Comparision of Proactive and Reactive Multicasting Routing Protocols in the Wireless Mesh Networks

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Abstract

Wireless mesh network is one of the most promising technologies in near future. WMN comes under the category of mobile ad-hoc networks to communicate with the internet through a single gateway or more than one gate way. It provides self-configuring, self-healing, and self-organized wires networks. In order to provide a multi-point communication within the wireless mesh networks, a multicast routing protocol is required. Multicast routing is a key technology for modern communication networks. Multicast Routing becomes a prominent technology for wireless communication networks various multicast routing protocols are developed for internet and ad-hoc communications this paper gives the overview of some of the existing proactive, reactive and hybrid multicast routing protocols over WMNs with its strengths and weaknesses. The following multicast routing protocols are selected for their performance comparison; they are On Demand Multicast Routing Protocol(ODMRP), Multicast Ad hoc On Demand distance Vector (MAODV) Protocol, Multicast Open Shortest Path First (MOSPF), Ad hoc Multicasting Routing Protocol(AM Route) Among them, MOSPF and AM Route is a proactive routing protocol.

Keywords- AM Route, MAODV, MOSPF, ODMRP, OPHMR

I. INTRODUCTION

The Wireless Mesh Network (WMN) is a wireless network and where the data is shared by the nodes which are connected in mesh topology. In the wireless mesh network the nodes not only for just sending and receiving of data, but also serve as a relay node for other nodes and each node collaborates in propagating data on the network. The structure of WMNs is shown in Figure1.

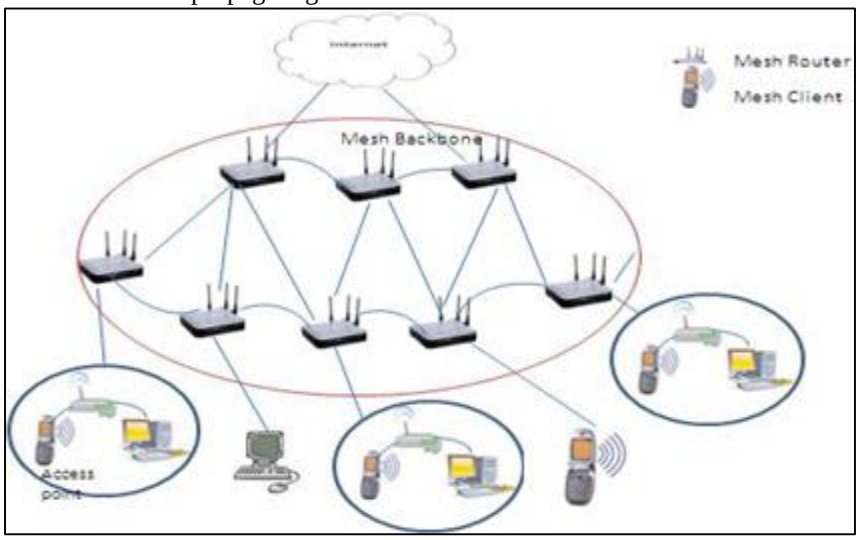

Fig. 1: Architecture of Wireless Mesh Network

WMN is the group of mesh clients, mesh routers and gateways connected through a mesh topology. Gateway: Network Gateway is a communication which as an interface to connect nodes in the network with internet. Mesh Router: The mesh router is a device for dispatching the data packets by choosing best path in the network. Mesh Client: Mesh client is a part of hardware or software connected in a mesh topology to avail the sources of router for transmission of data packet. In internet working, routing is the process of moving a packet of data from source to destination. A routing protocol specifies how routers communicate with each other, distributing of information that enables them to select routes between any two nodes on a computer network the network layer plays a major role in transmission of data from source to destination over multiple hops. The technologies like WLANs and

WMANs use a single wireless link, and hence have no need for a network layer. In contrast, for WMNs and MANETs the source and the destination can be several wireless hops away from each other, and hence the packets have to be routed and forwarded in the wireless network itself. To design such a route it needs some metrics those are:

A. Scalability/Efficiency
When the routing protocol has a high overhead and requires global information, it will be impossible to scale it with increasing number of nodes.

B. Reliability
The routing protocol should be able to reroute fast around failed nodes, broken links, and upon the failure of a gateway it should be able to redistribute the orphaned clients among neighbouring gateways. For these acquisitions, fast reconfiguration and sustain of multiple gateways are essentials.

C. Mobile User Connectivity
To assure consistent mobile user connectivity, the routing protocol should enable fast hand-offs.

D. Flexibility
The routing protocol should be pliable and adoptable to different network topologies.

E. QoS
In addition to support from the MAC layer, finding the optimal routes for all categories of traffic classes is a vital ingredient for QoS support. Load balancing, avoiding congested routes, and taking into account interferences patterns existent in a WMN are just some of the factors that directly affect the performance of WMNs. In MANETs, the traffic is assumed to be flowing between peremptory pairs of nodes while in WMNs, most of the traffic flows between the gateway and client nodes. Moreover, while the mobility of MANET nodes is usually similar, n WMNs, the nodes can be distinctly classified as either mobile or stationary. It is thus likely that for WMNs a custom routing protocol can reflective outperform general MANET protocols. Once the routes are established, data packets have to be forwarded between the clients and the gateway.
The following list includes the most commonly used performance metrics:

1) Hop Count
Hop count is the number of hops between the source and the destination.

2) Expected Transmission Count (ETX)
The metric is more precise to wireless communications. It considers for data loss due to medium access contention and environmental perils, and considers the number of retransmissions needed to successfully transmit a packet over a link.

3) Expected Transmission Time (ETT)
This metric is an enhancement of ETX as it further includes the bandwidth of the link in its computation [5]. This is of particular interest when different network technologies are used (IEEE 802.11a and IEEE 802.11b for instance) in order to favour channel disparate paths

4) Energy Consumption
Node energy level can be considered as a routing metric if some nodes are energy-constrained and their involvement in the routing process can lead to path failure if they suffer from energy diminution. This problem is particularly important in MANETs and WSNs.

5) Path Availability/Reliability
This metric estimate the percentage of time a path is available. Node mobility effect can be captured by this metric. It is particularly important in MANETs.
The remainder of the paper is organized as follows:
Section 2 gives the description of various proactive and reactive multicast routing protocols in wireless mesh networks.
Section 3 gives the simulation results.
Section4 gives the conclusion followed by references.

The wireless mesh networks decreases the cost of wireless communication with increase in efficiency and throughput of the wireless links between two nodes by sending multiple copies of the same message using broadcasting properties of wireless transmission. Multicasting decreases the cost, channel capacity consumption, energy utilization, data delivery ratio. Routing is the process of transmission of data packets. The goal of routing protocol is minimization of traffic overhead, identification of link failures caused by node mobility.

II. OVERVIEW OF PROTOCOLS

The multicast routing protocols of wireless mesh networks are reactive and proactive multicast routing protocols. This section explains MOSPF, AM Route from proactive routing protocols, ODMRP, MOADV from reactive routing protocols. Section III will give the description of proactive routing protocols; Section IV specifies the reactive routing protocols.

III. PROACTIVE ROUTING PROTOCOL

It chooses the available (existing) route for data transmission with all generating the route at the time of need. In the proactive routing each node maintain the information table of other nodes which are in that network. Proactive routing protocols are also called as table driven protocols. Proactive routing protocols works efficiently, for a small scale mesh networks with high mobility. Some of the proactive routing protocols are described in this section they are MOSPF, AM Route.

A. Multicast Open Shortest Path First

It means the multicast open shortest path first. Open shortest path first is a unicast link state protocol uses Dijkstra's shortest path from a router to every possible destination. MOSPF is a multicast proactive routing protocol which is the enhancement of OSPF. MOSPF uses a protocol called link state advertisement protocol. Each router of MOSPF maintains the list of nodes, groups using IGMP (Interior Gateway Multicast Protocol), and location of the members in a group. In MOSPF transmission of data is performed in two ways. They are: Source area and Backbone area. Source area multicast OSPF uses intra-area shortest path tree with leaf nodes and wild-card receivers. Backbone area uses multicast-receivers of the source area calculate the shortest path from source to the multicast forwarders using reverse cast. Four different routing decision making strategies are used by MOSPF. They are flooding, Reverse path forwarding (RPF), Reverse path broadcasting (RPB), and Reverse path multicasting (RPM).

1) Flooding

It simply broadcasts packets. The drawback of flooding is, it generates loops in the system.

2) Reverse Path Forwarding (RPF)

It is a mechanism which is for avoiding loops in the system. In RPF [8] router forwards single copy of the packet instead of sending all copies of packets by travelling of the forwarded packet through the shortest path from source to the router. RPF eliminate the loop in the system by checking route of the packet travelled from source to router of the packet travelled from source to router. The copy of the packet is through shortest path verified at routing table then it chooses that path for forwarding other copies of data. In that packet not travelled through shortest path then the packet leaves the router and come back again like this RPF eliminate the loops in the system.

3) Reverse Path Broadcasting (RPB)

It gives the guarantee of receiving of a multicast packet by each network without certain of loops, but does not give a guarantee of receiving only on copy by each network. The better solution to this problem is overcome by RPB. In RPB it selects a router as a parent router for each network which maintains the information of shortest path from parent router to the source. To avoid the loop, router (parent router) sends the packet to the source through that shortest path specified by parent router. RPB gives the guarantee of receiving one and only one copy of the packet by the destination.

4) Reverse Path Multicasting (RPM)

To improve the efficiency of network, multicast packet sends to the network having active members for that particular group. To do this it uses pruning and grafting.

B. Ad Hoc Multicasting Routing Protocol

Tree based routing protocol.AM Route is a proactive tree based multicast routing protocol. AM Route has to phases in its structure: Mesh creation phase and Tree Creation phase.

1) Mesh Creation Phase

In mesh creation phase a new member from a new group is selected as a core member by themselves using a simple core resolution mechanism. Each core member floods JOIN-REQ message for identification of the members belongs to other group. When a member of one group receives the JOIN-REQ packet from the core member of the same group belongs to different mesh then that member sends JOIN-ACK packet to the core member. If the node receives the JOIN-REQ from the core member belongs to the same mesh and same group the member sends a JOIN-NACK to the core member. In case, the node wants to disconnect from the group then also that node can send the same packet (JOINNACK) and separates from the group. When the core receives the JOIN-ACK from the other members then that core establishes the connection between from core member and the members belongs to other group using a bidirectional tunnel for data transmission. The member of the group maintains the details of the core member. If a member of the group receives the TREE-CREATE message from a new core member, it resets the core which is having highest IP value compared to the old core and new core member.

2) Tree Creation Phase

The tree creation phase is for generating shared tree .To generate such a tree core continuously transmits TREE-CREATE through unicast tunnel in the mesh. After getting of non-duplicate TREECREATE message, then node forward that message to all other links except incoming link. If the core receives duplicate TREE-CREATE message it discard the message and send TREE-CREATE-NACK to the incoming link. If a member sends a TREE-CREATE-NACK means, that node has connection in mesh. If that node sends TREECREATE- ACK it means, that node is free, has no connection, and willing to join in the tree structure. If any node want to discontinue (break) form from the link then it send TREE-CREATE-NACK message. An efficient and robust shared tree will be created by AM Route, and also keeps the multicast delivery tree as static in all conditions like changes in the network topology. When network node mobility is more AM Route will faces some of the problems like Loop formation, creation of a non-optional tree, and need higher overhead for selecting and assigning new core.

IV. REACTIVE ROUTING PROTOCOL

In reactive routing protocol choose the demand when the indication must be delivered to an unknown destination. In this protocol the routes are calculated when a node needs to send data to an unknown destination. So, route discovery is developed only when needed. This protocol saves the unused routes. Some of the reactive routing protocols are described in this section they are MAODV and ODMRP.

A. Multicast Operation of Ad Hoc on Demand Distance Vector

It means the Multicast operation of Ad hoc On-demand Distance Vector. Operation of Ad hoc On-demand Distance Vector (AODV) is a unicast routing protocol. Whereas MAODV is a Multicast reactive routing protocol. This is enhancement of AODV. Each node of MAODV maintain three routing tables .On that first table is Routing Table it is used for if the node is multicast tree member then the data send multicast group to other destination. Second table is Multicast Route Table used for listing the next hops for the tree structure of each multicast group. Third table is Request Table for Optimization purpose. In MAODV connect to multiple group members, as an On-demand routing protocol discovers the routes based on a Route Request (RREQ) message and Route Reply (RREP) message cycle. So, it is a hard state protocol. Finally, a member node of a multicast group wants to terminate its group member ship it must ask for AODV. In MAODV each group identified by a unique multicast address and maintained by using tree structure, several routers and group members.

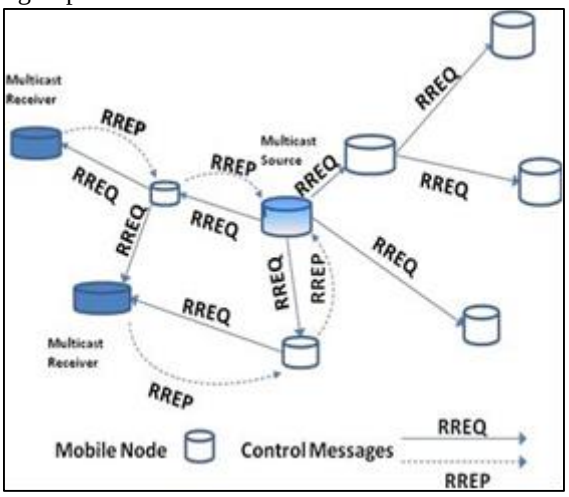

Fig. 2: MAODV Routing Protocol

It having the first member of the multicast group becomes the leader of the group. Leader takes the responsibility to maintain group sequence number and this number propagate to the entire group through Group HELLO (GRPH) message. Multicast Activation (MACT) is a node which acts as a next hop. Group member use the GRPH message to update their request table and distance to leader. Once the group is setup, group leader is ready to accept join message (RREQ) from others. When a source node sent to RREQ for multicast group, source node expected to receive multiple replies. One of the replies (RREP) caused a branch to connect the existing tree in order to avoid loops. If it is not a multicast tree, it just updates its multicast route table when necessary. In this group tree may have a break due to node mobility. At that time MAODV tries to repair the broken link, in this cost of breakage link is very expansive because of it requires nodes listen to any neighbour's transmission. If the node in downstream of the break point is responsible for repairing and broken link, either it broad cast RREQ and gets RREP, thus the link is fixed. This technique also avoids formation of the loop by preventing nodes on the same side of the break from responding to the RREQ. It is used to broadcast an expanding rings search, they are allowing for a local repair and check the RREQ. When a downstream node on the multicast tree receives the MACT message and determines this packet arrived from its upstream mode, it increases the hop count value in the MACT packet and updates its distance to the group leader. This procedure continues till

reaching to the leaf nodes. MAODV authenticate poor performance in terms of packet delivery ratio, throughput and end to end delay where breakage of link is frequent.

B. On-Demand Multicast Routing Protocol

It is a mesh based approach and uses a forwarding group concept. ODMRP means On-Demand Multicast Routing Protocol for multi-hop wireless networking. It is used for a mesh of nodes for each multicast group. Nodes are added to the mesh through a route selection. A soft state way is appropriated in ODMRP to maintain group membership. Therefore, no explicit control message is prescribed to leave the group. It applies "On demand" routing approach to avoid channel overhead. ODMRP routing structure consists of a request phase and reply phase. To design the forwarding mesh for multicast group, it handles two types of control packets: J Query and J-Reply. When a node has the information to send, but no route to the acceptor, a J-Query message is broad casted to the unified network. When a J-Query packet reaches to the multicast receiver, it creates a JReply, It checks if the next node address of one of the entries matches its own address.

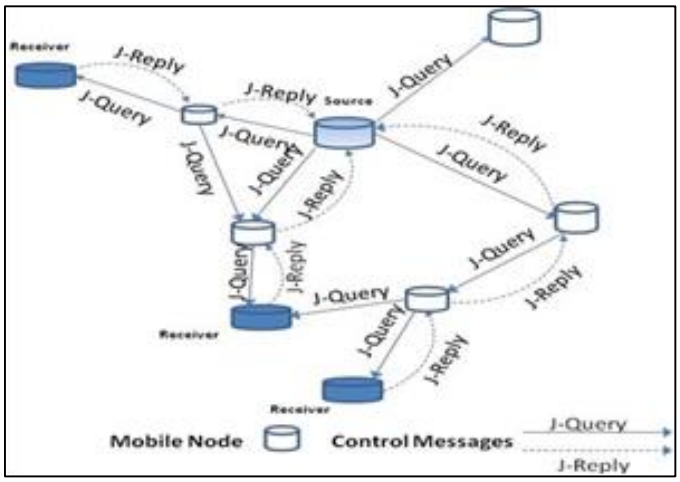

Fig. 3: ODMRP Routing Protocol

If the address is matched, the node is on the path to the source and it becomes a part of the forwarding group (FG) by setting FG flag. It then broadcasts its own J-Reply, which contains matched entries. The next hop IP address can be attained from the message cache. This process construct (or update) the routes from sources to receivers and builds the forwarding group. Membership information and route information is upgraded by recurrently (certain interval times) sending J-Query packet. Nodes only forward data packet if they belong to the forwarding group or if they are multicast group members.

The main disadvantage of ODMRP is high control overhead while maintaining current forwarder groups and all network request package flooding. This problem can be overcome using pre-emptive route maintenance, as suggested by Nguyen et al. Another disadvantage is that the same data packet propagates through multiple paths to a destination (duplicate packets), which reduces multicast efficiency. In addition, ODMRP has a scalability problem. Finally, the source must be part of the group's multicast mesh, even when they are not interested in receiving multicast packets.

V. CONCLUSION

The Wireless Mesh Network is the group of mesh clients, mesh routers and gateways connected through a mesh topology. Wireless Networks faces a major problem with routing. So, routing becomes interesting and attractive area of research. This paper gives the description of reactive and proactive multicasting routing protocols in wireless mesh networks and its strengths and weaknesses. And also discuss about compassion of Proactive and Reactive multicasting routing Protocols. This will become more useful to researchers to enhance the existing Protocols, to avoid the problem in the existing protocols.

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