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CYCLIC GROUP PROTOCOL: AN IMPROVED PROTOCOL FOR MULTICAST VIDEO TRANSMISSION IN MANET

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Abstract

Multicasting is an effectual technique where there is a large amount of information to be transmitted to a collection of hosts on a network. Due to the increasing number of its applications, especially video multicast, over ad hoc networks, is it important to discover new routing protocols that provide more quality. This paper proposes one such new protocol calledCyclic Group Protocol(CGP).This protocol forms specific groups of receiver nodes and uses them to distribute the packets of data sent by forming a cyclic bidirectional path inside the groups. The data packets are split according to the hop counts they encounter and data are transferred to the multicast receivers.

***Keywords*-- MAODV; MT-MAODV; ODMRP; CGP; MULTICAST.**

I. INTRODUCTION

Multicasting is the transmission of datagrams to a group of hosts identified by a single destination address. Multicasting is intended for group-oriented computing. The multicast service is critical in applications characterized by the close collaboration of teams (e.g. rescue patrol, battalion, scientists, etc.) with requirements for audio and video conferencing and sharing of text and images. Maintaining group membership information and building optimal multicast trees is challenging even in wired networks. However, nodes are increasingly mobile. One particularly challenging environment for multicast is a mobile ad-hoc network.In order to handle multicasting in mobile ad-hoc network, two different topologies are used viz. Multicast tree and Mesh topology. Multicast Ad Hoc On-Demand Distance Vector (MAODV) is anexample of a multicast routing protocol using the tree-based approach. The main idea behind the tree-based approach is that only one route is created between the multicast tree and any receiver. On-Demand Multicast Routing (ODMR) protocol is also an example of a multicast routing protocol but in contrast with

MAODV, using mesh- based approach instead of the tree-based approach. In the mesh-based approach, multiple routes are created between the source and the receiver. Some disadvantages of the mesh-based approach, that we can see in the On-Demand Multicast Routing (ODMR) protocol, is that it has low efficiency in multicast and it requires a high number of forwarding nodes to be able to provide these multiple paths.

An advantage of the mesh-based protocol is that, because it contains multiple paths between each source and receiver and if a path is broken then another path can be taken, thus it can be considered as more efficient. This efficiency also has a drawback: more efficiency means more control overhead due to the increase of data sources. The tree-based approach has, as a disadvantage, a higher possibility of dropping compared to the mesh-based approach. This is due because of the availability of a single path between the multicast group and the receiver, thus no backup route. This can be caused if there is high node mobility in the network cloud. As one advantage of the tree-based approach that can be considered, is the fact of having efficient and high forwarding because of its single path property. [5]

II. BACKGROUND

Multicast Ad Hoc On-Demand Distance Vector (MAODV) is a well-known routing protocol in the field of ad hoc networks and is an extension of the unicast protocol, Ad Hoc On-Demand Distance Vector (AODV).This protocol contains two main parts: multicast tree construction and multicast tree maintenance. It is also categorized as a receiver-initiated protocol.

MT-MAODV protocol discovers multicast routes on demand using a broadcast route discovery mechanism. When a node wishes to join a multicast group or it has data to send to the group but does not has a route to that group, it originates a route request (RREQ) message. Only the members of the multicast group respond to the join RREQ.

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If an intermediate node receives a join RREQ for a multicast group of which it is not a member or it receives a route RREQ and it does not have a route to that group, it rebroadcast the RREQ to its neighbors. But if the RREQ is not a join request any node of the multicast group may respond. Every node sets up pointers to determine the reverse route in its routing table upon receiving a RREQ. This entry may later be used to relay a response back to the route requester. This entry is not activated until or unless it gets multicast activation message from the requester. The responding node unicasts the route response RREP back to the route requester after the completion of necessary updates on its routing table. A node may receive multiple route reply for a route request. Usually node selects a route with the greatest sequence number and the shortest hop distance to the member of the multicast group and discards other routes. After that, node enables the selected next hop in it routing table and unicasts an activation message to that node. Upon receiving this message it activates the entry for that node in its multicast routing table. It does not forward the message further if it is a member of the multicast group otherwise it does. On the other hand, if it is not a member of the multicast group it may have multiple options to forward this activation message due to multiple route responses. It chooses best next hop and unicasts this activation message to the next hop. This process continues until activation message reached to the source of the route responder. Multicast AODV routing protocol requires to actively follow and respond to the changes in the multicast tree as it maintains hard state in its routing table. In order to terminate from the multicast group multicast AODV requires pruning. It allows a node to quit from the group if it is a leaf node in the tree otherwise it must remain in the tree as a non-group multicast member. Links are checked to detect link failures. When link failure is detected, downstream node is responsible for repairing the link. [9]

ODMRP (On-demand Multicast Routing Protocol) is mesh based, and uses a forwarding group concept (only a subset of nodes forwards the multicast packets). A soft-state approach is taken in ODMRP to maintain multicast group members. No explicit control message is required to leave the group. In ODMRP, group membership and multicast routes are established and updated by the source on demand. When a multicast source has packets to send, but no route to the multicast group, it broadcasts a Join-Query control packet to the entire network. This Join-Query packet is periodically broadcast to refresh the membership information and update routes.

When an intermediate node receives the Join-Query packet, it stores the source ID and the sequence number in its message cache to detect any potential duplicates. The routing table is updated with the appropriate node ID (i.e. backward learning) from which the message was received for the reverse path back to the source node. If the message is not a duplicate and the Time-To-Live (TTL) is greater than zero, it is rebroadcast. When the Join-Query packet reaches a multicast receiver, it creates and broadcasts a "Join Reply" to its neighbors. When a node receives a Join Reply, it checks if the next hop node ID of one of the entries matches its own ID. If it does, the node realizes that it is on the path to the source and thus is part of the forwarding group and sets the FG_FLAG (Forwarding Group Flag). It then broadcasts its own Join Table built upon matched entries. The next hop node ID field is filled by extracting information from its routing table. In this way, each forward group member propagates the Join Reply until it reaches the multicast source via the selected path (shortest). This whole process constructs (or updates) the routes from sources to receivers and builds a mesh of nodes, the forwarding group. After the forwarding group establishment and route construction process, sources can multicast packets to receivers via selected routes and forwarding groups. While it has data to send, the source periodically sends Join-Query packets to refresh the forwarding group and routes. When receiving the multicast data packet, a node forwards it only when it is not a duplicate and the setting of the FG_FLAG for the multicast group has not expired. This procedure minimizes the traffic overhead and prevents sending packets through stale routes. In ODMRP, no explicit control packets need to be sent to join or leave the group. If a multicast source wants to leave the group, it simply stops sending Join-Query packets since it does not have any multicast data to send to the group. If a receiver no longer wants to receive from a particular multicast group, it does not send the Join Reply for that group. Nodes in the forwarding group are demoted to non-forwarding nodes if not refreshed (no Join Tables received) before they timeout.[9]

III. Problem Definition

The scenario here is to connect 12 multicast receiving devices from a single centered source. Every receiver is located at certain level (say level d=2).Every receiver thus contain intermediate nodes between them and the source and these nodes are either parent node or ancestor nodes. The overall layouts of the nodes are as follows.

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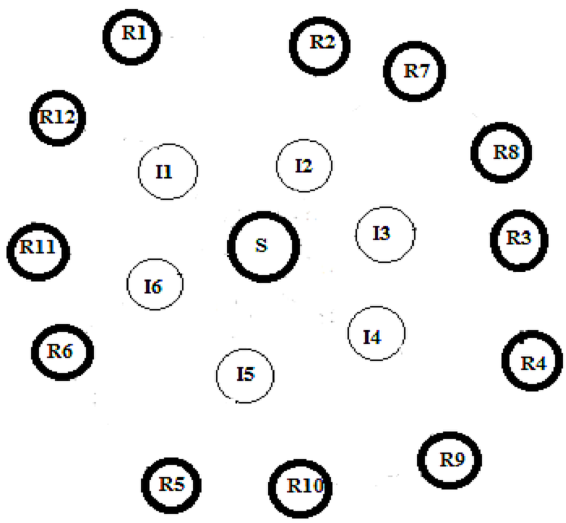

Figure 1.Problem with 12 receiver and single centered source.

Tree approach to this problem givesdifferent independent routes towards individual receiver. This leads to a worst case solution for multicast transmission. Loss of packet will be common in this technique when the number of receivers increase in multifold. Instead when a mesh based approach is employed, number of path between the nodes becomes too high leading to difficulty in packet forwarding.

Tree based approach does not lead to loss in efficiency due to the fact that it uses a single path for routing the packets to its receivers. Since, tree based approach and mesh based approach are counter to each other, the advantage of former approach is the disadvantage of the latter. Therefore, if any methodthat can utilize the advantage of both tree based and mesh based approach can be designed, then it will lead to high efficiency along with better through put and faster transmission without packet loss in the transfer process.

IV. PROPOSED MODEL

4.1.Model explanation

In this proposed protocol, the multicast transmitter is located at roughly a center location surrounded by a series of nodes that correspond to either receivers or intermediate transmitters.The algorithm requires details such as the node ID, the hop count to reach the node, collection of intermediate nodes, depth of the node, unicast minimum hop path to sender for each receivers.

Before the transmission process begins, the nodes are accumulated into a cyclic group. In order to achieve this group, the depth of the multicast nodes is used.

Two nearby nodes are taken, and verified for the same level of depth. The critical criteria is that the nodes taken must node have the same parent node .If the above specified conditions are satisfied then a path between these two nodes are established. Thus, a cyclic group of nodes is formed. Similar groups are formed by repeating the process until there are no nodes left nearby each other to establish a path.

The actual data transmission takes place after the group is formed and the depth of each group is noted. An equivalent amount of data is passed through the group and splitting of the data takes place during this routing based on the no. of hops left to reach the target node. Considering the depth of the group as ‘n’, the total no. of nodes in each group is calculated by equation (1):

No .of nodes=2*n+1 (1)

The data that will be received by each receiver will be expressed as in equation (2) and (3):

For receiver via maximum hop route,

(n/2n+1) (2)

For receiver via minimum hop route,

(n+1/2n+1) (3)

As the packets are split and sent, the overhead to carry large packets through many hops is reduced and finally the split packets received at the receiver are appended to obtain the full message. This process cannot be repeated for the reply from receiver to sender therefore the receiver uses unicast transmission of acknowledgement to send back the reply to the sender via the route with shortest hop count.

4.2.Algorithm

4.2.1 Generating path between receivers with same level of depth

step-1:Start

step-2:Process-I

step-3:Determine the level of depth for each multicast router.

step-4:If two nearby receivers have same level of depth then, GOTO STEP-5.

step-5:If the nearby nodes have same parent, then BREAK, else GOTOSTEP-6

step-6:Generate a path between the other two nodes.

step-7:Stop

4.2.2 Transmission of data

step-1:Start

step-2:Process-II

step-3:Perform process-I

step-4:Determine the maximum depth ‘n’ through every path from source.

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step-5:Send the number of copies of the data through the path equivalent to the maximum depth.

step-6:Perform process –III

step-7:Unicast all replies from different receivers to the source via the shortest route.

step-8:Stop

4.2.3 Data splitting according to hop calculation

step-1:Start

*step-2:Determine the total number of nodes in a circle by the formula (2*n)+1*

step-3:Use the minimum hop route to send (n+1)/(2n+1) fraction of packet to the receiver

step-4:Use the maximum hop route to send (n)/(2n+1) fraction of packet to the receiver

step-5:Append the received packet

step-6:Stop

4.3. Illustration

To explain this algorithm in more detailed manner, consider a sole sender S sending copies of same messages, and there are totally 12 multicast receivers named R1-R12 that require this message. According to this algorithm, the nearby receivers will first establish a path between them if they belong to the same level and not have same parent node. Therefore, nodes (R1,R2),(R3,R4),(R5,R6),(R7,R8),(R9,R10) and (R11,R12) are joined with a new generated path as shown below.

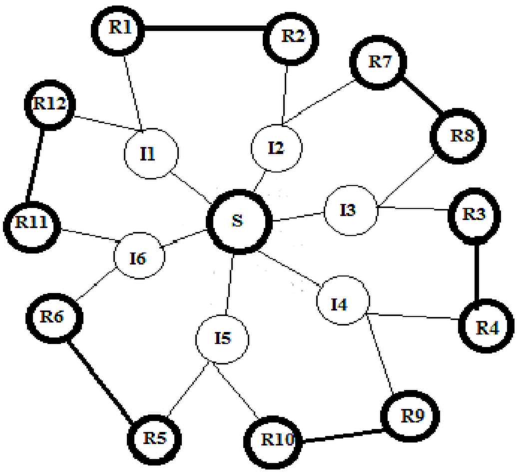

Figure 2.Generation of path between multicast receivers.

This step is followed by transmission of data.Here, the maximum depth of the receiving node is taken which is 2. So two copies of the same message is sent through each path from the source S, and splitting of data takes place. In each path, the total no. of nodes will be (2n+1) which in our case is (4+1)=5.

The splitting of message would be 50 % at level 1 to send to each group of the receivers and at level 2 the data are split into 2/5th for reaching node via maximum hop route and 3/5thfor reaching via minimum hop route as shown.

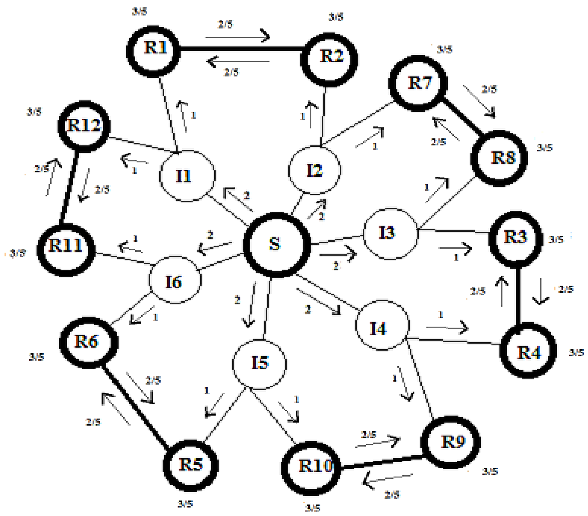

Figure 3.Transmission of message and message splitting.

Finally, the data are appended to get the full message. Thus, the data is received by the multicast receiver nodes.

V. CONCLUSION

The CGP is based on the sole idea of forming cyclic groups of nodes with the receiving node at the deepest location and transfer the data by splitting it equivalent to the hop .This protocol reduces the overhead caused due to transfer of large amount of data through several hops. The total no. of nodes can be controlled by setting up a threshold value above which a new sub group must be formed.This proposed protocol is a merge of both tree based and mesh based protocols. By this disadvantages encountered by both tree and mesh protocols are eliminated by their counterparts. This protocol can be used where optimal solution for routing cannot be achieved through both tree based and mesh based protocols. The limitations that this protocol might pose are that it is quiet complex to design, cost incurred for packet loss will be high and may affect more than one receiver node.

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