communication channels

1.2 CHARACTERISTICS OF MANET

- In MANET, each node acts as both host and router. That is it is autonomous in behavior.
- Multi-hop radio relaying- When a source node and destination node for a message is out of the radio range, the MANETs are capable of multi-hop routing.
- Distributed nature of operation for security, routing and host configuration. A centralized firewall is absent here.
- The nodes can join or leave the network anytime, making the network topology dynamic in nature
- Mobile nodes are characterized with less memory, power and light weight features.
- The reliability, efficiency, stability and capacity of wireless links are often inferior when compared with wired links. This shows the fluctuating link bandwidth of wireless links.
- Mobile and spontaneous behavior which demands minimum human intervention to configure the network.
- All nodes have identical features with similar responsibilities and capabilities and hence it forms a completely symmetric environment.
- High user density and large level of user mobility.
- Nodal connectivity is intermittent.

1.3 CHALLENGES IN MANET

Regardless of the attractive applications, the features of MANET introduce several challenges, before a wide commercial deployment can be expected. These include

1. Dynamic topologies: Nodes are free to move arbitrarily; thus, the network topology which is typically multi hop, may change randomly and rapidly at unpredictable times, and may consist of both bidirectional and unidirectional links

2. Routing: Since the topology of the network is constantly changing, the issue of routing packets between any pair of nodes becomes a challenging task. Most protocols should be based on reactive routing instead of proactive. Multi cast routing is another challenge because the multi cast tree is no longer static due to the random movement of nodes within the network. Routes between nodes may potentially contain multiple hops, which is more complex than the single hop communication.

3. Device discovery: Identifying relevant newly moved in nodes and informing about their existence need dynamic update to facilitate automatic optimal route selection.

4. Bandwidth constrained:

5. Variable capacity links: Wireless links will continue to have significantly lower capacity than their hard wired counterparts.

6. Power constrained and operation: Some or all of the nodes in a MANET may rely on batteries or other exhaustible means for their energy. For these nodes, the most important system design criteria for optimization may be energy conservation. For most of the light weight mobile terminals, the communication related functions should be optimized for lean power consumption. Conservation of power and power aware routing must be taken into consideration.

7. Security and Reliability: In addition to the common vulnerabilities of wireless connection, an ad hoc network has its particular security problems due to e.g. nasty neighbor relaying packets. The feature of distributed operation requires different schemes of authentication and key management. Further, wireless link characteristics introduce also reliability problems, because of the limited wireless transmission range, the broadcast nature of the wireless medium (e.g. hidden terminal problem), mobility induced packet

losses, and data transmission errors. Mobile wireless networks are generally more prone to physical security threats than are fixed cable nets. The increased possibility of eavesdropping, spoofing, and denial of service attacks should be carefully considered.
8. Quality of Service (QoS): Providing different quality of service levels in a constantly changing environment will be a challenge. The inherent stochastic feature of communications quality in a MANET makes it difficult to offer fixed guarantees on the services offered to a device. An adaptive QoS must be implemented over the traditional resource reservation to support the multimedia services.
9. Internetworking: In addition to the communication within an ad hoc network, internetworking between MANET and fixed networks (mainly IP based) is often expected in many cases. The coexistence of routing protocols in such a mobile device is a challenge for the harmonious mobility management.
10. Multicast: Multicast is desirable to support multiparty wireless communications. Since the multicast tree is no longer static, the multicast routing protocol must be able to cope with mobility including multicast membership dynamics (leave and join).
11. IP Layer Mobile Routing: An improved mobile routing capability at the IP layer can provide a benefit similar to the intention of the original Internet, viz. "an interoperable internetworking capability over a heterogeneous networking infrastructure".
12. Diffusion whole problem: The nodes located on boundaries of holes may suffer from excessive energy consumption since the geographic routing tends to delivers data packets along the whole boundaries by perimeter routing if it needs to bypass the hole. This can enlarge the hole because of excessive energy consumption of the node boundaries nodes.

1.4 ROUTING in MANET

"Routing is the process of information exchange from one host to the other host in a network."Routing is the mechanism 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, etc. 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 Vs Hierarchical architecture.

b) Proactive Vs Reactive routing protocol.

c) Hybrid protocols.

1.4.1 Flat vs. Hierarchical Architecture

Hierarchical network architecture topology consists of multiple layers where top layers are more seen as master of their lower layer nodes. There are cluster of nodes and one gateway node among all clusters has a duty to communicate with the gateway node in other cluster. In this schema there is a clear distribution of task. Burden of storage of network topology is on gateway nodes, where communicating different 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. Examples include Zone-based Hierarchical Link State (ZHLS) routing protocol. Where in flat architecture there is no layering of responsibility. Each and every node does follow the same routing algorithm as any other node in the network.

1.4.2 Proactive vs. Reactive Routing Protocol

In proactive routing scheme every node continuously 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. Current routing protocol like Link State Routing (LSR) protocol (open shortest path first) and the Distance Vector Routing Protocol (Bellman-Ford algorithm) are not suitable to be used in mobile environment. Destination Sequenced Distance Vector Routing protocol (DSDV) and Wireless routing protocols were proposed to eliminate counting to infinity and looping problems of the distributed Bellman-Ford Algorithm.

Examples of Proactive Routing Protocols are:
a) Global State Routing (GSR).
b) Hierarchical State Routing (HSR).
c) Destination Sequenced Distance Vector Routing (DSDV).

Pros:

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.

Cons:
These maintain the complete network graph in current state, where it is not required to send packets to all those nodes.

Consumes lots of network resources to maintain up-to-date status of network graph**.**

Reactive routing protocol

Every node in this routing protocol maintains information of only active paths to the destination nodes. A route search is needed for every new destination therefore the communication overhead is reduced at the expense of delay to search the route. Rapidly changing wireless network topology may break active route and cause subsequent route search.

Examples of reactive protocols are:

a) Ad hoc On-demand Distance Vector Routing (AODV).
b) Dynamic Source Routing (DSR).
c) Location Aided Routing (LAR).
d) Temporally Ordered Routing Algorithm (TORA).

Pros:

These are bandwidth efficient protocols.
Routes are discovered on demand basis.
Less Network communication overhead is required in this protocol.

Cons:

These have very high response time as route is needed to be discovered on demand, when there is some packet to be sent to new destination which does not lie on active path.

1.4.3 Hybrid Routing Protocols in MANET

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

2. LITERATURE SURVEY

Routing protocols are basically of two types DV and LS used or packet forwarding.
Link State and Distance Vector

Link state routing protocol keeps a routing table for complete topology, which is built up finding the shortest path of link cost. The information of link cost is transmitted periodically by all nodes using flooding technique. Each node updates its routing table using new link cost information gathered. Link cost information may be inconsistent because of the dynamic behavior of topology or wireless medium, such as instantaneously incorrect long propagation delay etc. This may result in short-lived long routing loops, which disappear on link updates.

Destination sequenced distance vector routing is adapted from the conventional Routing Information Protocol (RIP) to ad hoc networks routing. It adds a new attribute, sequence number, to each route table entry of conventional RIP. Using the newly added sequence number, the mobile nodes can distinguish stale route information from the new and thus prevent the formation of routing loops. The main purpose of DSDV is to address the looping problem of conventional distance vector routing protocol and to make the distance vector routing more suitable for ad hoc network routing. However DSDV arises route fluctuations because of its criteria of route updates. At the same time, DSDV does not solve the common problem of all distance vector routing protocols, the unidirectional link problem. It is difficult to determine the maximum setting time. DSDV does not support multipath routing. The destination central synchronization suffers from latency problem. It has excessive communication overhead due to periodic and triggered updates. Each node must have a complete routing table.

AODV protocol is a flat routing protocol. It does not need any central administrative system to handle the routing process. The AODV protocol is a loop free and avoids the counting to infinity problem, which were typical to the classical distance vector routing protocols, by the usage of sequence numbers. AODV tries to keep the overhead of the messages small. If host has the route information in the routing table about active routes in the network, then the overhead of the routing process will be minimal. Reactive protocols like AODV tend to reduce the control traffic messages overhead at the cost of increased latency in finding new routes.

OLSR is also a flat routing protocol; it does not need central administrative system to handle its routing process. The proactive characteristic of protocol provides that the protocol has all the routing information to all participated hosts in the network. However, as a drawback OLSR protocol needs that each host periodically sends the updated topology information throughout the entire

network, this increases the protocol bandwidth usage. But the flooding is minimized by the MPRs, which are only allowed to forward the topological messages. OLSR protocol is well suited for the application which does not allow the long delay in the transmission of data packet. The best working environment for OLSR protocol is dense network, where the most communication is concentrated between large of nodes. Great advantage of the OLSR protocol is that immediately knows the status of the link and it is possibly to extend the quality of service information to such protocol so that the hosts know in the advantage of the quality of the route, this feature is completely impossible in AODV, because of its reactiveness. Extending the OLSR protocol the quality of service feature will result additional latency and overhead.

DSR allows the network to be completely self-organizing and self-configuring, without the need for any existing network infrastructure or administration. The DSR protocol allows nodes to dynamically discover a source route across multiple network hops to any destination in the network. 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 source routing allows packet routing 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. All aspects of the protocol operate entirely on-demand, allowing the routing packet overhead of DSR to scale automatically to only that needed to react to changes in the routes currently in use.

- Route Discovery is the mechanism by which a node S wishing to send a packet to a destination node D obtains a source route to D. Route Discovery is used only when S attempts to send a packet to D and does not already know a route to D.
- Route Maintenance is the mechanism by which node S is able to detect, while using a source route to D, if the network topology has changed such that it can no longer use its route to D because a link along the route no longer works. When Route Maintenance indicates a source route is broken, S can attempt to use any other route it happens to know to D, or can invoke Route Discovery again to find a new route. Route Maintenance is used only when S is actually sending packets to D.

ExOR, an integrated routing and MAC protocol that increases the throughput of large unicast transfers in multi-hop wireless networks. ExOR chooses each hop of packet's route after the transmission for that hop, so that the choice can react which intermediate nodes actually received the transmission. This deferred choice gives each transmission multiple opportunities to make progress.

BASIC IDEA:

A simplified version of ExOR might work as follows. A source node has a packet that it wishes to deliver to a distant destination. Between the source and destination are other wireless nodes willing to participate in ExOR. The source broadcasts the packet. Some sub-set of the nodes receives the packet. The nodes run a protocol to discover and agree on which nodes are in that subset. The node in the sub-set that is closest to the destination broadcasts the packet. Again, the nodes that receive this second transmission agree on the closest receiver, which broadcasts the packet. This process continues until the destination has received the packet. No selfish nodes are considered here.

It is a pure network layer scheme that can be built top off-the-shelf wireless network equipment. Nodes in the network use a lightweight proactive source routing protocol to determine a list of intermediate nodes that the data packet should follow en route to the destination. Here, when a data packet is broadcast by an upstream node and has happened to be received by a downstream node further along the route, it continues its way from there and thus will arrive at the destination node sooner. This is achieved through cooperative data communication at the link and network layers.

A lightweight proactive source routing protocol so that each node has complete knowledge of how to route data to all other nodes in the network at any time. When a flow of data packets are forwarded towards their destination, the route information carried by them can be adjusted by intermediate forwarders. Furthermore, as these packets are forwarded along the new route, such updated information is propagated upstream rapidly
without any additional overhead. As a result, all upstream nodes learn about the new route at a rate much faster than via periodic route exchanges.

Opportunistic data forwarding to another level is taken by allowing nodes that are not listed as intermediate forwarders to retransmit data if they believe certain packets are missing.

- Proactive source routing: PSR runs in the background so that nodes periodically exchange network structure information have a BFS to route packets to destination.
- Large-scale live update: When data packets are received by and stored at a forwarding node, the node may have a different view of how to forward them to the destination from the forwarder list carried by the packets. Forwarding node is allowed to update routing information of packets.
- Small-scale retransmission: A short forwarder list forces packets to be forwarded over long and possibly weak links. CORMAN allows nodes that are not in the forwarder list to retransmit data, if packets not received successfully.

Disadvantages:

- If the forwarder node is a malicious node, it can cause problems in the routing information.

- Deciding which intermediate node will do the retransmission is a problem of concern.

Route assignment is one of the operational problems of a communication network. The function of a routing algorithm is to guide packets through the communication network to their correct destinations. Traditional Distance Vector Algorithm based on distributed Bellman Ford Algorithm for shortest path computation is that suffer counting to infinity problem and bouncing effect. Two new routing algorithms, PFA and LPA, for flat networks which are devoid of the drawbacks of traditional algorithms.PFA reduces the number of temporary loops can occur and LPA is the first routing algorithm that is loop free at every instant.

Path Finding Algorithm (PFA)

Maintains distance table, routing table and link cost table

- ✓ On receiving a routing update from a neighbor, each node check consistency of predecessor information of all neighbor(of K)
- ✓ Has fast convergence

Whenever there is a link failure, an update message is sent to neighbor, each node receiving the update message not only updates the table by deleting the concerned entry, but also searches for new routes through other neighbors and update the table.

Loop Free Path Finding Algorithm (LPFA)

Normal loop free algorithms expects the

1. Routes to synchronize along multiple hops.

2. Exchange path information that can include all the routes in the path from source to destination

LPFA removes such loops by reporting an infinite distance for the destination to all its neighbors and by waiting for those neighbors to acknowledge its messages with their own distance and predecessor information before the router changes its successor.

A mobile ad-hoc network (MANET) is a self-configuring infrastructure less network of mobile devices connected by wireless Links. Cooperative Communication typically refers to a system where users share and coordinate their resources to enhance the data transmission quality. It is an overview of the relay communication, in which many sources also serve as relay for each other. The Cooperative Communication (CC) is used to tackle the problem of opportunistic data transfer in mobile adhoc networks.CC is a pure network layer scheme that can be built on top off-the-shelf of wireless networking equipment. Nodes in the network make use of a lightweight proactive source routing protocol to determine a list of intermediate nodes that the data packets should follow a route to the destination. Data Packets will arrive at the destination node quicker, which is achieved by using cooperative data communication.

In VANET vehicle mobility will cause the communication link between vehicles to frequently broken. Link failure will lead to increase routing overhead and degradation of network scalability. A new protocol Hybrid Location-Based Ad-Hoc Routing is designed to address this issue. It is a combination of modified AODV with greedy forwarding geographic routing protocol. AODV is augmented with Expected Transmission Count metric (ETX).Intermediate vehicles reports broken route to source vehicles. HLAR initiate route discovery in on-demand fashion.

Table 1: COMPARISON BETWEEN THE THREE CATEGORIES OF ROUTING PROTOCOLS

Parameters	Table-Driven (Proactive)	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	Always available	Computed as per need	Depends on location of destination
Scalability	100 nodes	> 100	> 1000
Routing Information	Keep stored in table	Doesn't store	Dependson requirement
Routing Philosophy	Mostly flat	Flat	Hierarchical

3. CONCLUSION

This literature survey is based on Routing in MANET. Here discussed the characteristics, applications and challenges and various types of routing protocols for efficient and effective communication between the mobile nodes participating in a dynamically

established network of nodes. The routing protocols are broadly classified into Proactive, Reactive and Hybrid. Traditional routing protocols are not suitable for Opportunistic Data Forwarding.ODF needs a special routing protocol, PSR is a good choice for ODF

BIBLIOGRAPHY

[1] C. E. Perkins and P. Bhagwat, "Highly dynamic Destination-Sequenced Distance-Vector Routing (DSDV) for mobile computers," Comput. Commun.Rev., vol. 24, pp. 234–244, Oct. 1994.

[2] C. E. Perkins and E. M. Royer, "Ad hoc On-Demand Distance Vector (AODV) routing," RFC 3561, Jul. 2003. [Online]. Available: http://www.ietf.org/rfc/rfc3561.txt

[3] T. Clausen and P. Jacquet, "Optimized Link State Routing Protocol (OLSR)," RFC 3626, Oct. 2003. [Online]. Available: http://www.ietf.org/rfc/rfc3626.txt

[4] D. B. Johnson, Y.-C. Hu, and D. A. Maltz, "On The Dynamic Source Routing Protocol (DSR) for mobile ad hoc networks for IPv4," RFC 4728, Feb. 2007. [Online]. Available: http://www.ietf.org/rfc/rfc4728.txt

[5] S. Biswas and R. Morris, "ExOR: Opportunistic multi-hop routing for wireless networks," in Proc. ACM Conf. SIGCOMM, Philadelphia, PA, USA, Aug. 2005, pp. 133–144.

[6] Z. Wang, Y. Chen, and C. Li, "CORMAN: A novel cooperative opportunistic routing scheme in mobile ad hoc networks," IEEE J. Sel. Areas Commun., vol. 30, no. 2, pp. 289–296, Feb. 2012.

[7] S. Murthy, "Routing in packet-switched networks using path-finding algorithms,"Ph.D. dissertation, Comput. Eng., Univ. California, Santa Cruz, A, USA, 1996

[8] L.Shriinithi and K.Santhi," Survey on Cooperative Opportunistic Routing Scheme in MANET", International Journal of Advent Research in Computer & Electronics (IJARCE) Vol.1, No.1, March 2014

[9] M. Al-Rabayah and R. Malaney, "A new scalable hybrid routing protocol for VANETs," IEEE Trans. Veh. Technol., vol. 61, no. 6, pp. 2625–2635, Jul. 2012.