Cost Effective DYMO Protocol for MANET

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Abstract
Mobile adhoc networks (MANETs) are autonomous collection of mobile nodes which communicate over relatively bandwidth constrained wireless links. In such a network, each mobile node operates not only as a host but also as a router, forwarding packets for other mobile nodes in the network that may not be within direct wireless transmission range of each other. Each node participates in an ad hoc routing protocol that allows it to discover “multi-hop” paths through the network to any other node. Routing in MANET is a big challenge, in this paper we have discussed in depth about the various on demand routing protocols in MANET. This paper presents a comprehensive summarization and a comparative study of the Dynamic MANET On-demand (DYMO) protocol for MANET and existing protocols. Comparative study shows that DYMO is only a good choice if the nodes are mobile and wireless multi hop.

Keywords: MANET, REACTIVE, PROACTIVE, HYBRID, DSR, LAR, ABR, DYMO.

1. Introduction

Mobile adhoc Network (MANET) is a collection of self-configuring mobile node without any infrastructure. The mobile nodes with wireless radio interface are connected by wireless links where each device in a MANET is free to move independently and randomly with capability of changing its links to other devices frequently [1]. It is a multihop process because of the limited transmission range of energy constrained mobile nodes and thus each device in network topology acts as a router. Due to the dynamic nature of network topology the routes changes very fast and frequent and so the efficient routing protocols plays important roles in handling it. They should be capable to ensure the delivery of packets safely to their destinations. MANETs are also capable of handling topology changes and malfunctions in nodes through network reconfigurations [1].

2. Routing in MANET

A mobile adhoc network (MANET) is a dynamic wireless network which has a free movement of nodes and arranges in a random manner. Without the help of any pre-existing network infrastructure, the MANETs can be setup wherever and whenever necessary. Being an autonomous system, the mobile hosts act as routers and have a random movement [2].

Multi-hop routing is used for communication in every mobile node (MN) in the MANET, since both the router and the user role is played by the MN. The dynamic nature of network topology and the resource constraints makes MANET routing a tedious process. Transmitting messages through wireless channels become a major problem due to link reliability. The minimum hop count routing selects path with less capacity rather the best paths that exist in the network and so good quality paths are not built using this routing [2].

There are three categories of routing protocol. These are as:

2.1 Table-Driven Routing Protocols

Table-driven routing protocol [3] attempt to maintain consistent, up-to-date routing information from each node to every other node in the network. These protocols require each node to maintain one or more tables to store routing information, and they respond to changes in the network topology by propagating updates routes throughout the network in order to maintain a consistent network view.
2.2 On Demand Routing Protocols
A different approach from table-driven routing is on-demand routing [4]. This type of routing creates routes only when desired by source node. When a node requires a route to a destination, it initiates a route discovery process within the network. This process is completed once a route is found or all possible routes permutations have been examined. Once a route has been established, it is maintained by a route maintenance procedure until either the destination becomes inaccessible along every path from the source or until the route is no longer desired.

2.3 Hybrid Routing Protocols
Based on combination of both table and demand driven routing protocols, some hybrid routing protocols are proposed to combine advantage of both proactive and reactive protocols. The most typical hybrid one is zone routing protocol [5]. As to the major division of routing protocols, Table I gives a comparison of table-driven, demand-driven and hybrid routing protocol.

<table>
<thead>
<tr>
<th>Characteristics</th>
<th>Table Driven</th>
<th>Demand Driven</th>
<th>Hybrid</th>
</tr>
</thead>
<tbody>
<tr>
<td>Network Organization</td>
<td>Flat</td>
<td>Hierarchical</td>
<td>Hierarchical</td>
</tr>
<tr>
<td>Topology Dissemination</td>
<td>Periodical</td>
<td>On-Demand</td>
<td>Both</td>
</tr>
<tr>
<td>Route Latency</td>
<td>Available</td>
<td>Available</td>
<td>Both</td>
</tr>
<tr>
<td>Mobility Handling</td>
<td>Periodical</td>
<td>Route Maintenance</td>
<td>Both</td>
</tr>
<tr>
<td>Communication Overhead</td>
<td>High</td>
<td>Low</td>
<td>Medium</td>
</tr>
</tbody>
</table>

3. On Demand-Driven Routing Protocols
In MANET, there are three types of routing protocols: Table-driven, On-demand and Hybrid routing protocol. These can be further classified:

![Various routing protocols](image)

**Figure 1: Various routing protocols in On-Demand routing in MANET**

3.1 AODV
Ad hoc on-demand distance vector is a reactive routing protocol. This property implies that it requests a route when it needs one and the nodes which do not want to take part in active communication, need not to maintain routing tables. AODV has two basic operations: route discovery and route maintenance [6]. AODV uses RREQ, RREP and RERR messages to find and maintain the routes. In route discovery, when a source node desire a route to the destination node for which it does not have a route, it broadcast a route request (RREQ) message in the network. RREQ message contains source IP address, destination IP address, sequence number, hop count and broadcast ID. A neighbor receiving a RREQ may send route reply (RREP), if it is either the destination or if it has unexpired route to the destination. When destination node send a route reply (RREP) message to the source node, a forward path is formed. Now source node will send the data through this path. In route maintenance, when a link breakage in an active route is detected, the node notifies this link breakage by sending a route error (RERR) message to the source node. The source node will reinitiate the route discovery process if it still has data to send [6].
on the following selection criteria: routes consisting of nodes with higher associativity ticks has higher preference even over routes with smaller number of hops. For routes with equal number of associativity ticks, the route with the smaller hop count is selected. If the routes have the equal number of associativity ticks and hop counts, one of the routes is randomly selected. The selected route is used to construct a REPLY packet and returned to the source S via the selected route. The intermediate nodes on the route from D to S will consequently mark their routes to D as valid and subsequently inactivate all other possible routes to D. The main drawback of this approach is short beaconing interval to reflect association degree precisely [10].

### 3.4 Dynamic Source Routing

The Dynamic Source Routing protocol is composed of two main mechanisms to allow the discovery and maintenance of source routes in the ad hoc networks:

#### Route Discovery: The mechanism by which a source node, to send a packet to a destination node, obtains a route to the destination. Route discovery is used only when the source node attempts to send a packet to a destination and does not already know a route to that destination.

#### Route Maintenance: The mechanism by which a node is able to detect a route to send a packet to a destination,. If the network topology has changed. If this is the case then it must no longer use this route to the destination because a link along the route broken. Route maintenance for this route is used only when the source node is actually sending packets to the destination [11]. A source puts the entire routing path in the data packet, and the packet is sent through the intermediate nodes specified in the path. If the source does not have a routing path to the destination, then it performs a route discovery by flooding the network with a route request (RREQ) packet. Any node that has a path to the destination in question can reply to the RREQ packet by sending a route reply (RREP) packet. The reply is sent using the route recorded in the RREQ packet. The responsibility for assessing the status of a route falls to each node in the route. Each must insure that packets successfully cross the link to the next node. If it doesn’t receive an acknowledgement, it reports the error back to the source, and leaves it to the source to establish a new route. While this process could use up a lot of bandwidth, DSR gives each node a route cache for
them to use aggressively to reduce the number of control messages sent. If it has a cache entry for any destination request received, it uses the cached copy rather than forward the request. In addition, it promiscuously listens to other control messages for additional routing data to add to the cache [11].

3.5 The DYMO Routing Protocol
The Dynamic MANET On-demand (DYMO) [12] is a reactive, multihop, unicast routing protocol. The DYMO is a memory concerned routing protocol and stores minimal routing information and so the Control Packets is generated when a node receives the data packet and it doesn’t have any valid route information. The basic operations of DYMO are [1]:

a). Route Discovery
b). Route Maintenance

3.5.1 Route Discovery
The source router generates Route Request (RREQ) messages and floods them for destination routers for whom it doesn’t have route information. Intermediate nodes store a route to the originating router by adding it into its routing table during this dissemination process. The target node after receiving the RREQ responds by sending Route Reply (RREP) message. RREP is sent by unicast technique towards the source. An intermediate node that receives the RREP creates a route to the target and so finally it reaches to originator. Then routes have been established between source and destination in both directions [1].

3.5.2 Route Maintenance
Route maintenance consists of two operations. It avoids expiring good routes and so it updates reverse route lifetime on data reception and forward route lifetime on data transmission. The DYMO nodes monitors link over which traffic is flowing in order to cope up with dynamic network topology. A Route Error (RERR) message is generated when a node receives a data packet for the destination for which route is not known or the route is broken. This RERR notifies other nodes about the link failure. The source node reinitiate route discovery quickly as it receives this RERR. Hello messages are used by all nodes to maintain routes to its neighbor nodes.

The sequence numbers are used in DYMO to make it loop free. These sequence numbers are used by nodes to determine the order of route discovery messages and so avoid propagating stale route information. The DYMO routing protocol is designed for memory constrained devices in mobile ad hoc networks (MANETs) as it quickly determines route information dynamically [1].

3.6 Cost Effective DYMO Protocol
The DYMO protocol, however, does not perform well with low mobility. The control message overhead for such scenarios is rather high and unnecessary. Another limitation lies in the applicability of the protocol as stated in the DYMO Draft which states that DYMO performs well when traffic is directed from one part of the network to another. It shows a degraded performance when there is very low traffic, random and routing overhead outruns the actual traffic. So DYMO have needed to improve by some modification and make the DYMO cost-effective, where the cost is the product of routing overhead and end-2-end delay. The cost effective DYMO protocol will have to reduce end-2-end delay and overhead in low as well as high mobility.

Cost of any protocol can be calculated by end-2-end delay /PDF(packet delivery ratio). If we decrease the end-2-end delay or increase the PDF, then cost will get decreased. The end-2-end delay can be reduced by implementing artificial intelligence. So, we will implement the Ant behavior in the DYMO protocol. The DYMO protocol perform two task—one is route recovery & other is route maintenance. The route recovery process will be performed by the Ant & the route maintance will be done using normal DYMO protocol. If any new path is needed only then Ant behavior will effect. This will result in reduced end-2-end delay due to shortest path & same path follow nature of Ant.

4. Conclusion
An adhoc routing protocol is a convention that controls how nodes decide which way to route packets in MANETs. This paper classified the routing protocols into three categories Reactive (On-demand), Proactive (Table-driven) or Hybrid. The table-driven ad hoc routing approach is similar to the connectionless approach of forwarding packets, with no regard to when and how frequently such
routes are desired. This is not the case, however, for on-demand routing protocols. When a node using an on-demand protocol desires a route to a new destination, it will have to wait until such a route can be discovered. This paper presents a brief description of several routing protocols which are proposed for adhoc mobile networks. It has also presented a comparison of currently on-demand routing protocol, and reveals their features, differences and characteristics. The field of adhoc mobile networks is rapidly growing and changing and whiles it is not clear that any particular algorithm or class of algorithm is the best for all environment, each protocol has definite advantages and disadvantages, and is well suited for certain situations.

References