The Survey of Routing Protocols in Wireless Network

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Abstract

Mobile Ad-hoc network (MANET) is the main research area from several years. The key component in this is the routing of packets over the network. As the nodes in MANET are mobile it is difficult to set the fixed path. It is a challenge to route theses packets. There are many routing protocols available who has its own features. MANET has two main types table driven routing protocol and on demand routing protocol. Mainly the dynamic routing is preferable due to the mobile nature of nodes. This paper discusses the table driven as well as the on demand routing protocols of MANET.

1. Introduction

Mobile ad hoc network is simply a self-configuring wireless network of mobile devices. In mobile ad hoc network each node acts as a router for the packets [1] in which every node will forward the packet to next node. Several studies have been performed on the congestion occurred in the routing of packets. The protocols defined before have worked on avoiding congestion by considering either delay or load of the intermediate node [2].The gathered information is used for establishing the path between the nodes. The main issues in MANET are that they must respond very quickly to the topological changes in the network. There are many protocols exists which exposes the problems of routing in mobile ad hoc network. It is divided into two classes when a node is trying to acquire route to the destination. These protocols may generally categorize as Table driven (proactive) and on demand routing protocols (reactive) [3]. In this we will study different types of table driven protocols such as WRP (Wireless Routing Protocol) [4] and DSDV (Destination-Sequenced Distance-Vector) [5]. Also the on demand routing protocols such as AODV (Ad hoc on Demand Distance Vector) routing protocol [7], DSR (Dynamic Source Routing) protocol [9].

The remaining paper is organized as follows. In section 2, discusses about the characteristics of routing protocols. Section 3 provides the different protocols for the MANET. Section 4 discusses the comparative study of MANET Protocols. Section 5 discusses about the applications of MANET and section 6 concludes the paper.

2. Characteristics of ad-hoc routing Protocols

The characteristics of ad-hoc routing protocols are as follows which are defined in RFC 2501[6]:

1. Distributed operation

This property is essential to ad hoc networks. It is self-evident that ad hoc networks operate in distributed manner because of their very nature.

2. Loop-freedom

This property is generally desirable. It refers to avoiding packets spinning around in the network for arbitrary time. Solutions such as TTL values can be used to limit performance effects of the problem. However, a more structured or a sophisticated solution will probably lead to better overall performance.

3. Demand based operation

Ad hoc routing does not have to assume uniform traffic load in a network but it can adapt to traffic patterns on need basis. This will increase route discovery delay but when implemented intelligently bandwidth and energy resources can be more efficiently utilized.

4. Proactive operation

This is opposite to demand based operation. If additional delays that occur in demand based operation are unacceptable, proactive approach can be used especially when energy and bandwidth capacities support the use of proactive operation.

5. Security

Because of the vulnerabilities in the physical security, ad hoc routing protocols are exposed too much kind of attacks. Maintaining link layer security is in practice harder with ad hoc networks than with fixed networks. Sufficient routing protocols security is desirable. Sufficient within this context covers prohibiting disruption or modification of protocol operation.

3. Protocols in MANET

The protocols are subdivided into 3 categories according to their functionality, Table-driven or Proactive Protocol, On Demand or Reactive Protocols and Hybrid routing protocols.

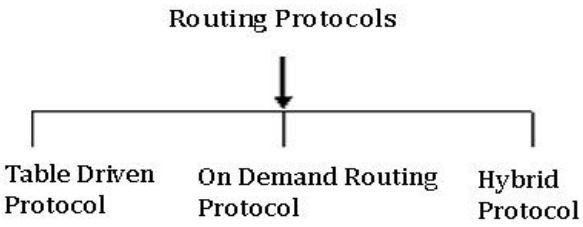

Figure 1. Routing protocols in MANET

3.1. Table Driven Routing Protocol

In Table-driven routing protocols each node maintains one or more tables containing routing information to every other node in the network. All nodes update their tables to maintain up-to-date view of the network. The nodes will propagate the update message when the network topology changes to maintain the up-to-date information about the network. Some of the routing protocols are discussed as follows.

3.1.1 The Wireless Routing Protocol (WRP). The Wireless Routing Protocol (WRP) [7] is a table-based distance-vector routing protocol. Each node maintains four tables Distance table, a Routing table, a Link-Cost table and a Message Retransmission list. The Message Retransmission List will have the sequence number of updated message also the counter for retransmitting message and list of updates which are sent in a message. If there is any link change the node informs to each by sending update message. The update message is sent when there are updates from neighbours or changes in a link. If there is no any update from the nodes the HELLO message will be sent for ensuring the connectivity. If this message comes from the new node then that node will be added to the list. The main disadvantage of this protocol is to maintain the four different tables which consumes large amount of memory. Also for checking the connectivity it sends HELLO packet which consumes the power and bandwidth.

3.1.2 Dynamic Destination-Sequenced Distance-Vector Routing Protocol (DSDV). The Dynamic Destination-Sequenced Distance-Vector Routing Protocol (DSDV) Routing algorithm [8] is based on the idea of the classical Bellman-Ford routing algorithm with certain improvements. Each node maintains table for Next Hop on path, distance (in hops) to the destination and Sequence number (for current route). As it's a table driven routing protocol it exchanges updates with its neighbour. A station also transmits its routing table if a significant change has occurred in its table from the last update sent. The routing table sent in two ways: 1. Full Dump 2. Incremental update. A full dump sends complete routing table to its neighbour and could span many packets. In an incremental update only those entries from the routing table are sent that has a metric change since the last update and it must fit in a packet. The route labelled with highest sequence number is used. Two routes with the same sequence number then the route which has the best metric is used for routing packets. The advantage of this protocol is, it only maintains the best path instead of maintaining multiple paths to every destination. It also solves the routing loop problem [10]. The disadvantages of this protocol are it requires regular updates of its routing table which uses battery power and small amount of bandwidth even when the network is idle. It is also not suitable for highly dynamic network.

3.2. On Demand Routing Protocol

These protocols do not contain up-to-date information as that of table driven routing protocol. Instead of maintaining the routes list at every node the routes will be created when needed. When a source wants to send packets to a destination, it invokes a mechanisms called as route discovery mechanism to find the path to the destination. The route will be available until the destination is reachable or until the route is removed from the list. This section discusses a few on-demand routing protocols.

3.2.1Ad-hoc On Demand Distance Vector Routing Protocol (AODV). In AODV the netwo-rk will not go for route discovery until a connection is needed. It is used to minimize the number of broadcast requests by creating routes when needed. When a network requires a connection it will broadcast a request. Other nodes present in AODV

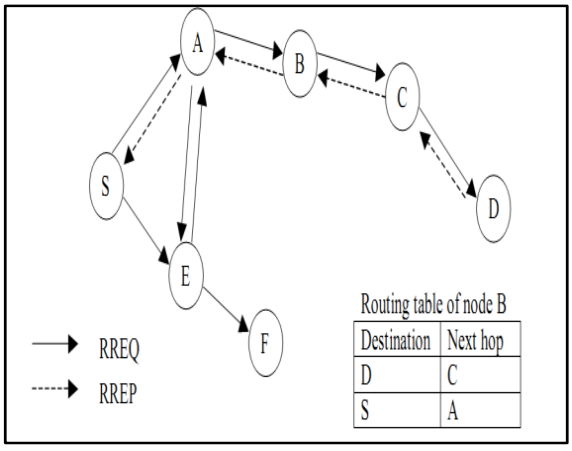

Figure 2. Route Discovery in AODV Protocol

will forward this requested message, and records the node from which it has heard the route request, it will create temporary route back to the requested node. The figure 2 shows the route discovery process in AODV protocol. The request will be forwarded until it reaches the intermediate node

which will contain latest information about the route or till it reaches the destination. When a node receives such a message and if already has a route to the desired node, the message will be sent back to the requesting node through temporary route. The requesting ode then uses the route with least number of hops through other nodes. The entries which are unused will be recycled after a time. A routing error is passed back to a transmitting node, and the process is repeated when the link fails. The main aim of the protocol is to lower the number of messages so the capacity of the network will be conserved. For example, for each route request, it has a sequence number. Nodes will use this sequence number so that it will not be repeated for route requests that they have already passed. The time to live is another feature which deals with the route requests number that limits how many times they can be retransmitted. The feature of it is that if a route request fails, another route request may not be initiated until twice as much time has passed as the timeout of the previous route request. The advantage of AODV is that along the existing link it doesn't create any extra traffic. The Distance Vector Routing is simple in terms of the memory requirement. But the main disadvantage is that it requires much time to establish connection. Also it is heavier in terms of initial communication establishment.

3.2.2 The Dynamic Source Routing Protocol (DSR).

It is another on-demand protocol designed to restrict the bandwidth consumed by control packets in ad hoc wireless networks by eliminating the periodic table-update messages required in the table-driven approach. The main use of this protocol is, it does not require informing the presence of node to its neighbors. That means for informing the node is available other protocols uses the periodic hello packet (beacon) which is eliminated in DSR protocol. The basic idea of establishing the route is same for DSR (and all other on-demand routing protocol) is by sending the RouteRequest packets all over the network. When the destination receives the RouteRequest packet it will respond to the source by sending the RouteReply packet which has the route traversed by the RouteRequest packet received. When a source node that does not have a route to the destination and if it has data packets to be sent to the destination, it initiates process by using RouteRequest packet. These RouteRequest packets will be sent over the network. It will send over network by rebroadcasting the packet to its neighbors. It will be rebroadcasted if the node has not forwarded it already and also the packet's Time to Live (TTL) counter has not been exceeded. Each of the RouteRequest will have a Sequence number which is generated by the source node and also contains the path traversed by the packet. A node, after receiving a RouteRequest packet, checks for the sequence number on the packet before forwarding it to the next node. The packet will not be forwarded if it is a duplicate RouteRequest. The sequence number on the packet plays important role which is used to prevent the formations of loop and also to avoid multiple transmissions of the same RouteRequest packets by an intermediate node that will be received through multiple paths over the network. Thus, all nodes forward the RouteRequest node except the destination node while constructing the route to the destination. A destination node, will reply to the source node after receiving the first RouteRequet by using the

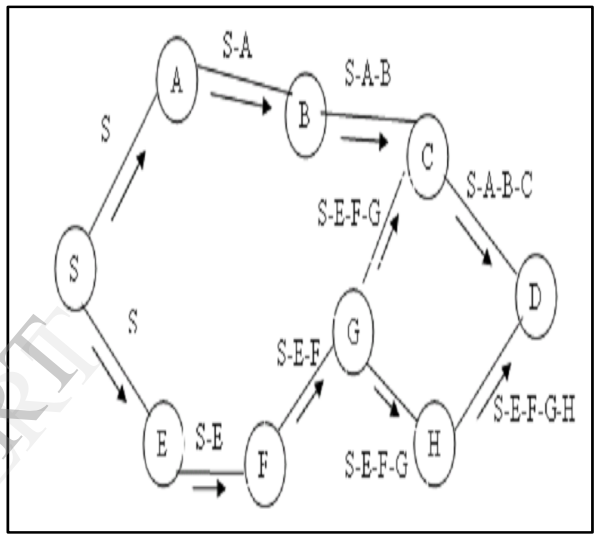

Figure 3. Building Route Record in DSR

reverse path which is traversed by the RouteRequest packet. The promiscuous mode is another way of learning about the traversed route of neighbor node. It's the node in which a node can receive the packets that are neither addressed to nor broadcasted. The figure 3 shows the Record Building in DSR protocol.

4. Comparison of Table driven and on demand Routing Protocol

The following table summarises the comparison between the table driven and on demand routing protocols.

Table 1. Comparison between Table Driven and on demand Routing Protocol

Table Driven Routing Protocol	On Demand Routing Protocol
Consistent Information- It maintains the consistent information of each and every node.	On demand information – It will maintain the route when needed.
It has poor performance due to the high mobility.	It has better performance than table driven protocol.
It has higher amount of traffic control.	It has smaller amount of traffic control.
It requires higher bandwidth.	It requires lower bandwidth.

5. Applications of MANET

The following table shows the applications of Mobile Ad hoc network (MANET). The MANET is used in various sectors [11].

Table 2. Applications of MANET

Applications	Description / Services
Tactical Networks	Military Communication
Educational	Virtual Classroom or Conference Rooms
Emergency Services	Rescue Operations
Sensor Network	Remote Sensor for Weather, earth activities
Entertainment	Multiplayer Games
Home & Enterprise Networking	Shared Whiteboard Applications.

6. Conclusion

In this paper we have discussed about the Mobile Ad hoc network protocols. Also we have discussed about the categories of them, i.e. Table Driven and On Demand Routing Protocols. Also the characteristics and applications of MANET are discussed. Each and every protocol of MANET has its own characteristics which can be used in certain situations. The MANET which is now widely used still remains with some of the challenges. In future there will be some new technologies to tackle with these challenges.

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