Study on Broadcasting Techniques and Characteristics in Mobile Ad hoc Networks

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Abstract—*The mobile ad hoc networks comprise of dynamic nodes without any fixed infrastructure. It is possible for each and every node to acts as sender and router in order to forward the packets between the nodes since the nodes cannot communicate directly among themselves. These communication techniques are termed as broadcasting since it floods messages from one node to all the other nodes in the MANET. The broadcasting in MANET uses unicast (or) multicast routing protocols to broadcast control information for the purpose of route establishment. The key focus of broadcast protocols is to reduce the overhead (redundancy, contention, collision) for reaching all the nodes in network. These overhead caused by broadcasting is usually costly and are referred as broadcast storm problem. This paper provides different broadcast schemes available in order to overcome the broadcast storm problem caused by redundant retransmissions.*

Keywords-Mobile Ad hoc Networks, Broacasting, Route Establishment, Overhead, Broadcast Storm Problem.

I. INTRODUCTION

The mobile ad hoc network consists of autonomous nodes communicating among themselves. They do not require any fixed infrastructure since, they are self – configuring networks and does not require any central administrator. Due to the dynamic nature of nodes the major challenge occurs during routing a packet from the source to destination. As mentioned earlier the nodes are dynamic in nature so the path between the nodes changes periodically. For initiating a path to transmit data it is essential to identify (or) establish a path for transmission starting from the source to the destination using route discovery process. The route discovery is achieved via different routing protocols which of three types as,

A1. Proactive Routing Protocol

These routing protocols require every node to maintain up-to-date information of each and every node in the network.

A2. Reactive Routing Protocol

These routing protocols require a route from source to destination on demand rather maintaining frequent update.

A3. Hybrid Routing Protocol

These routing protocols combine the features of proactive and reactive routing protocols and hence use the both.

In mobile ad hoc networks the main issue happens during routing. Since the nodes are free to move and they are battery operated there happens frequent path failures. These path failures in parallel introduce route discovery process which increases the overhead in routing protocols. It affects the end – to – end delivery and packet delivery ratio. It is mandatory to reduce the overhead during route discovery process.

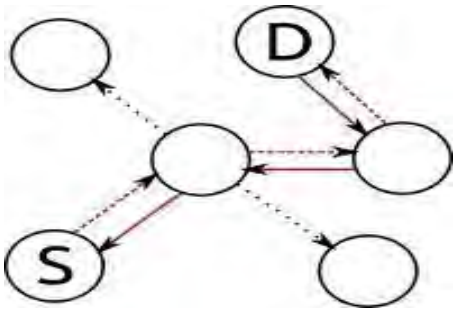

Fig.1: Route Request during Path Failures

The figure 1.1 pictures a route request from source to the destination through all the possible outgoing links in order to identify (or) establish a path between the source (S) and destination (D) during path failures.

B. Challenges in MANET

The following are the factors that are applicable only to MANET, but are not limited to,

B1. Dynamic Topology

The nodes are free to move and it does not require any fixed infrastructure. Due to this dynamic nature the path between the nodes are not static.

B2. No Fixed Infrastructure

The ad hoc networks do not impose any fixed infrastructure and so they do not require any central administrator. The nodes can join the network (or) leave the network anytime since they are self – configuring.

B3. Bandwidth Constraints

There is only limited bandwidth available between the communicating nodes. The communication is less reliable since it makes use of electromagnetic waves through air.

B4. Energy Constraints

The nodes within the network are battery operated which exhaust over time thus reducing the active duration of node. It requires techniques for energy management.

B5. Path Failures

Due to the dynamic nature of nodes there is no static link between the nodes thus resulting in frequent link breakages leading to frequent path failures and route discoveries.

II. BROADCASTING

The mobile ad hoc network makes use of broadcasting for route discovery process. It involves flooding a message from one node to all other nodes within the network. The broadcasting technique forms the fundamental communication technique in MANET. The route discovery process involves transmission of route request (RREQ) packets from source to destination through every outgoing links which is also known as blind flooding. The transmitted RREQ packets are received by all the surrounding nodes which try to find out whether these packets are already contained (or) not. If the packets are not contained already they are to be retransmitted and this is performed till all the nodes have received and transmitted the broadcast packets at least once.

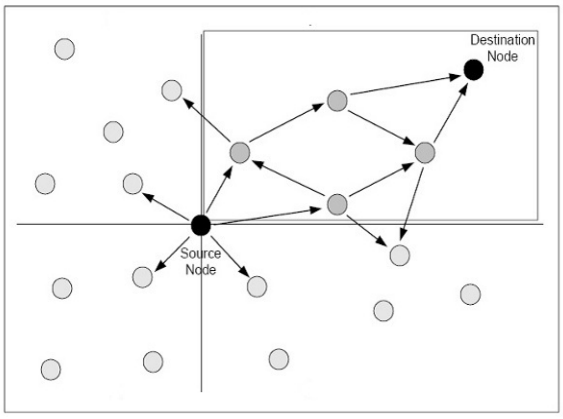

Fig. 1.2: Broadcasting in MANET

The figure 1.2 pictures the broadcasting technique in MANET where during path failure the source node finds path to the destination. So, the route request packet is send through all the possible nodes and establishes a route to the destination.

A. Characteristics of Broadcasting

The characteristics of broadcasting are discusses below but are not limited to,

A1. Spontaneous

The broadcasting can be performed by a node at any time. Due to this spontaneous triggering it retards synchronization and no prior information about the connectivity is known.

A2. Unreliable

The broadcasting involves communicating the messages to all (or) some of the nodes within the network. It does not provide any acknowledgement due to,

- The host gets isolated from the network.
- It causes redundant retransmissions around the sender.
- Many applications do not need 100% broadcasting techniques.

The route discovery process using broadcasting introduces redundant retransmissions while sending route request packet. It occurs when a node decides to rebroadcast a message to its neighbors where it already holds that message. These retransmissions become useless and can introduce broadcast storm problems.

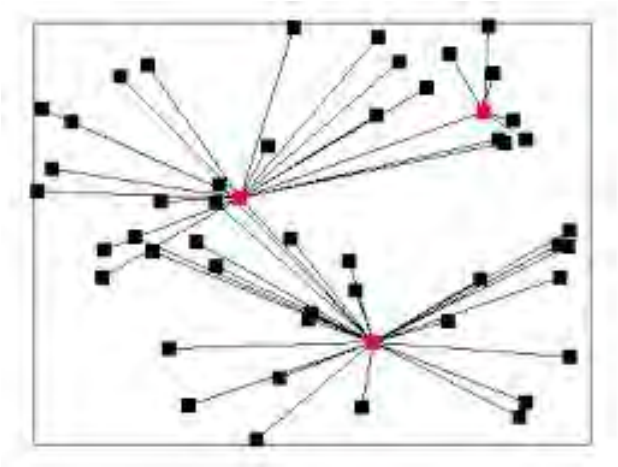

Fig. 1.3: Rebroadcasting during route discovery

The figure 1.3 pictures the redundant retransmission occurring during the transmission of route request packet. It shows that the rebroadcasting of messages to the neighboring nodes can cause broadcast storm problems since those nodes can also be neighbors for other transmitting nodes also.

B. Problems Occurs during Broadcast Storm Problem

The broadcast storm problem occurs due to redundant retransmissions which can give rise to the following drawbacks.

B1. Redundant Rebroadcasts

It results during the retransmission of broadcasted messages to all (or) some of its neighbors which already contains that message.

B2. Contention

There occurs a disagreement by the nearby neighbor nodes with the host and among themselves, if it tries to rebroadcast the already broadcasted message.

B3. Collision

Due to lack of acknowledgement and absence of collision detection mechanism there occurs more damages.

III. BROADCASTING TECHNIQUES

The broadcasting techniques in MANET involve the following techniques.

A. Simple Flooding

In this technique the source node within the network delivers a message to all of its neighbors where they check whether those messages are already contained within them (or) not. If the results are positive then the

packets will be dropped (or) if the results are negative the packets are delivered to all the neighbors. The process is continued until all the nodes are contained with the messages.

Merits

- The broadcasting retards the mobility of nodes.
- Blind flooding assures coverage and also guarantees the delivery of broadcasted packets to every node within the network.
- It ensures no packet losses.

Demerits

- It can drain out the battery power of nodes.
- The redundant retransmissions can introduce broadcast storm problem which also leads to contention and collisions.

B. Probabilistic based Method

B1. Probability based Flooding

The technique involves each node to forward a broadcast packet with a probability upon receiving it for the first time.

Merits

- In case of dense networks the number of nodes tends to share the similar transmission range but in sparse network the shared coverage area is less.\
- Here, not all the nodes try to rebroadcast which consistently saves energy.

B2. Counter based Method

When a node tries to rebroadcast the broadcast message to its neighboring nodes it will be blocked by a busy medium (or) queuing of messages. Since, there occurs a situation where a node hears the same message again and again from other rebroadcasting nodes before starting the transmission of messages by the node.

B3. Distance based Method

The decision is made based on the distance calculated between the nodes.

B4. Location based Method

The decision is made upon the location information of the broadcasting nodes. The location information is gathered using positioning devices, receivers, etc. It also assists during the route discovery process.

B5. Cluster based Method

The technique groups the network nodes into a number of overlapping clusters. Here the path between the clusters is recorded rather than the nodes.

Merits

- It increases the routes lifetime.
- It decreases the amount of routing control overheads.

C. Neighbor based Method

This technique involves each node to acquire knowledge of its neighbors which is achieved by periodic “HELLO” messages. The nodes upon receiving this message will compare it with the neighbor list of sending node. The receiving node tries to explore additional nodes by rebroadcasting if it results positive else the receiving node will drop that message. The neighbor knowledge methods are achieved as,

C1. 1 – Hop Neighbor Method

It is assumed that each node keeps the information about 1 – hop neighbors. It is obtained by exchanging the “HELLO” messages.

C2. 2 – Hop Neighbor Method

This technique allows a 1 – hop neighbor to be registered as a neighbor for another node. It follows asymmetric links between the nodes. The transmission of information also follows exchange of “HELLO” messages.

D. Area based Method

This technique is best suited for availing additional coverage area since the node should be located at the boundary of the sender nodes transmission range. By this the rebroadcast achieves additional coverage area. It is to be noted that the receiver should not be present near the sending node, if so it offers quite less coverage area.

The area based broadcasting involves the following techniques,

D1. Distance based Method

The decision is made based on the distance calculated between the nodes.

D2. Location based Method

The decision is made upon the location information of the broadcasting nodes. The location information is gathered using positioning devices, receivers, etc. It also assists during the route discovery process.

D3. Cluster based Method

The technique groups the network nodes into a number of overlapping clusters. Here the path between the clusters is recorded rather than the nodes.

Merits

- It increases the routes lifetime.
- It decreases the amount of routing control overheads.

IV. CONCLUSION

The paper focuses on the main problem that occurs in MANET, the route discovery process for which the broadcasting techniques have been studied along with its characteristics and challenges. From all the broadcasting techniques discussed in the earlier chapter the area based methods are chosen for a elaborate study since its performs good when compared with the merits and drawbacks of all the techniques. It is chosen as the best choice for avoiding redundant rebroadcasts.

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