Transmission Redundancy Elimination in MANETs for Effective Broadcasting

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ABSTRACT

In Mobile Ad-hoc Network (MANETs) one of the most basic fundamental operations is broadcasting. Broadcasting is operated with flooding which leads to the problem such as transmission redundancy and packet collision. This requires a lot of energy resource of the node. The flooding algorithm provokes a more number of unnecessary packet rebroadcasts, wasting allocated bandwidth, causing contention and packet collision. There are some efficient flooding algorithms existing to tackle the redundancy problem. The earlier proposed algorithms require either maintaining 2-hop neighbor information or have to select subset of nodes. In this project, the algorithm proposed is used at the receiver end. Each node, receiving a broadcast packet, will broadcast the cut message along with the packet identity and the path information to all other connected nodes. Unlike the most existing techniques, each node tracks the neighboring nodes information from which redundant messages are received. This proposed algorithm achieves local optimality by breaking the cycles between them. When each the node receives the packet, the cut messages are broadcasted to minimize the cycle redundancy. The receiver node is involved in the process of decision making and so the decision is taken by the receiver node. The proposed system would be capable of easily included with the existing system as the decision is to be taken by the receiver node. The proposed system is an improved version of the existing algorithm, which is more graceful in interpreting existing protocols.

Keywords

Wireless ad hoc networks, flooding, broadcasting, transmission redundancy

1. INTRODUCTION

One of the basic communication operations is broadcasting where one node transmit a message to the neighboring nodes in the network. Some of the routing protocols used in broadcasting are ad hoc on demand routing protocols. Broadcasting is used to revise the topology to sustain the network. In broadcasting when a node receives the message for the first time then it will forward the messages to all other nodes connected in the network, message flooding, there arise a problem of redundant transmission which results in packet collision. The broadcast redundancy significantly rises as the average number of neighbors increases [1]. In Ad-hoc network, a packet collision occurs when two or more nodes try to transmit a packet from corner to corner the network at the same time. When a packet collision increases, the packets may be either discarded or sent back to their own originating stations and then once again retransmitted in a timely manner to avoid further collision. Packet collisions may result in the loss of packet reliability or can slow down the performance of a network. When this redundancy increases it results in the severe network congestion and significant performance degradation, a fact called the broadcast storm problem [5]. It is also difficult to reduce the number of forwarding nodes in broadcasting. The broadcasting algorithms in this group can reduce the number of broadcasts in the network and guarantee full delivery [4], [6]. In broadcast-based systems, we use message flooding to broadcast messages. There is no specific destination; hence, every neighbor node is contacted and then forwards the message to its own neighbors until the message's lifetime expires. Such systems have been successfully deployed in practice to form universal ad hoc networks due to their cleanness and flexibility. Here, we focus on broadcast based ad hoc architectures. The main objective is to reduce the redundant transmission with the neighbor information. The important aspect is to reduce the forwarding nodes while all the nodes must receive the messages without any problem. The redundancy in the flooding operation must be reduced. This redundancy can be reduced using the packet identification. The algorithm uses the 1-hop neighbor information and with that information the node which receives the packet from other node will rebroadcast the cut message to all other connected nodes. The information collecting message is broadcasted to all other nodes to identify the duplicate nodes. With that duplicate node the unnecessary path is temporarily disconnected to reduce the redundant transmission of the same message.

 To minimize the redundant transmission by reducing the number of forwarding nodes.

 To reduce the packet collision.

Duplicate messages will affect the reply time of nodes in the network since they need bandwidth and resources, which are essential for the connectivity of the network. In this paper, we describe the Distributed Cycle Minimization Algorithm (DCMP), which aims at disconnecting the cyclic paths at considered locations in order to avoid initiation of duplicate messages in the network. In DCMP, any node that detects a replica message can initiate the cutting process.

This involves two steps:

First, the nodes in the cycle should select a lead node. At the second step, the cycle is disconnected at a well-defined point with respect to the lead node. Lead nodes are also important for maintaining the nodes connectivity and optimal structure of the network when nodes enter or exit without notification. Since any node can become a lead node via a scattered process, the system is prone to failures.

The main features of DCMP are the following:

1. It reduces extra duplicate messages.

2. It requires few messages to control; therefore, we have minimum overhead.

3. DCMP is appropriate for dynamic networks with frequent node arrivals and departures since it is fully dispersed and requires only localized changes to the network's structure.

The rest of the paper is organized as follows. Section 2 presents the related work. Next in section 3, the proposed work is detailed and the algorithms are elaborated. In section 4, the experimental results are presented. Section 5 concludes the paper and discusses the direction for future work.

2. RELATED WORK

There are two broadcasting algorithm used in MANET 1]. The first is the sender based broadcasting algorithm in which a schedule can be set at any time. The usual sender based algorithm is used with a change in the scheduling the received packet. Second is the receiver based algorithm. The work proposed by the receiver algorithm is termed as Responsibility-Based Scheme (RBS) in which the decision is taken whether to broadcast the message or not. The proposed RBS can reduce the average number of broadcast which is less than one of the best known approximations for the required broadcasts. Although this algorithm is simple to implement, it has its own limitations in reducing the number of broadcasts. The major difficulty in the approaches using 1-hop or 2-hop information is the selection of the subset of neighbors for forwarding the flooding message. Some broadcasting algorithms do not require any information exchange. Flooding and probabilistic broadcasting algorithms such as [10] and [7] fit this group. Flooding mechanism is initially used in broadcasting in MANET, where each node after receiving the message from the other neighboring nodes must transmit the received message to all other connected nodes. Similarly in probabilistic algorithms the probability of the transmission is calculated according the nodes in connection. Probabilistic algorithms cannot guarantee full delivery. However, they can reduce the number of broadcasts at minimum computational overhead. Further the broadcasting algorithms can be classified into neighbor-designating and self- pruning. In neighbor designating algorithms [5], [8], each node selects the status of the forwarding node. The challenge here is to choose a smallest subset of nodes to forward the message. With the 1-hop neighbor information the subset of forwarding nodes can be selected. In self- pruning, the status of each node is determined using the local information. The main challenge is to find an effective self-pruning condition. The flooding with self-pruning (FSP) algorithm proposed in the receiver based algorithm usually used 1-hop information. In this scheme the message after received by the receiver have to attach the information about all its 1-hop neighbor information as a forwarding list. Each node compares this 1-hop neighbor information with its already available 1-hop neighbor. If all the 1-hop neighboring nodes are available in the list then it will stop forwarding the message to other nodes, else it will forward [7]. In self-pruning broadcasting protocol [4], a node will not forward the message if the broadcasting condition id satisfied. In the static network with an best MAC layer, only a division of nodes forward the broadcasting packet and still guarantee the entire network delivery. This self-pruning rule is the enhancement of the coverage condition. This probabilistic approach was investigated well in [7]. It showed a curve with the success ratio for probabilistic flooding which tends to become linear for the system with minimum degree of nodes. In these schemes, the transmission of non-redundant transmission might be dropped out, without being forwarding additionally. This will cause some of the nodes to be failed in receiving the flooding messages. In addition to these challenges, setting the appropriate threshold for the various network situations is also an issue. Another comparable work with this broadcasting in MANET is Edge Forwarding [8]. The transmission coverage of each node is partitioned into six equal size parts. After receiving the flooding message from the neighboring node, each node makes its decision on its own based on the availability of the nodes in the overlapped areas.

3. PROPOSED WORK

The proposed approach provides an effective broadcasting in Mobile Ad-hoc Network. The aim of the algorithm is to reduce the redundant transmission of the flooding messages. In general broadcasting algorithm [1], the message received by the node is scheduled for broadcast. But the scheduling in the broadcasting is done at the first time when it receives the message for the first message.

Algorithm1. A general broadcast-based algorithm

1: Extract information from the received message M

2: if M has been scheduled for broadcast or does not contain the Node IDs.

3: drop the message

4: else

5: set a defer timer

6: end if

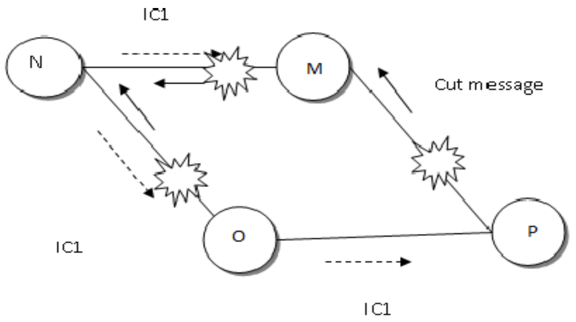
7: When defer timer expires

8: Select a subset of neighbors to forward the message

9: Attach the list of forwarding node to the message

10: Schedule a broadcast

The proposed algorithm requires negotiation among all nodes involved in a cycle about the best way to cut the cycle. Therefore, the probability of generating a disconnected network is minimized. The negotiation process is efficient, requiring two messages for each node per cycle. Also, the gathered information during intervention is used to repair the network with low transparency when nodes join or fail/quit without notification.



Cycle Elimination Model

The unstructured network topology contains many cyclic paths, which initiate many redundant messages in the system. Although these messages can be identified, they still consume a large proportion of the bandwidth and other resources, causing restricted access in the entire network. The Distributed Cycle Minimization Protocol (DCMP), a dynamic fully decentralized protocol that significantly reduces the duplicate messages by eliminating avoidable cycles. As packets are transmitted through the nodes, DCMP identifies the difficult paths and attempts to break the cycles with the maintenance of the network connections.

In the proposed system, the redundancy is minimized at the each node by tracking the duplicate paths available for an each node. To detect the duplicate path in the network, a node will broadcast the packet with initially generated with the control message and broadcast to all other neighboring nodes in the network. This control message is named as 'Information Collecting' message; the message is assigned a unique ID. To ensure that each IC message is single, we introduce an extra field, called DetectionID, which represents the path of the connection from where the message comes from.

Path information	Packet ID	Node information	...	...	Node information

Structure of Information Collecting Message

The node which receives the message from its neighboring node will rebroadcast the cut message with the packet id and pat of the received packet.

Path Information	Packet Information

Structure of the Cut message

The above two diagrams indicate the information furnished in the IC message and Cut message. The node, receiving the cut message with the same packet id and path information will break further transmission to other nodes. After detecting the cut message the cycle has to be minimized to reduce the redundant transmission. Then, the duplicate node connection is disabled temporarily for the receiving node from which the cut message is received. To disable the connection temporarily the receiver node must determine the duplicate. To determine this, we introduce one another message type called Cut Message (CM). Cut Message contains the GUID and DetectionID, which are set equal to the GUID and DetectionID of the equivalent IC message. Since the cut message disables the connection for the particular node broadcast, the redundant transmission of same message will be minimized.

Precondition: node M receives an IC message from node N

1. Search for the identical IC message as:
   Pkid (N)=Pkid(M)
2. If found then,
3. Combine the information into one
4. Using this decide which node is to be disabled
5. After decision, forward the message
6. Else
7. Append the node information
8. Search the history for each IC message

Algorithm for handling IC message

The algorithm above and below is modified from [15] can be used to reduce the broadcast the messages. The above algorithm is used in peer networks in former. Now we can implement this in Mobile Adhoc Networks.

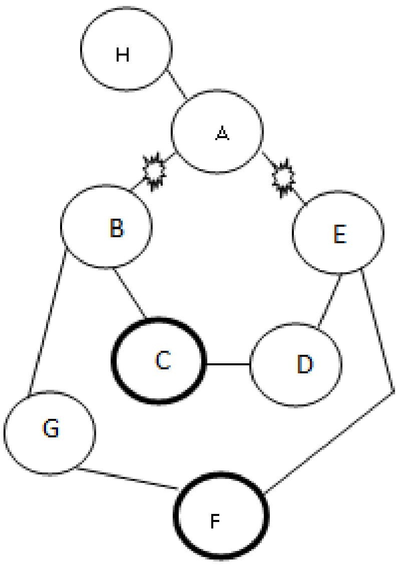
Each node compares the packet ID of the received cut message and IC message. If they are found similar then that packet is not broadcasted else the message is broadcasted. At this point the node information is required to make the decision. If the node information is not similar then the list of forwarding node is attached to the forwarding message.

Precondition: Node N receives cut message

1. If N have to be disabled then
2. If the connection is still active then
3. Disable it
4. Else search the history for IC message
5. Pkid (N)=Pkid (M)
6. If found then send cut message

Algorithm for handling Cut Message

The partition of the network sometimes results into two unconnected parts. In DCMP, this corresponding problem is greatly reduced, mainly because the cutting position is defined deterministically. Nevertheless, as we show in below diagram, it is still possible to split the network. For simplicity, in this example, we measure the power P of a node only by its degree; therefore, the Gate Node in the cycle ABCDEA is C, and the one in the cycle ABGFEA is F. The connection opposite to C is AE, whereas the one opposite to F is AB. Hence, if the two connections are disabled simultaneously, nodes A and H are isolated from the network.

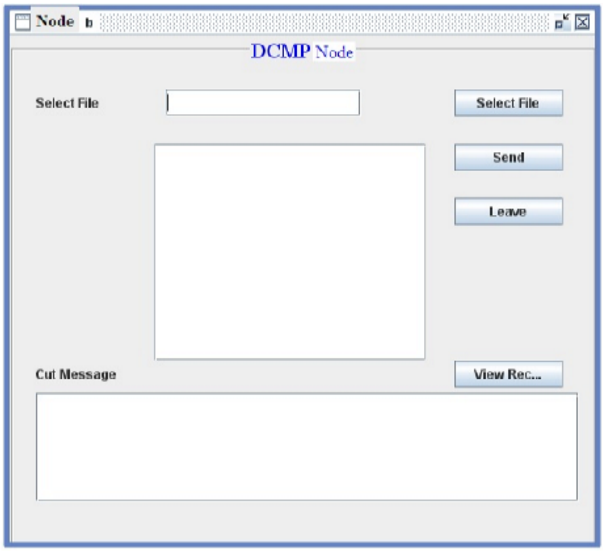


Network Split in DCMP

4. EXPERIMENTAL SETUP

In section 3 we have proposed an algorithm to minimize the redundancy problem in broadcasting in Mobile Ad hoc Networks. We considered the ratio of broadcasting nodes with the total number of nodes as the metric to evaluate the performance of the proposed broadcasting algorithms. We have to evaluate this metric with two parameters: transmission range and node density. In each, we uniformly distributed nodes. A randomly generated topology was discarded if it led to a disconnected network. In the paper the broadcasting is reduced by the sending the cut message to the nodes from which the messages received. Hence whenever a packet is sent to the neighboring node a cut message is received indicating the acknowledgement.

The following diagram shows how to establish the connection between the nodes. The connection establishment for each node will be done. At first the total number of nodes must be entered. Then the name for each node must be specified. Then the connection between each node is specified with its corresponding node name. After the connection establishment only every node has the access to login to with each node. The implementation has been done. In the implementation each node will broadcast the message to its neighbors. Hence each node will send the cut message to all other connected nodes. By reducing the probability of transmission the redundancy is reduced.



Each Node Selection

5. CONCLUSION

In this paper, the foremost problem which often arises in the broadcasting of the Mobile Ad Hoc Network was identified. The problem of flooding has been encountered. Although many algorithms are developed each one has its own limitations. The feasibility analysis for implementing the proposed work has studied. This requires 1-hop neighbor information. The Mobile Ad Hoc Network has been constructed with mesh topology. The protocol used will considerably reduce the redundant transmission. However the algorithm is used to reduce the redundant transmission along updating the network topology. Also the used algorithm have significantly reduce the number of forwarding nodes when compared to earlier schemes. By reducing the probability of transmission the redundancy is reduced.

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