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Routing Algorithm in MANET

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Abstract*—A Mobile Ad-Hoc Network is a collection of wireless nodes forming a temporary network without using any centralized access point, infrastructure, or centralized administration. MANETs are generating lots of interest due to the dynamic topology and decentralized administration. There are different aspects which are taken for research like routing, synchronization, power consumption, bandwidth considerations etc. This paper concentrates on routing algorithm which is the most challenging issue due to the dynamic topology of the ad hoc network. Routing is an important issue in a mobile ad hoc network because it is infrastructure less. In a mobile ad hoc network a node acts both as host and router. There are different routing algorithms proposed for MANETs which makes it quite difficult to determine which protocol is suitable for different network conditions are proposed by their quality of service offerings. In this paper a survey of routing algorithm is made.

***Keywords*—AODV, MANET, OLSR, Routing Algorithms, TORA, ZRP.**

I. INTRODUCTION

In the last couple of years, the use of wireless networks has become more and more popular. MANET is made up of three words: MOBILE (Movable or Transportable), AD-HOC (Temporary or for specific purpose), NETWORKS (Flexible data applications which use networks to communicate). A MANET can be defined as a system of autonomous mobile nodes that communicate over wireless links without any preinstalled infrastructure. MANETs are useful in places that have no communications infrastructure or when that infrastructure is severely damaged. Mobile ad hoc network is a type of ad hoc network that can change locations and configure itself on the fly. In ad hoc networks every communication terminal communicates with its partner to perform peer to peer communication.

II. TYPES OF MANET ROUTING ALGORITHS

A. Based on the information used to build routing tables

i. *Shortest Distance algorithms*: algorithms that use distance information to build routing tables.

ii. *Link State algorithms*: algorithms that use connectivity information to build a topology graph that is used to build routing tables.

B. Based on when routing tables are built

i. *Proactive algorithms*: maintain routes to destinations even if they are not needed.

ii. *Reactive algorithms*: maintain routes to destinations only when they are needed.

iii. *Hybrid algorithms*: maintain routes to nearby nodes even if they are not needed and maintain routes to far away nodes only when needed.

III. ROUTING ALGORITHMS

A. PROACTIVE ALGORITHM

Proactive algorithm also known as Time Driven Routing algorithm, workout routes in the background independent of traffic demands. Each node uses routing information to store the location information of other nodes in the network and this information is then used to move data among different nodes in the network.

EXAMPLE PROACTIVE ROUTING ALGORITHMS

i. Destination Sequenced Distance Vector (DSDV)

The procedure of DSDV

Each node maintains a table with an entry possible destination [4][6].

Each entry specifies:

i. The destination identifier.
ii. The next hop on the route to the destination.
iii. The distance (in terms of hop) to the destination.
iv. A sequence number that specifies how fresh the route is.

Nodes exchange their routing tables with their neighbors periodically.

Based on the received tables, nodes update their routing tables.

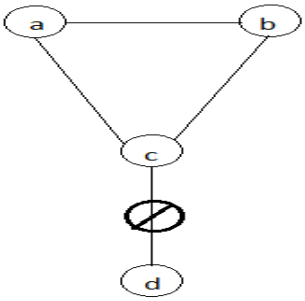

Fig 1. DSDV

Disadvantages

i. Large routing overhead.
ii. Uses only bidirectional links.
iii. Suffers from count to infinity problem.

ii. Optimized Link State Routing (OLSR)

OLSR is a modular proactive hop by hop routing protocol. It provides the fresh path of destination base of table driven approach. It is an optimization of pure link state algorithm in ad hoc network [2][3]. The routes are always immediately available when needed due to its proactive nature. The key

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concept of the protocol is the use of "multipoint relays" (MPR). Each node selects a set of its neighbor nodes as MPR.

i. Every node creates a list of its one hop neighbor.
ii. Neighbor node exchanges their lists with each other.
iii. Based on the received lists, each node creates its MPR.
iv. The members of MRP are the only nodes that can retransmit the link state information in an attempt to limit the flood.

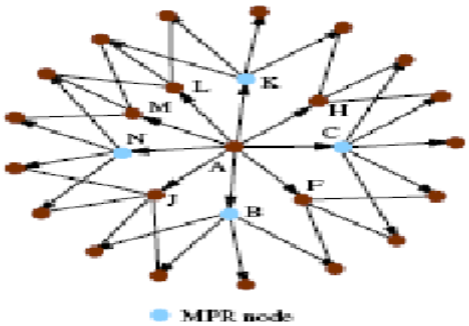

Fig 2. OLSR

A. REACTIVE ROUTING ALGORITHM

Reactive protocols also known as On Demand Routing Protocols, establish routes between nodes only when they are required to route data packets[1][2][3]. There is no updating of every possible route in the network instead it focuses on routes that are being used or being setup. When a route is required by a source node to a destination for which it does not have a route information, it starts a route discovery process which goes from one node to the other until it arrives at the destination or a node in between has a route to the destination.

EXAMPLE OF REACTIVE ALGORITHM

i. AD HOC ON DEMAND DISTANCE VECTOR (AODV)

The philosophy in AODV, like all reactive protocols, is that topology information is only transmitted by nodes on demand [2][4][5]. When a node wishes to transmit traffic to a host to which it has no route, it will generate a route request (RREQ) message that will be flooded in a limited way to other nodes. This causes control traffic overhead to be dynamic and it will result in an initial delay when initiating such communication.

AODV defines three types of control messages for route maintenance:

i. RREQ – A route request message is transmitted by a node requiring a route to a node. As an optimization AODV uses an expanding ring technique when flooding these messages. Every RREQ carries a time to live (TTL) value that states for how many hops this message should be forwarded. This value is set to a predefined value at the first transmission and increased at retransmissions. Retransmissions occur if no replies are received. Data packets waiting to be transmitted should be buffered locally and transmitted by a FIFO principal when a route is set.

ii. RREP – A route reply message is unicasted back to the originator of a RREQ if the receiver is either the node using the requested address, or it has a valid route to the requested address. The reason one can unicast the message back, is thatevery route forwarding a RREQ caches a route back to the originator.

iii. RERR – Nodes monitor the link status of next hops in active routes. When a link breakage in an active route is detected, a RERR message is used to notify other nodes of the loss link. In order to enable this reporting mechanism, each node keeps a "precursor list", containing the IP address for each its neighbours that are likely to use it as a next hop towards each destination.

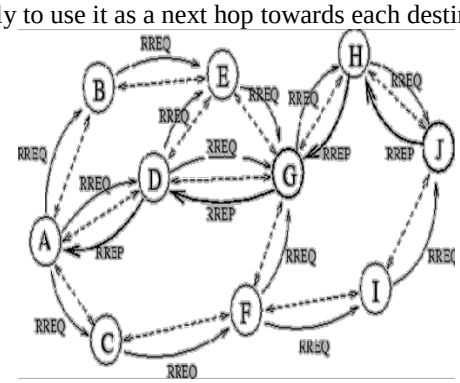

Fig 3.AODV

Algorithm description

a) Each node maintains two numbers: sequence # and broadcast_id #.

2- Only neighbor nodes that are members of an active route exchange hello message if they have not exchanged packets to insure connectivity.

b) To discover a route to the destination, the source sends RREQ packet to its Neighbors, the message contains:

< src_addr, src_seq_#, broadcast_id, dst_addr, dst_ seq_#, hop_cnt >

4- Any intermediate node receives a RREQ for the first time keeps track of the src_add ,src_broadcast_id , src_ seq_#, dst_add , and the address o f the node delivered the RREQ and sets a reverse path to the source.

i. TEMPORALLY ORDERED ROUTING ALGORITHM(TORA)

TORA is a routing algorithm and is mainly used in MANETs to enhance scalability [8][9]. TORA is an adaptive routing protocol. It is therefore used in multi-hop networks. A destination node and a source node are set. TORA establishes scaled routes between the source and the destination using the Directed Acyclic Graph (DAG) built in the destination node. This algorithm does not use shortest path theory, it is considered secondary. TORA builds optimized routes using four messages. Its starts with a query message followed by an update message then clear message and finally optimizations message. In Fig 4, node A is the source and node H is the destination. Node a broadcasts a query message across the network. Only one-hop neighbors to the destination reply to a query. When the query reaches a node with information about the destination, this node sends

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back an update. In this case, node D and node G are one hop away from the destination. Therefore, they will propagate Updates as shown in Fig5.

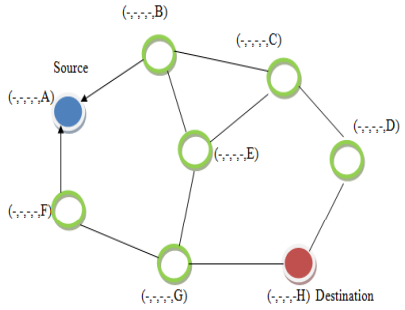

Fig 4.Route Discovery in TORA – QRY message.

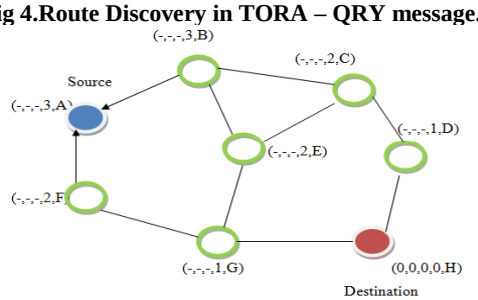

Fig5. Route Discovery in TORA- Update message.

B. HYBRID ROUTING ALGORITHM

Hybrid Routing Protocols, combine both Table based routing protocols with on demand routing protocols. They use distance-vectors for more precise metrics to establish the best paths to destination networks, and report routing information only when there is a change in the topology of the network[7][8]. Each node in the network has its own routing zone, the size of which is defined by a zone radius, which is defined by a metric such as the number of hops. Each node keeps a record of routing information for its own zone.

EXAMPLE OF HYBRID ROUTING ALGORITHM

i. ZONE ROUTING PROTOCOL (ZRP)

Hybrid reactive/proactive protocol. Proactive procedure only to the nodes within a routine zone of radius p. Reactive procedure to nodes beyond the routing zone by querying only a subset of the network nodes

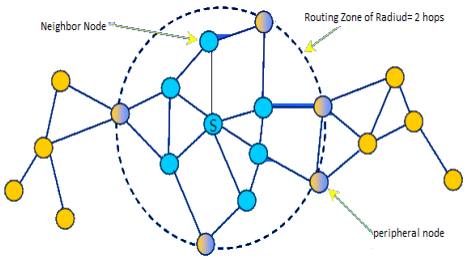

Fig 6. ZRP

IV. RESULTS

Due to dynamic topology of ad hoc networks routing is one of the challenging issues in these networks. There are various types of routing protocols and these are suitable for different situations. It is seen that due to route discovery mechanism by reactive routing protocols overhead is very low in these protocols in contrast to proactive routing protocol in which overhead increases due to routing information stored in routing tables. But due to route discoveryprocess the latency in the Reactive protocols increases whereas latency is very low in proactive protocols due to the fact that the routing information is already being stored in routing table and is available whenever needed. The Hybrid protocols have combined the advantages ofboth Reactive and Proactive protocols. The latency is decreased by using proactive protocol inside the zone and overhead is decreased by using reactive protocol outside the zone. Hence a protocol is presented which improves the performance of network byusing theadvantages of both reactive and proactive protocols.

V. PERFORMANCE MATRICES

Throughput: This is the parameter related to the channel capacity. It defined as the maximum possible delivery of the message over the channel. It is usually measured in bits per second.

Routing Overhead: It is defined in terms of number of control packets need to be sent for the route discovery as well as route maintenance so as to send data packets.

Average Delay: It is defines as the time taken by the packet to reach from source to destination. It is measured in seconds. It is also known as end to end delay.

Packet Delivery Ratio:It is defined as the ratio of incoming data packets to the received data packets. We can understand that AODV has the better packet delivery ratio.

Scalability: It is defined as the performance of routing protocols in presence of large number of nodes. Generally the performances of routing protocols degrade in presence of large number of nodes.

VI. CONCLUSION

In this paper an effort has been made on the comparative study of MANET, Proactive, Reactive, Hybrid routing algorithms. Study of these algorithms has been given. Examples of each algorithm are given with diagrams and explain how they work. There are various shortcomings in different routing protocols and it is difficult to choose routing protocol for different situations as there is trade-off between various protocols. The field of mobile ad hoc networks is very vast and there are various challenges that need to be met, so these networks are going to have widespread use in the future.

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