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Routing Protocols in Mobile Ad-Hoc Networks: A Review

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Abstract

In recent years mobile ad hoc networks have become very popular and lots of research is being done on different aspects of MANET. Mobile Ad Hoc Networks (MANET) is a system of mobile nodes (laptops, sensors, etc.) that interacts without the assistance of centralized administrator or access points. The infrastructureless and the dynamic nature of these networks demands for new set of networking strategies to be implemented in order to provide efficient end-to-end communication. In this paper main emphasis is on routing techniques which is the most challenging issue due to the dynamic topology of mobile ad hoc networks. There are different strategies proposed for efficient routing which claimed to provide improved performance. There are different routing protocols proposed for MANETs which makes it quite difficult to determine which protocol is suitable for different network conditions. This paper provides an overview of different routing protocols in MANETs and also provides a comparison between them.

Keyword: Adhoc, MANETs, Routing Protocol, Dynamic Topology, Mobile.

Introduction

Wireless Networks

Wireless networks provide connection flexibility between users in different places. Moreover, the network can be extended to any place or building without the need for a wired connection. Wireless networks are classified into two categories:

Infrastructure Network

An Access Point (AP) represents a central coordinator for all nodes. Any node can join the network through AP. In addition, AP organizes the connection between the Basic Set Services (BSSs) so that the route is ready when it is needed. However, one drawback of using an infrastructure network is the large overhead of maintaining the routing tables.

Ad Hoc networks

A wireless ad hoc network is a decentralized type of wireless network. The network is ad hoc because it does not rely on a preexisting infrastructure, such as routers in wired networks or access points in managed (infrastructure) wireless networks. Ad Hoc networks do not have a certain topology or a central coordination point. Therefore, sending and receiving packets are more complicated than infrastructure networks.

Mobile ad-hoc network (MANET)

Recent trends in wireless communications have expanded possible applications from simple voice services in early cellular networks (first and second generation, 1G and 2G) to new integrated data applications. 4G technology is now new promising application of mobile technology. It is basically new generation of mobile devices.

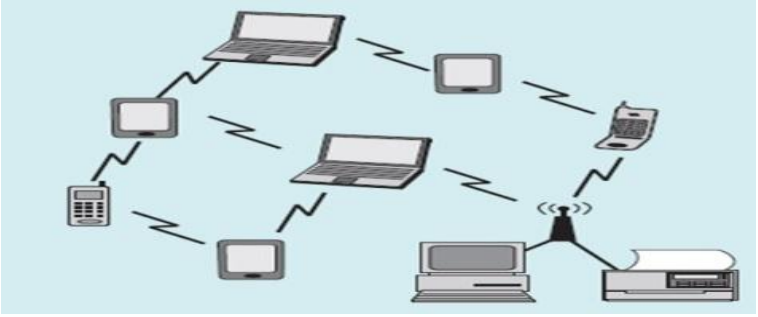

Fig 1. Mobile ad-hoc network

In a MANET, the router connectivity may change frequently, leading to the multi-hop communication paradigm that can allow communication without the use of BS/AP, and provide altenative connections inside hotspot cells. A dual-mode MS can operate in both the infrastructure (communicating directly to a BS or AP) and MANET modes using the WLAN interface. A MANET is a type of ad-hoc network that can change locations and configure itself on the fly. All nodes in this network are mobile and they use wireless connections to communicate with various networks.

Characteristics of MANETs

1. Dynamic topologies,
2. Bandwidth constrained,variable capacity links
3. Energy constrained operation
4. Limited physical security.

Types of MANETs

1. Two popular types of MANET are
2. VANET (Vehicular Ad-hoc network) and
3. IMANET (Internet based ad-hoc networks).

Applications of MANETs

1. Militiary Battle Field
2. Commercial Sector
3. Local Level
4. Personal Area Network (PSN)
5. Disaster Recovery

Routing in MANETs

Routing is one of the core problems of networking for delivering data from one node to the other. Wireless ad-hoc networks are also called Mobile ad-hoc multihop networks without predetermined topology or central control. This is because MANETs can be characterized as having a dynamic, multihop, potentially rapid changing topology. The aim of such networks is to provide communication capabilities to areas with limited or no existing communication infrastructures. A MANET is usually formed by mobile nodes using wireless communications. It uses a peer-to-peer multihop routing instead of a static network infrastructure to provide network connectivity.

Routing Protocols in MANETS

Classification of Current Routing Protocols

An intelligent routing strategy is required to efficiently use the limited resources while at the same time being adaptable to the changing network conditions such as: network size, traffic density and network partitioning. In parallel with this, the routing protocol may need to provide different levels of QoS to different types of applications and users.

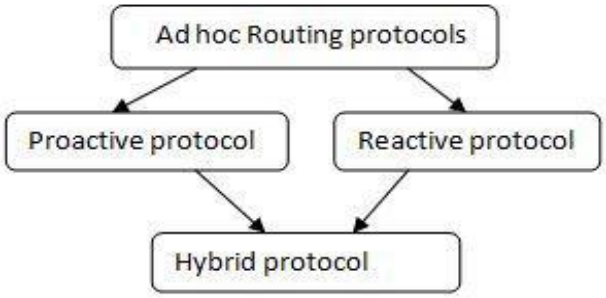

Fig 2: Routing Protocols in mobile ad-hoc network

Proactive Routing Protocols

In proactive routing protocols, each node maintains routing information to every other node in the network. The routing information is usually kept in a number of different tables. These tables are periodically updated and/or if the network topology changes. The difference between protocols exists in the way the routing information is updated, detected and the type of information kept at each routing table. Furthermore, each routing protocol may maintain different number of tables. This section describes two proactive protocols.

Destination-sequenced distance vector (DSDV)

DSDV is developed on the basis of Bellman–Ford routing algorithm with some modifications. In this routing protocol, each mobile node in the network keeps a routing table. Each of the routing table contains the list of all available destinations and the number of hops to each. Each table entry is tagged with a sequence number, which is originated by the destination node. Periodic transmissions of updates of the routing tables help maintaining the topology information of the network. If there is any new significant change for the routing information, the updates are transmitted immediately. So the routing information updates might either be periodic or event driven. DSDV protocol requires each mobile node in the network to advertise its own routing table to its current neighbors. The advertisement is done either by broadcasting or by multicasting. By the advertisements, the neighboring nodes can know about any change that has occurred in the network due to the movements of nodes. The routing updates could be sent in two ways: one is called a „„full dump"" and another is „„incremental."" In case of full dump, the entire routing table is sent to the neighbors, where as in case of incremental update, only the entries that require changes are sent.

Wireless Routing Protocol (WRP)

WRP belongs to the general class of path-finding algorithms, defined as the set of distributed shortest path algorithms that calculate the paths using information regarding the length and second-to-last hop of the shortest path to each destination. WRP reduces the number of cases in which a temporary routing loop can occur. For the purpose of routing, each node maintains four things: 1.A distance table 2. A routing table 3.A link-cost table 4. A message retransmission list (MRL). WRP uses periodic update message transmissions to the neighbors of a node. The nodes in the response list of update message should send acknowledgments. If there is no change from the last update, the nodes in the response list should send an idle Hello message to ensure connectivity. A node can decide whether to update its routing table after receiving an update message from a neighbor and always it looks for a better path using the new information. If a node gets a better path, it relays back that information to the original nodes so that they can update their tables. After receiving the acknowledgment, the original node updates its MRL. Thus, each time the consistency of the routing information is checked by each node in this protocol, which helps to eliminate routing loops and always tries to find out the best solution for routing in the network.

Reactive Routing Protocols

Reactive routing protocol is also known as on demand routing protocol. In this protocol route is discovered whenever it is needed Nodes initiate route discovery on demand basis. Source node sees its route cache for the available route from source to destination if the route is not available then it initiates route discovery process. The on- demand routing protocols have two major components:

Route Discovery

Source nodes consults its route cache for the available route from source to destination otherwise if the route is not present it initiates route discovery. The source node, in the packet, includes the destination address of the node as well address of the intermediate nodes to the destination.

Route Maintenance

Due to dynamic topology of the network cases of the route failure between the nodes arises due to link breakage etc, so route maintenance is done. Reactive protocols have acknowledgement mechanism due to which route maintenance is possible Reactive protocols add latency to the network due to the route discovery mechanism. Each intermediate node involved in the route discovery process adds latency. These protocols decrease the routing overhead but at the cost of increased latency in the network. Hence these protocols are suitable in the situations where low routing overhead is required. Various well known reactive routing protocols present in MANET are DSR, AODV, TORA and LMR. This section describe DSR and AODV.

Dynamic Source Routing (DSR)

DSR protocol requires each packet to carry the full address (every hop in the route), from source to the destination. This means that the protocol will not be very effective in large networks, as the amount of overhead carried in the packet will continue to increase as the network diameter increases. Therefore in highly dynamic and large networks the overhead may consume most of the bandwidth. However, this protocol has a number of advantages over routing protocols such as AODV, LMR and TORA and in small to moderately size networks (perhaps up to a few hundred nodes), this protocol may perform better. An advantage of DSR is that nodes can store multiple routes in their route cache, which means that the source node can check its route cache for a valid route before initiating route discovery, and if a valid route is found there is no need for route discovery. Another advantage of DSR is that it does not require any periodic beaconing (or hello message exchanges), therefore nodes can enter sleep node to conserve their power. This also saves a considerable amount of bandwidth in the network.

Ad Hoc on-Demand Distance Vector Routing (AODV)

The AODV [8] routing protocol is based on DSDV and DSR [19] algorithm. It uses the periodic beaconing and sequence numbering procedure of DSDV and a similar route discovery procedure as in DSR. The most distinguishing difference is that in DSR each packet carries full routing information, whereas in AODV the packets carry the destination address. This means that AODV has potentially less routing overheads than DSR. The other difference is that the route replies in DSR carry the address of every node along the route, whereas in AODV the route replies only carry the destination IP address and the sequence number. The advantage of AODV is that it is adaptable to highly dynamic networks. However, node may experience large delays during route construction, and link failure may initiate another route discovery, which introduces extra delays and consumes more bandwidth as the size of the network increases.

Conclusion

This paper discusses the various aspects of mobile ad-hoc networking, the different routing protocols used for wireless sensor networks. Also, we compared DSDV and AODV routing protocols for ad hoc networks. DSDV uses the proactive table-driven routing strategy while AODV uses the reactive On-demand routing strategy. AODV performs better under high mobility simulations than DSDV. High mobility results in frequent link failures and the overhead involved in updating all the nodes with the new routing information as in DSDV is much more than that involved AODV, where the routes are created as and when required. AODV uses on -demand route discovery, but with different routing mechanics.AODV uses routing tables, one route per destination, and destination sequence numbers, a mechanism to prevent loops and to determine freshness of routes. There are still many challenges facing wireless ad hoc networks. However because of these advantages, wireless ad hoc networks are becoming more and more prevalent in the world.

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