Multicast Ad-hoc On-demand Distance vector Routing :A Survey

Harsha Chandran K C
PG Scholar
Department of Information Technology
Govt.Engineering college Bartonhill,
Trivandrum

Jayasree P S
Assistant Professor
Department of Information Technology
Govt.Engineering college Bartonhill,
Trivandrum

Abstract

Ad hoc networks are composed of a set of mobile and wireless nodes.It consist of a collection of mobile nodes without the required intervention of any centralized access point or existing infrastructure. This paper presents Ad-hoc routing protocol such as Ad-hoc On-demand Distance Vector(AODV) routing protocol,Multicast Ad-hoc On-demand Distance Vector(MAODV) routing protocol etc. This paper describes the MAODV in detail.The multicast operation of the Ad-hoc On-demand Distance Vector(AODV) routing protocol is intended for use by mobile nodes in an ad-hoc network.MAODV offers quick adaption to dynamic link conditions,low processing, memory overhead, and low network utilization.It creates bidirectional shared multicast trees connecting multicast sources and receivers.These multicast trees are maintained as long as group members exist within the connected portion of the network.Each multicast group has a group leader whose responsibility is maintaining the group sequence number, which is used to ensure freshness of routing information.

I. Introduction

Ad-hoc network consists of a group of mobile nodes that communicate with each other over wireless links. Each node in an ad-hoc network is not only a possible source/destination of some packets, but also a router for other packets to their final destination. Ad-hoc network has several key characteristics such as high mobility, limited energy, low bandwidth and limited computing capability.

Many routing protocols have been proposed for ad-hoc networks.They are classified as table driven or proactive,on demand or reactive and hybrid. Some examples of table driven routing protocols are Destination Sequenced Distance-Vector Routing Protocol (DSDV), Wireless Routing Protocol (WRP), and Optimized Link State Routing (OLSR).In dynamically changing environments On demand protocols shows high performance . Some examples of these protocols are DSR and AODV.

II. Ad-hoc On-Demand Distance Vector routing protocol

Ad-hoc on Demand Distance Vector Routing Protocol (AODV) is a protocol designed for MANETs [2] which builds routes between a source and a destination only on-demand of source nodes. In AODV, only one route is maintained per destination.Unlike proactive protocols, which maintain updated information about all routes which are related to each node in its routing table, AODV is considered as a reactive protocol, meaning that it builds routes between a source and a destination, only when required by source nodes. In AODV, routing table stores information about the next hop to the destination and also stores a sequence number to guarantee loop-free routes.AODV specifies three types of control packets for discovering and maintaining routes: Route Request (RREQ), Route Reply (RREP), Route Error (RERR) packets [1].

A. Route Discovery

The Route discovery process starts when a source node desires to send a message to a destination node and does not have a valid route.A RREQ packet contains source identifier, destination identifier, source sequence number, broadcast identifier, time to live field, and a hop count. The source node broadcasts a route request packet (RREQ) to its neighbour nodes, which then forward the request to their neighbour nodes, and so on. The process continues until either the destination node, or an intermediate node with an updated (fresh enough) route to the destination, is reached by this request. Then, the node responds with a route reply packet (RREP) back to the neighbour from which it first received the RREQ. The reply packets are routed back along the reverse path established by the request packets. The reply packets that travel along the intermediate nodes set up forwarding entries in the routing tables. These table entries point to the node from which the RREP was received. There is a timer associated with each route entry. The entries expire if not used by data packets. Destination sequence numbers are used by AODV to ensure loop-free routes and up to date routing information.

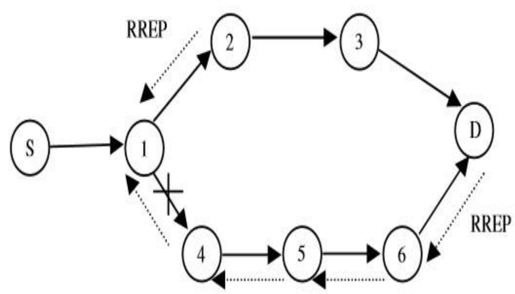

Fig. 1. A Simple Example

B. Route Maintenance

A mobile node maintains a route table entry for each destination of interest.Each route table entry contains the following information:

- Destination
- Next Hop
- Number of hops
- metric
- Sequence number for the destination
- Active neighbours for this route
- Expiration time for the route table entry

Every node broadcasts a Hello packet periodically for local connectivity. The node assumes a link break to the neighbour node if it does not receive any packet from a neighbour node for some time. If a node moves out of the radio range of its neighbour, the upstream neighbour propagates a link failure notification (route error packet - RERR) to each of its upstream neighbours to inform the failure of part of the route. The failure notification is propagated until the source node is reached. When the source node is reached by the routing error packet it initiates a new route discovery process.

C. Drawback of AODV Protocol

One drawback of AODV that has been extensively focused is the single route abstraction. When a link failure is encountered in the primary current route, single route abstraction requires a source node to establish a new route discovery process.

We consider the example as shown in Fig. 1, we assume that node S wants to communicate with node D while it does not have a valid route in the routing table, it propagates a RREQ packet and then broadcasts it. Assuming that node 1 does not have a valid route to node D, it forwards the RREQ to node 2 and node 4. Assuming that there is a valid route to node D in the routing table of node 2 and there is not a valid route to node D in the routing table of node 4 or node 5. When node 2 receives the RREQ, it propagates a RREP packet towards node S. When node 4 receives the RREQ packet forwarded by node 1, it forwards the RREQ packet to node 5 (assume node 3 is beyond the radio range of node 4). Then node 5 forwards the RREQ packet to node D. Node D sends a RREP packet which has an incremented destination sequence number to node S. When the RREP propagated by node 2 is forwarded to node S, the route S-1-2-3-D will be written to the routing table of node S. Then node S starts to send packets to node D. When the RREP propagated by node D reaches node S, the route S-1-2-3-D will be discarded and be replaced by the route S-1-4-5-6-D even the route S-1-2-3-D is still valid. The reason is that the destination sequence number of route S-1-4-5-6 is larger than the destination sequence number of route S-1-2-3-D. If node 1 detects a link break during the process that node S communicating with node D, node S should reinitialize a route discovery process. Finally, node S may receive a RREP including the route S-1-2-3.

III. Multicast Ad-hoc On-Demand Distance Vector routing protocol

Multicast protocol is a key technique to the group team application, which benefits in the significant reduction of network loads when packets need to be transmitted to a group of nodes. Multicast protocol must guarantee the performance requirements: adaptable to the dynamic change of network topology, timeliness, minimizing routing overhead and efficiency etc [7]. Multicast is a communication approach for groups on information source using the single source address to send data to hosts with same group address.MAODV topology is based on multicast tree adopting broadcast routing discovery mechanism to search multicast routing, which sends data packets to each group nodes from data source.

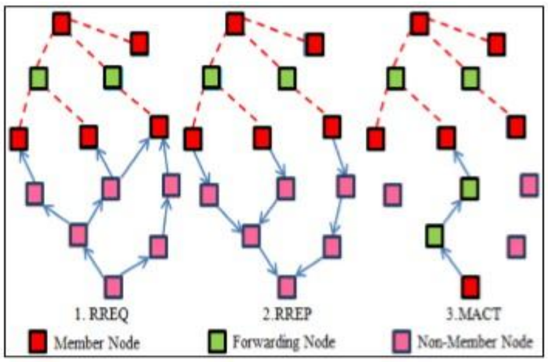

Fig. 2. MAODV Protocol

A. Route Discovery

MAODV use route request (RREQ) and route reply(RREP) which already exist in AODV. If a node wants to join in or send messages to a multicast group while there is no path to the multicast group, it will broadcast a RREQ, any multicast group member will respond to the request message if necessary. If RREQ is not a Join Request, any node with updated(serial number is greater than RREQs) routing path can respond directly. If non-multicast node receives RREQ request, or the node is not available to the target group, it will forward RREQ directly.

B. Route Maintenance

a) Multicast Tree Maintenance: Group leader maintains the multicast groups serial number by broadcasting Group Hello periodically.Group Hello is extended from the Hello message in AODV, which is consisted of multicast address, multicast serial number, hop count and TTL(Time to Live).

b) Node Leave: If the node is not a tree leaf, it still can act as a router only by setting multicast address 0, else it will send Add and Prune (P marked MACT) to prune itself. When its upstream node receives P-marked MACT, it will delete this node from its multicast routing table. If the node is a multicast member or not a tree leaf, the prune process ends, else send the P-Marked MACT to its upstream node continuously.

c) Disconnection Repair: When the link is disconnected due to node mobility or other reasons, it will broadcast RREQ to rejoin in the multicast group,only the member with latest serial number and its hop less than multicast group hop can respond.If the upstream node which has lost its node is not a multicast group member, and becomes the tree leaf, then it will set the timer to rebuild and if in certain period, it is still not be activated, the Add and Prune will be sent to prune the node itself. If the network is divided due to the repair failure, the divided network needs new group leader. If the nodes initiating repair is a multicast group member, then it will become the group leader, or the new group leader will be selected by sending G-Marked MACT.

d) Tree Merge: When the node receives Hello message, if it is a multicast group member and contains group members of the lower address group leader, it will initiate tree-rebuild process.

C. Link Repair mechanism of MAODV

In MAODV, when a link breakage is detected, the downstream node is responsible for initiating the repair procedure. In order to repair the tree, downstream node broadcasts RREQ-J message with multicast group leader extension included.The multicast group hop count field in multicast group leader extension is set equal to node’s current distance to multicast group leader, only nodes no further to the group leader can respond.A node receiving the RREQ-J respond by unicasting a RREP-J only if it satisfy the following constraints: It is a member of the multicast tree, its record of the multicast group sequence number is at least as great as that contained in RREQ-J and its hop count to the multicast group leader is less than or equal to the contained in the multicast group hop count extension field.

After waiting for RREP-J wait time, the source node selects the best path from the RREP-J messages received and subsequent route activation is performed by a MACT-J message. Once the repair is finished, it is likely that the node which initiated the repair is now at a different distance to the group leader. In this case, it must inform its downstream nodes about their new distance to the group leader. The node performs this task by broadcasting a MACT-J message with the new hop count to leader contained.When a downstream node receives the MACT-J message and determines that this packet arrived from its upstream node, it increments the hop count value contained in the MACT-J and updates its distance to the group leader. The problem associated with this link repair mechanism is that the shortest path to the group leader is not ensured and it can lead to tree partitioning.

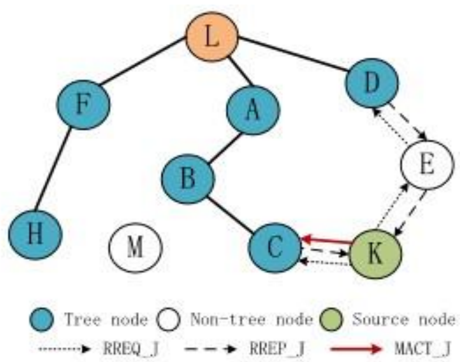

Fig. 3. Link Repair Mechanism of MAODV

IV. Improved Link Repair Technique for Group Team Communication in MAODV(GT-MAODV)

In GT-MAODV the tree node with the least hop to the source node and the least hop to the group leader is selected as the optimal repair node for connecting [4]. Unlike MAODV, GT-MAODV sets the weights of hop count to group leader higher than weights of hop count to multicast tree when determines the optimal repair node which means selecting the shortest path to group leader first and selecting the shortest path to multicast tree only if all the candidate route paths have same length to the group leader. Hence, the shortest path to the group leader can be ensured.

V. Conclusion

In surveying on MAODV, We have focused research papers on AODV and MAODV protocol and different approaches to improve the link repair technique in MAODV.Due to the popularity of the MAODV protocol a number of variations and improvements on the core protocol have been proposed by researchers to address specific issues with the protocol.

References

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