Overview of Improving Robustness of MAODV Protocol by Combining Tree and Mesh Structures

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Abstract: *Mobile ad hoc networks (MANETs) plays an important role in the communication in the network must be set up temporarily and quickly. Since the nodes move randomly routing protocols must bring strong and constant to ensure successful packet delivery. Advantage of multicast routing is the ability to reduce communication costs and saving the network resources by just a copy of the message over the shared compound. Several destinations Based on the data delivery structure can multicast routing protocols are divided into two groups is a tree-based and other mesh-based. Tree-based protocols have high efficiency and low consumption of more bandwidth and may have poor robustness, since only one connection between two nodes exists. Like a tree based multicast routing protocol, MAODV (Multicast Ad hoc On-demand Vector) shows an excellent performance in lightweight ad hoc networks. Since the load on the network increases, QoS (Qu ality of S ervice) degraded. I n this paper, we summarize the effect of network load on MAODV protocol and an optimized protocol MAODV-BB propose (Multicast Ad hoc On-demand vector with backup Branches), the robustness of the MAODV protocol improved by the combination of advantages of tree structure and the grating structure. It can not only update shorter branches, but also build a multicast tree with back-branches. MAODV-BB protocol improves the network performance over conventional MAODV in heavy load ad-hoc networks.*
Keywords: *backup branch, MAODV, multicast routing, tree structure.*

I. Introduction

Mobile ad hoc networks [1-2] (MANETs) are self-dependent wireless networks there is no fixed structure and central management. Nodes communication done via multihop wireless links and the nodes move randomly. When two mobile nodes are not within radio range, the communication between them can be recognized through intermediate nodes. Multicast routing is an effective way to transmit packets from one point or multi-points to multi-points, which can decrease the consumptions of network bandwidth and host power by sending the same data to multiple recipients. Based on the structure used for data delivery, most of the existing multicast routing protocols [3-4] can be classified into two categories: tree-based and mesh-based protocols.

In tree-based multicast routing protocols, all the routers form a tree structure with the source node as the root, thus there is only one single path between every pair of source and receiver. In the mesh-based multicast routing protocols keep more than one path between each pair of source and receiver, and delivers a more robust data delivery path; sometimes, it brings on more control overhead to maintain multiple paths. The study reviews the operation of treebased and mesh-based multicast routing using MAODV (Multicast Ad hoc on-demand Vector) and ODMRP (On-Demand Multicast Routing Protocol) as examples of treebased and mesh-based protocols, respectively. ODMRP shows better (by roughly 10%) packet delivery ratios than MAODV. Since MAODV delivers packet along a multicast tree, a single packet drop upstream can avoid a large number of downstream multicast receivers from receiving the packet.

The absence of redundant routes affects performance greatly as node mobility results in frequent link breakages and packet drops. Routing protocol overhead can be especially harmful in typical MANET scenarios where nodes are both bandwidth- onstrained and energy-constrained.Considering the advantages of tree-based multicast routing protocols that high forwarding efficiency and low consumptions of bandwidth, several researchers have managed to optimize existing tree-based multicast routing protocols and improve robustness of the protocols in various methods.

In this paper, we consider a tree-based case and propose an optimized protocol MAODV-BB (Backup Branches) to improve the performance of MAODV in heavy load ad hoc networks. The key idea of MAODV-BB algorithm is to make full use of GRPH (Group-hello) messages that the group leader broadcasts periodically to update shorter tree branches and construct a multicast tree with backup branches. The shorter branches reduce the resource occupied and the existence of backup branches avoids large numbers of tree reconstructions and enhances robustness of the protocol. The improved protocol not only doesn't bring extra control overhead, but also ensures high packet delivery ratio and low end-to-end delay.

II. Multicast Routing Protocols

Multicast routing delivers many benefits and to support dissimilar set of applications. There are many multicast routing protocols have been intended. The purpose of multicast routing is to develop the strength of tree-based multicast routing protocols. These are the optimization of selecting the method of mechanism are - I) node mobility prediction. II) The creation of multiple trees. III) The application of multipath routing, reducing the communication cost. IV) Saving the network resources by sending single copy of the message over the shared link important to different destinations and so on.

1) **E-MAODV:** Entropy-based long-life multicast routing protocol in MAODV (E-MAODV). In this entropy concepts are used to develop an analytical modeling, and choose the long life multicast routing as per entropy metric. This development decreases the number of route renewal and assurances the route stability in dynamic mobile networks, but it increases difficulty of route developments.

2) **NMP-MAODV:** Furthermore, this paper takes no additional measure to reimbursement of broken tree branches. NMP-MAODV (Node Mobility Prediction-MAODV) assurances non-disconnection communication by active-link switch before mobile node breaks away from upstream node's signal range. The multicast group members set the combined cycle and calculate the predicted exit time. If the result is less than threshold, then turn to the active-link switch process. If the link switch process fails, it will recruit the MAODV repair process. The improved protocol can operate properly in highly mobile network, but it increases additional control overhead due to broadcasting S-marked MACT and M-marked the tree disconnection cannot be maintained at MACT messages.

3) **RMAODV** (Reliability of the Multicast Ad Hoc On-Demand Distance Vector): This routing protocol is proposed, which is based on a protocol relay concept. The basic systems for reliable communication can be classified as I) Sender initiated approach and II) Receiver initiated approach. I) Receiver initiated approach:- In this approach each receiver maintains receiving records and requests retransmission via a negative acknowledgement (NACK) when errors occur. In RMAODV, we use the receiver initiated approach and protocol relays are placed along the multicast tree. Each relay node has only one upper relay to request a retransmission. However, one relay node may have numerous lower relay nodes. When a relay node detects a loss, it sends a NACK back to its upper relay node. The improved protocol has a better performance for packet delivery ratio and decreases the number of packet retransmissions, but it increases the probability of receiving data repetition to the receivers in a multicast group.

4) **MT-MAODV:** An optimized routing protocol MT-MAODV (Multiple Tree-MAODV)[9], which focuses on issue related to video multicast over mobile ad hoc networks. In order to keep continuous video streaming, it propose an extension to MAODV to build two highly-disjoint trees. In MT-MAODV, the video is divided into two independent sub-streams and is communicated separately along these trees. In light of this, the video source must have a connection to both trees so that the traffic allocator can split the traffic accordingly. However, if a node that attempts to join the multicast group has only one option to be connected to the multicast group, which is through another node u, considering that connectivity is giving higher concern than tree disconnectedness, node u must become the forwarding node for both tree-1 and tree-2. This method can considerably reduce the of connection packet loss if the multicast trees are highly disjoint. But if a high level, the performance of improved protocol will be under the limitations.

5) **MP-MAODV:** (Multipath Routing-MAODV) extends MAODV to create two node-disjoint routes to increase network efficiency and balances the network loads. It adds two extra control messages MACT-S (multicast activation with the flag S) and RREP-S (route reply the flag S) for selecting and creating disjoint paths. Truly, the backup path is built from the source node to the multicast tree, so it has nothing to do with the efficiency of the multicast tree structure. Sometimes, it is still only one link between two on-tree nodes. Moreover, when the structure of multicast tree is a large-scale, the problem of heavy network load cannot be solved efficiently. Above all, no effective improvement focusing on the tree structure itself has been taken to optimize tree-based multicast routing protocols. To overcome such incompetence, we combine advantages of the tree structure and the mesh structure to optimize the multicast tree structure, including updating shorter tree branches and constructing a multicast tree with backup branches to improve reliability of the protocol.

III. MAODV Protocol Introduction

MAODV is an on-demand routing protocol based on distance vector, which is proposed by IETF MANET. In this section, we give a brief description of route mechanism in MAODV and the effect of network load on the MAODV protocol.

3.1 Route mechanism

MAODV is a routing protocol designed mainly for ad hoc networks. In addition to unicast routing, AODV supports :- I) Multicast and II) Broadcast. MAODV protocol constructs a shared delivery tree to support multiple senders and receivers in a multicast session. The route mechanism in MAODV mainly consists of route creations and route maintenances. As a tree-based multicast routing protocol, MAODV relies on flooding through the whole network to discover the routing path and establish the multicast tree. When a source node wants to join a multicast group or has data to send to the multicast group, it will broadcast a route request (RREQ) message. In-between nodes establish reverse route and forward the RREQ message. After receiving a RREQ message, the members of multicast group reply a route reply (RREP) message to setup a forward path. If the source node receives one or more RREP messages from the destination nodes before timeout, it chooses one of the routes with the largest sequence number and the smallest hop count. Then it starts the route by unicasting a multicast activation (MACT) message to the next hop and starts to send multicast data packets.

In MAODV, the route recovery will start directly when there is an on-tree node notices a link broken. Initially, there is need to determine whether the broken link is upstream or not. If it is, the node will delete the upstream node in its next-hop list, drop multicast data packets which should be sent and then send RREQ message with the flag J to reconstruct a new tree branch. Then, the node will delete the downstream node in its next-hop list and then set pruning timer.

3.2 Impact of network load on the MAODV protocol:

In light load ad hoc networks, the given mechanism of multicast route recovery is effective because most of the applications permit a small amount of packets lost before the multicast route recovery is completed. Sometimes, when the network is highly loaded, large number of packets will be discarded and poor strength of the tree-based protocols appears. So that, depending on the original route maintenance in MAODV cannot ensure the network performance.

IV. Improvement Of Multicast Routing

To overcome the effect of network load and improve strength of the MAODV protocol, we extend MAODV protocol to construct a multicast tree with backup branches from two aspects:-1) Process of backup branches selection and addition. 2) Mechanism of multicast tree maintenance.

4.1 GRPH message expansion

In MAODV, the group leader periodically broadcasts GRPH messages to inform or the multicast group information. In order to select and add backup branches properly, we extend original GRPH (Group-hello) messages with the number of active downstream branches in MAODV-BB (Backup Branches).

4.2 Backup branches selection and addition in MAODV protocol

When an on-tree node firstly receives a GRPH message with the same multicast group leader address and multicast group address, it updates the multicast group information in its group leader table and multicast routing table. Normally, the GRPH message is recognized as the multicast group leader address and the multicast group address. We add one backup routing table for each on-tree node to save the information of its backup tree branch in MAODV-BB.

V. Conclusion

This paper summarizes tree based protocols and MAODV protocol. Also improved protocol MAODV-BB based on MAODV that increases strength of the MAODV protocol by combining advantages of the tree structure with the mesh structure. The purpose of MAODV-BB is to make full use of GRPH messages that the group leader broadcasts periodically to update shorter tree branches and construct a multicast tree with backup branches. It improves the tree structure and also decreases the frequency of tree reconstruction. MAODV-BB protocol improves the network performance over conventional MAODV in heavy load ad hoc networks, which meets QoS requirements for communication in a MANET.

Acknowledgements

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