A Globally Accessible List (GAL) Based Recovery Concept In Mobile Ad-hoc Network

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ABSTRACT

A mobile ad-hoc network is a mobile, multi-hop wireless network which is capable of autonomous operation whose primary role is to provide a reliable end to end communication between nodes in the network. However achieving reliable transmission in mobile wireless network is crucial due to change in the network topology caused by node mobility. Modern communication network is becoming increasing & diverse. This is the consequence of an increasing array of devices & services both wired & wireless. There are various protocols to facilitate communication in ad hoc network like DSR and TORA. However these approaches end up in the inefficient utilization of resources after link failure and congestion. This paper proposes an approach to get over this problem .We have added some static nodes which only keeps information related to the current working path and also helps in quick recovery in case of link failure .

Keywords: GAL (Globally Accessible List), Route Request, Route reply, Route cache

1. INTRODUCTION

An ad- hoc network is a group of wireless mobile computers (or nodes), in which individual nodes cooperate by forwarding packets for each other to allow nodes to communicate beyond direct wireless transmission range .The main characteristics of ad hoc network are-

 ➢ Topology changed frequent

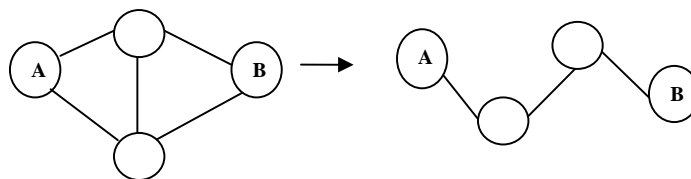 ➢ Bandwidth constrained

 ➢ Variable capacity wireless links

figure 1

 ➢ Energy constrained nodes

 Limitations of the Wireless ad-hoc Network

 ➢ packet loss due to transmission errors

 ➢ variable capacity links

 ➢ Broadcast nature of the communications

In this paper we consider the important problem of ad-hoc network protocols to do unnecessary processing in case of a link failure, congestion and inefficient utilization of resources. In DSR[2] when a link in a route breaks, the node which has discovered a link failure propagates this information to its previous node in the route which in turn propagates it back to its previous node until it reaches to the sender. Also the nodes encountered along this process perform a check whether they are using that same broken link in any of their routes, if so then it discards all those routes. The problem is that we have to go through many hops in order to report a link failure to the sender and the nodes not using the broken link have to unnecessarily check for the usage of broken link.

Our work differs from previous research in this significant ways. Our goal is to propose a mechanism which can quickly report link failure to the sender and solves the problems mentioned above. Restoration using BP is the best way of ensuring the QoS of high-speed networks, since a BP not only provides a fast restoration mechanism but also guarantees 100 percent survivability when the network suffers a single link failure. We have introduced the concept of globally accessible lists (GAL) which keeps record of all the links in a route currently used by a sender and is accessible by all the nodes of the network. When a link fails then instead of reporting it to the sender via propagation through previously encountered intermediate nodes, it is reported to the GAL node which directly reports it to all the senders who are using the broken link, thus saving a lot of unnecessary processing and enhancing the performance. When the senders gets this message from the GAL it switches to another route (backup path) not using the broken link.

2. RELATED WORK DONE

2.1 Basic form of DSR

DSR is an entirely on-demand ad hoc network routing protocol composed of two parts: Route Discovery and Route Maintenance. In this section, we describe the basic form of Route Discovery and Route Maintenance in DSR. In DSR, when a node has a packet to send to some destination and does not currently have a route to that destination in its Route Cache, the node initiates Route Discovery to find a route; this node is known as the initiator of the Route Discovery, and the destination of the packet is known as the Discovery's target. The initiator transmits a **ROUTE REQUEST** packet as a local broadcast. Each node receiving the **ROUTE REQUEST**, if it has recently seen this request identifier from the initiator, discards the REQUEST. Otherwise, it appends its own node address to a list in the REQUEST and rebroadcasts the REQUEST. When the **ROUTE REQUEST** reaches its target node, the target sends a **ROUTE REPLY** back to the initiator of the REQUEST, including a copy of the accumulated list of addresses from the REQUEST. Route Maintenance is the mechanism by which a node sending a packet along a specified route to some destination detects if that route has broken, for example because two nodes in it have moved too far apart. DSR is based on source routing: when sending a packet, the originator lists in the header of the packet the complete sequence of nodes through which the packet is to be forwarded. Each node along the route forwards the packet to the next hop indicated in the packet's header, and attempts to confirm that the packet was received by that next node; a node may confirm this by means of a link-layer acknowledgment. If, after a limited number of local retransmissions of the packet, a node in the route is unable to make this confirmation, it returns a ROUTE ERROR to the original source of the packet, identifying the link from itself to the next node as broken. The sender then removes this broken link from its Route Cache; for subsequent packets to this destination, the sender may use any other route to that destination in its Cache, or it may attempt a new Route Discovery for that target if necessary.

For high-speed networks, a restoration mechanism based on backup path[1] provides a means for assuring their survivability. This mechanism significantly reduces the consumption of backup capacity while still maintaining a high degree of survivability.

This mechanism was implemented in wired network; the usage of back up path in wired network has increases the survivability of network because it uses the link disjoint back up paths .it is easy to choose a back up path rather than maintenance of failed link.

We have used this idea of backup path in our proposed mechanism as a substitute of maintenance phase in wireless mobile network.

TORA[3] is also a distributed routing protocol for mobile, multihop, wireless networks. This protocol has 3 phases of working .Creating routes, maintaining routes and erasing route. Maintenance of route cause the network to bear excessive overhead.

3. PROBLEM FORMULATION

The communication in ad-hoc network is carried out using protocols like DSR, TORA etc. These protocols take more time and do unnecessary processing when a link breaks and it is reported to the sender. The performance can be enhanced if the above problems are avoided. The mechanism proposed in this paper aims to provide a solution to these problems. These problems also justifies the need to use globally accessible list (GAL)

The problems are-

➢ In DSR when a link fails it is reported to the sender by propagating this message to its previous node. The node in turn sends it back to its previous node until it reaches the sender. This process of sending messages hop by hop wastes time.

➢ In DSR when a message reporting link failure is being propagated through intermediate nodes, all the encountered nodes have to check whether it is using the broken link in any of its route. This way any of the nodes not using the broken link also ends up making a check. This is extra processing and unnecessary as well.

➢ In DSR the routes stored in the route cache are not arranged in any order so any random route gets selected.

➢ In TORA when a link failure occurs, the node tries to repair the route. This is time taking and can be a long process.
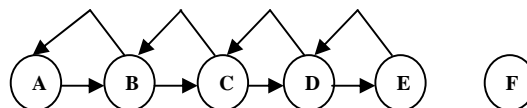

Figure 2. Operation of DSR when a link failure is reported to the source node

4. GLOBALLY ACCESSIBLE LIST (GAL)

It is a static node assumed to be accessible by all the nodes of the network. It contains information about all the links in a route that is currently being used to communicate. All the links of the working path are represented in the GAL. The address of the sender who is using that link in its working path is stored at the place where all the information regarding that link is saved in GAL.
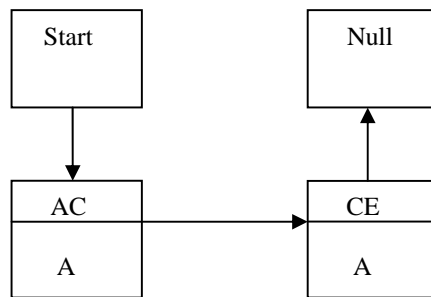
Figure 3. Globally Accessible List

Suppose a route A-C-E containing links AC and CE is chosen as current working path by the sender A. Then the storage in GAL would probably look like what is shown in **figure 3**.

If the size of the network increases, we can add multiple GAL nodes which are time synchronized and they update each other whenever any change is made in the data stored in GAL.

When a link fails, GAL is informed and it reads the entry corresponding to the broken link in GAL. All the senders mentioned in this entry are informed about this link failure. The sender then switches over to the next route which does not contain the broken link. Thus by using GAL we can inform the sender about any link break in lesser time as compared to DSR. When source node receives a message from GAL, then it decides, to which path it should pass the packet. The decision is based on optimization: which of the available pathways is the optimum pathway. GAL also ensures that only the sender nodes affected by a link break are informed, without forcing any unaffected node to make a check whether the broken link is being used by it in any of its route. This enhances the performance of the system and also having lots of benefits.

 ➢ Delay of network will reduce.
 ➢ Throughput will increase.
 ➢ Reliability of network will increase as congestion is being reduced.
 ➢ This GAL can be easily updated in case of topological changes.
 ➢ This GAL can also be used as a distributed database.
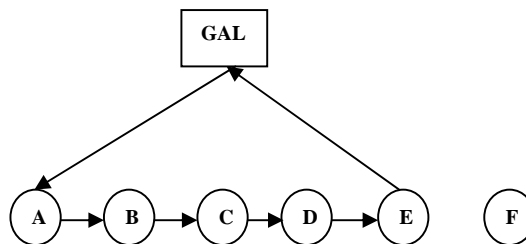 ➢ Source node can take decision of changing routes with the help of GAL

Figure 4. E directly informs the source node A via GAL instead of opting path EDCBA

5. PROPOSED MECHANISM

5.1 Route creation

When a node has a packet to send to some destination and does not currently have a route to that destination in its Route Cache, the node initiates Route Discovery to find a route; this node is known as the initiator of the Route Discovery, and the destination of the packet is known as the Discovery's target. The initiator transmits a ROUTE REQUEST packet as a local broadcast, specifying the target and a unique identifier from the initiator. Each node receiving the ROUTE REQUEST, if it has recently seen this request identifier from the initiator, discards the REQUEST. Otherwise, it appends its own node address to a list in the REQUEST and rebroadcasts the REQUEST. When the ROUTE REQUEST reaches its target node, the target sends a ROUTE REPLY back to the initiator of the REQUEST, including a copy of the accumulated list of addresses from the REQUEST. When the REPLY reaches the initiator of the REQUEST, it caches the new route in its Route Cache.
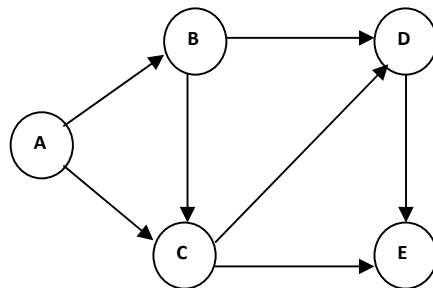

Figure 5

TABLE I   Dynamic Table of Source node "A"

Position	Path	Hop count
1	A-C-E	3
2	A-B-D-E	4
3	A-B-C-E	4
4	A-C-D-E	4
5	A-B-C-D-E	5

Source node A will arrange these paths on basis of hop count, means shortest path 1st & maintains table

The figure 5 shows the wireless network of five nodes, where A is source node and E is destination node.

{A, B, C, D, E} = nodes frame

This finds the following paths.

1. P1 - A-B-D-E
2. P2 - A-C-E
3. P3 - A-B-C-D-E
4. P4 - A-B-C-E
5. P5 - A-C-D-E

5.2 Selection of working path

The sender now sorts the list of routes in ascending order based on the hop count. The shortest path is chosen as the working path and rest of the routes serve as the backup paths and are saved with the sender. The information of the current working path is send to the GAL (all the links). All the links of the current working path are represented in the GAL. Information associated with a link is the status of the link and the address of the sender using the link.

We have assumed three types of links namely (Active link , Congested link , Broken link) in this method.

5.3 Route maintenance

Route Maintenance is the mechanism by which a node sending a packet along a specified route to some destination detects if that route has broken, for example because two nodes in it have moved too far apart. When sending a packet, the originator lists in the header of the packet the complete sequence of nodes through which the packet is to be forwarded. Each node along the route forwards the packet to the next hop indicated in the packet's header, and attempts to confirm that the packet was received by that next node; a node may confirm this by means of a link-layer acknowledgment. If, after a limited number of local retransmissions of the packet, a node in the route is unable to make this confirmation then the events shown in **figure 6** take place.

All the routes from sender to receiver are found &   stored in route cache of source node
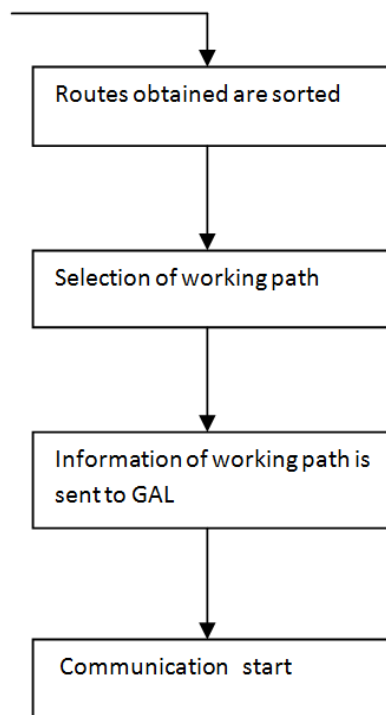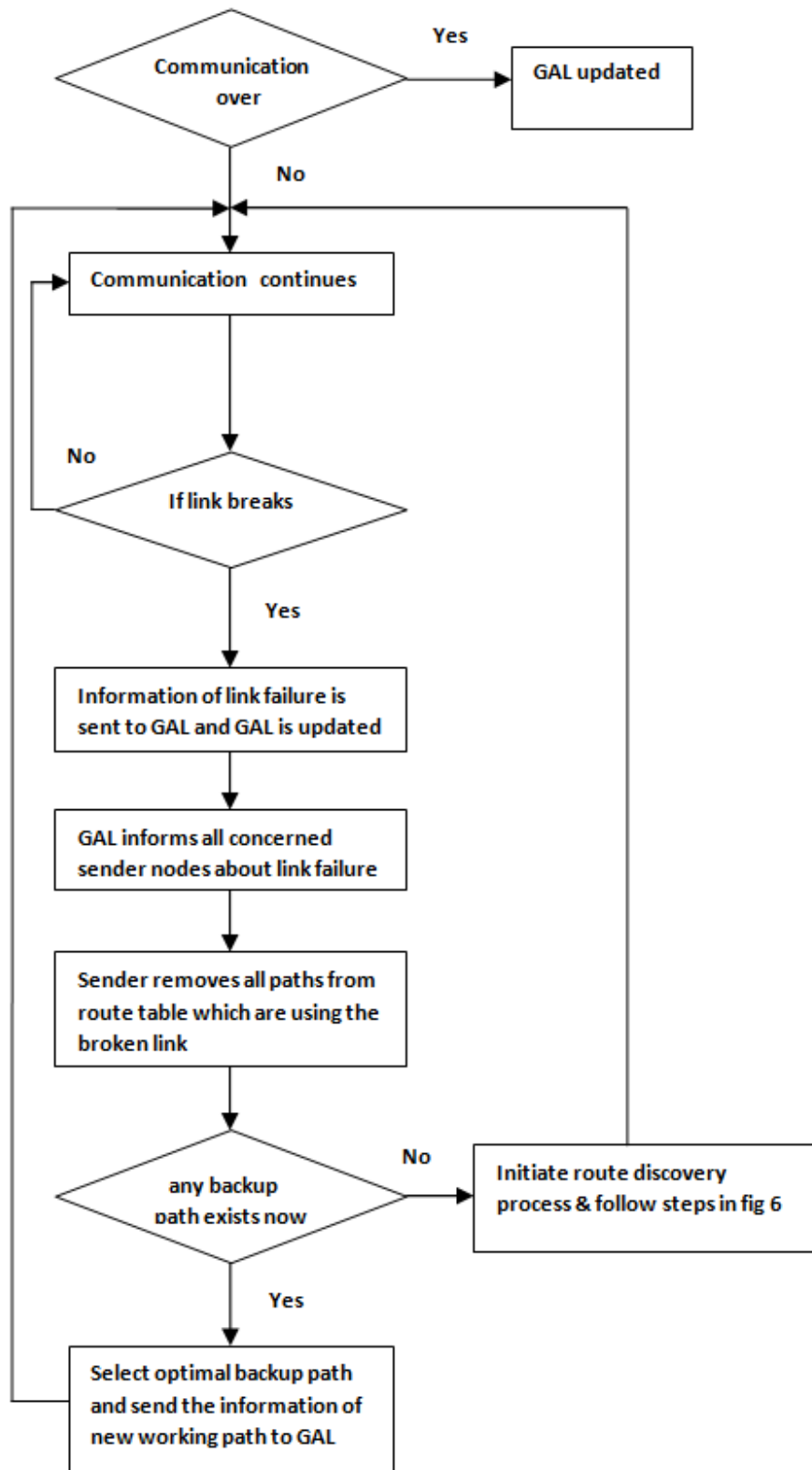

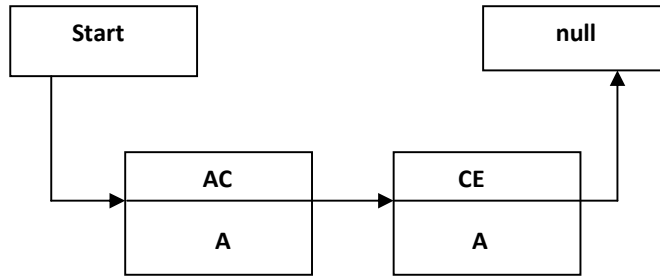Figure 6.

Figure 7. Route Maintenance

Figure 8. Globally accessible list (GAL) when A starts using the route ACE
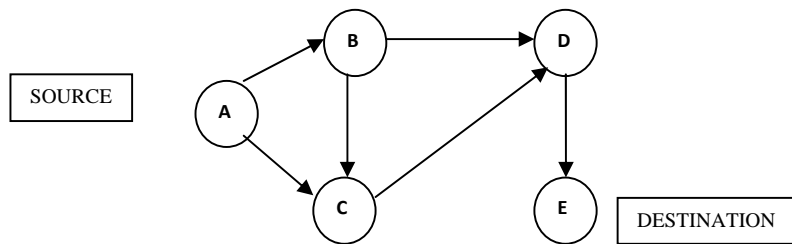

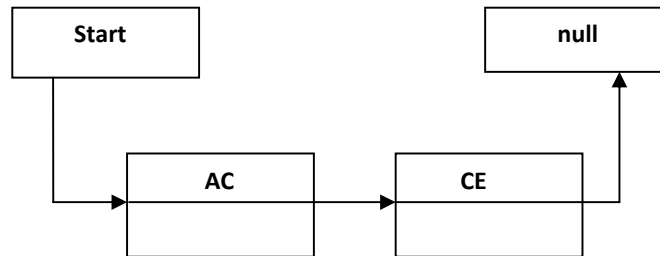Figure 9. (Case 1) link between nodes C and E fails

Figure 10. GAL when link CE fails

Table II. Of source A, when link CE fails

Position	Path	Hop count
1	A-B-D-E	4
2	A-C-D-E	4
3	A-B-C-D-E	5

5.4 At GAL

 (a) Node sends the information of the link break to the GAL.

(b) GAL sends this information to all the concerned senders who are using this link.

(c) GAL also removes the address of the sender from all the links stored in it.

5.5 At sender node

(a) It chooses the next route from the sorted list which does not contain the broken link.

(b) It now sends the information of the new route to the gal which saves the address of the sender along with the links of the route.

Now the communication resumes. After a sender finishes its entire sending process, sends a packet to the GAL informing it of the completion of the sending process. Gal removes the address of the sender from all the links stored. This process helps in dealing with congestion as well. Whenever there is delay in receiving acknowledgement due to congestion, the sender switches the next best path. This process is carried out in the same way in which a node deals with link failure or link break.
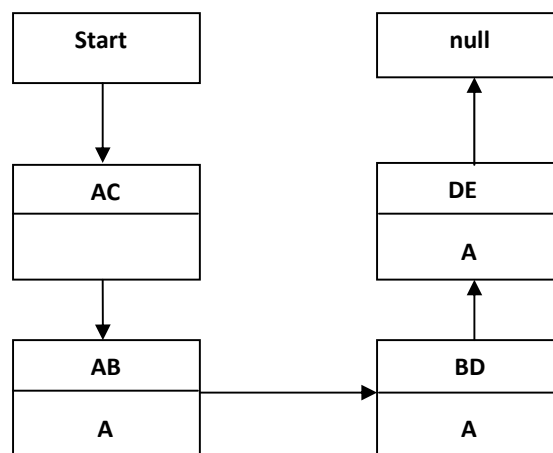

Figure 11. Updated GAL when path ABDE is selected

6. CONCLUSION

The proposed algorithm introduces a concept of GAL (globally accessible node). It is expected to consume resources in efficient manner as compared to DSR, TORA. It is also expected to provide fast communication between source and destination nodes in the case of a link failure. The performance of DSR degrades when the network size increases (greater than 100 nodes). Proposed mechanism will perform better under such circumstances. It also is expected to reduce the unnecessary processing at the communicating nodes and reduce congestion. Thus it increases the efficiency & scalability of network hence provides better QoS to network.

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