A ROUTING ALGORITHM FOR LOCALIZATION OF LINK FAILURE IN MANET

Srinivas Aluvala[1],Deepika Vodnala[2],Nagendar Yamsani[3],Dr. S. Phani Kumar[4]
[1,3]Asst. Professor, SR Engineering College
[2] Research Scholor, GITAM University
[4]Professor and HOD, GITAM University
[1]srinu.aluvala@gmail.com, [2]deepuvodnala8@gmail.com, [3]nagendar.yamsani@gmail.com,
[4]phanikumar.s@gmail.com

***Abstract*—Routing is a critical task in Mobile Ad hoc Networks (MANET's) due to the adaption of dynamic topology. Plenty of routing protocols were proposed and in use. Routing and route maintenance is a challenging task in MANETs due to frequent link failures which causes more data loss and delay. To overcome such problems, many of link repair mechanisms were proposed, still all of these have some limitations. This paper proposes a routing algorithm for route maintenance based on localization of link failure called DSR-LLF. It takes decision based on location of failure link of source route. Our proposed algorithm may achieve better packet preserving, increases the number of delivered packets to destination and performance of DSR.**

***Keywords*—MANET,DSR-LLF, dynamictopology, routing, preserving.**

I. Introduction

MANET is a collection of wireless mobile nodes which comply with the other nodes in moving packets in multi-hops without any control. The nodes mobility is random, therefore MANET has dynamic topology. Due to the approach of dynamic topology, link failures in MANET's occur frequently. These failures cause many problems such as data loss, delay in transmission etc and many other factors, which results in the degradation of capability of the network. Routing in MANET is crucial because of its dynamic topology. Many routing protocols have been proposed and in use for MANET, and these protocols categorized as proactive and reactive routing protocols.

Reactive routing protocols are mostly used because of their low frequency of route discovery in comparison with pro-active routing protocols. DSR is mostly implemented in MANET. DSR protocol comes with, Route Discovery and Route Maintenance mechanisms, which work hand in hand to allow nodes in the network to discover and maintain routes to carry the data packets to the destination. However, the link failures in the network can significantly increases the overhead and decreases the performance of the network, because link failure may result in packet loss, delay and may also need global information of the nodes in the network to discover a new route, when no other route is available in route cache.

Route maintenance is one of the major challenges in MANET. To mitigate the link failure problems, many local link repair mechanisms were proposed. But those mechanisms do not work on the basis of location of link failure in source route and does not make use of relay node location in source route. Our proposed routing algorithm works on link failure location in source route.

II. Discovery And Maintenance Of Route

The key features of DSR routing protocols are laid on the implementation process of source routing. This protocol implements Route Discovery and Route Maintenance, works hand in hand to allow nodes in the network to discover and maintain routes to transmit the packets to the destination.

A. *Discovery of Route*

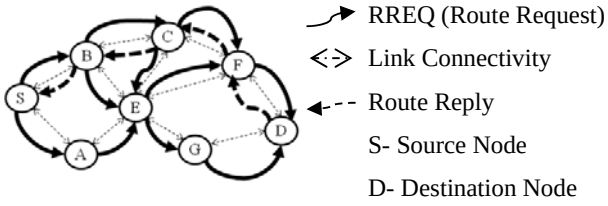

Figure 1. Discovered Route (**S, B, C, F, D**)

The above figure shows the route finding mechanism of DSR. When source node (S) wants to transmit data packets to the destination node (D) initially, it looks its routing cache for a path to the destination, if found then source node forward the packet accordingly to the route found in route cache. Else, source node (S) broadcasts Route Request Packet (RREQ) to all the neighbor nodes which are in the range of its transmission. Each RREQ contains sender address, receiver address, request ID, and route record. In this process if any node receives the packet of route request, it process the request, RREQ processing steps:

- If this (current) route request is found with that node, in the list of very recently seen requests, then the route request is not processed further.
- In case, if a node's address is already present in the route cache of the current node in the request, then the route request packet is discarded and do not process it further.
- Else, if the request matches with the destination node's own address, in this case the route record in the packet knows the route by which the request packet reached this destination node from the source. So a copy of this route is sent in a route reply packet to the source.

Else, add the current node address, in the route request, and again broadcasts the request. So the route request is propagated over the network till it reaches the intended destination node, which then results in replying to the source. In our above example, when a route request packet reaches at the destination (D), it returns a Route Reply Packet (RREP) along with the vise versa of a recorded path to the source (S), which is (S, B, C, F, D).

B. *Maintenance of Route*

When relay node sends the packet and if it is found that it's not reachable to the next node in the source route because of any reason then it propagates a route error message to the source. To preserve packet loss relay node initially checks its route cache for an alternate route to destination, in case if a route is found then it forwards the packet and informs the source about the available new route to destination. When source node receives route error packet, it discards all routes which contains the failure link.

III. Route Repair Mechanisms

DSR_DI in DSR adopts route repair mechanisms based on downstream node's Information. DSR_DI broadly classified into two algorithms such as Local relay node cache search algorithm and local area route discovery. To find the new routes to any downstream node, when a link failure occurs, DSR_DI implements a mechanism called local relay node cache search algorithm to search the alternate route to any downstream node in the network. In other case, it applies local area route discovery algorithm to search a route to any downstream node. The DSR-DI protocol will raise the performance of DSR protocol. In Proximity Approach to Connection Healing (PATCH) if the link between source and destination breaks off, assumed to be always exists from relay node, in most cases, an alternate route to the original next node via neighboring nodes. In these scenario, if a request packet is put to find an alternate node which is at a distance to the original route with limited time-to-live (e.g. 2 hops), at this instance the possibility to put right the existing route should be high and the overhead on the intermediate nodes should be much lower when compared to end-to-end global recovery. In Witness-Aided Routing (WAR) when a link breaks off, it carries out recovery mechanism by broadcasting the data packets with predefined hop limits. WAR renders fast route recovery, but needs more

control on the overhead since data packet is broadcasted as a recovery packet. Associability Based Routing (ABR), a routing technique to select the routes which are likely to be long-lived. In case, if a link breaks off, two scenarios come over. In scenario one if relay node is situated in less than the first half part of the source route, then a route error is sent to the source, so the source will handle route discovery to recover the route. In scenario two relay node will transmits over the network a route request with a hop count equal to the left number of hops that was in the current failured route. In this case destination only will able to response to the route request. If this succeeds, this route is found to be an alternate and no route error will be reported. Or else, a route error will be sent to the node next to the relay node, which in turn repeats the above two scenarios techniques again and again. This process is recursively carried out until the broken route is set right. Implementing of this approach needs more bandwidth and delay is more if in the process of route repair, if failing recursion keeps on going. Relative Distance Micro-discovery Ad Hoc Routing (RDMAR) also employs a similar mechanism of local repair of route as ABR. However, the location of the localized route repair is assumed from the node cache record.

A. Existing DSR Algorithms Limitations

- Forwarding of every packet on the network causes flooding and maximum consumption of bandwidth occurs.
- Number of error messages is more.
- Packet drops/losses are more.
- As network size increases the efficiency decreases.

B. Local Link Recovery Mechanisms

- Local information plays vital role in making decisions.
- Load on all in between nodes is more.
- All the in between nodes from source to destination adopt same processes of recovery irrespective of their location in the source route.

C. Based on Downstream Nodes Information

- If a failed link is distant to destination, their exists always a possibility of overhead on intermediate nodes.
- If the mobility of the nodes is highly then more links failure occurs and may decrease the entire network performance.

IV. Proposed Algorithm

To overcome the above discussed mechanisms limitations, this paper introduces a new algorithm DSR-LLF based on DSR which make up the decisions depending on the location of the Relay Node (i.e. where the link failure is found) in source route.

A. DSR-LLF brief Description

When a failure occurs in the routing, the DSR, DSR-DI and PATCH will not take decision based on the failed link location in source route. Our proposed algorithm DSR-LLF is mainly a route maintenance algorithm, which takes decision depending on the location of failure link in source route. DSR-LLF divide source route into three clusters, i.e. source cluster, destination cluster and intermediate cluster, if possible equal sized regions otherwise it divides the regions with the source and destination clusters equal in size and intermediate cluster larger in size compared to the source and destination. Conditionally the intermediate cluster needs to be equal in size with the source and destination clusters or else larger in size but not in small.

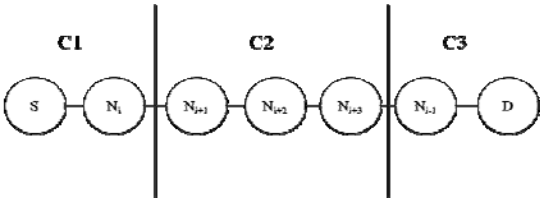

Figure 2. Clustering of Source Route

In the above figure cluster denoted with C: 1 is for the nodes near to the source node called Source cluster, C: 2 is for the intermediate cluster which is in between the source and destination, C: 3 is for the nodes near to the destination called destination cluster. When a relay node forwards packet to the next node in

source route and if it founds link failure then the proposed algorithm DSR-LLF work as follows:

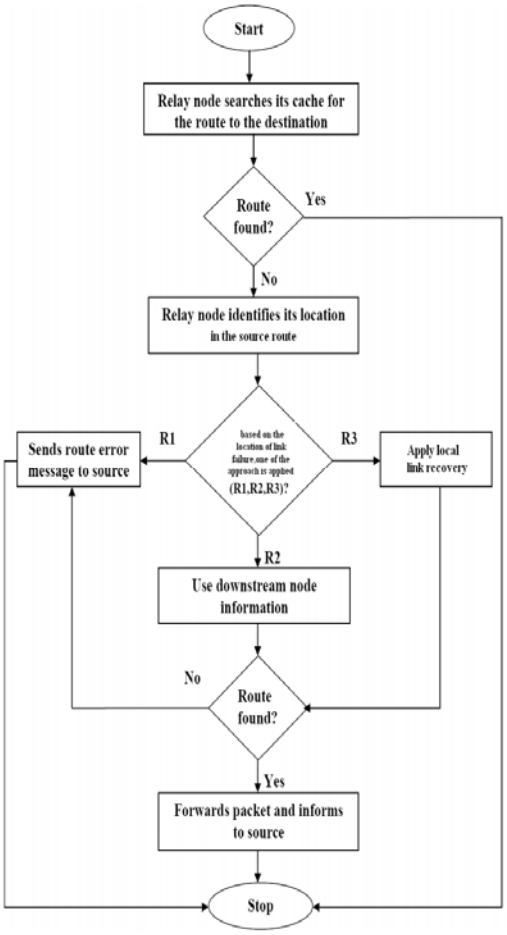

Figure 3. Working process of DSR_LLF

- Firstly, Relay Node looks into its route cache for another route to the destination.
- If it finds the route then forwards the packet to destination using new available route and inform it to the source about the new route.
- Otherwise, Relay Node identifies the location of failure, where the Relay node relates to any one of the cluster.
- If Relay Node belongs to Source Cluster, then Route Error message is send to source. So source make decisions to find the route to the destination.
- If Relay Node belongs to Destination Cluster, then Route Error message is send to destination. Then relay node will make use of downstream information to find new route to destination, if new path is found, relay node forwards the packet and informs to source.
- If Relay Node belongs to intermediate cluster, then recovery of the link can be done locally using one hope or two hope requests. So Local Link Recovery is applied at Relay Node. Relay Node forward the packet and informs to source when link recovery is successful.

V. Algorithm Outcomes

The proposed algorithm DSR-LLF may overcome the limitations of already existing algorithms. It improves the route maintenance mechanism of DSR. Because of divide and solve approach intermediate nodes load will vary and depends on their cluster. Expected results of DSR-LLF are:

- Packet salvaging and delivery ratio is increased.
- Number of error messages are reduced.
- Scalability of network as compared to DSR will improve.

VI. Conclusion

The DSR-LLF algorithm works when a link failure occurs in MANET. It takes decision depending on the location of link failure in the source route. Source route is divided into three clusters, and depending on the cluster of relay node DSR-LLF will apply a right mechanism for route maintenance. Because of unique approaches intermediate nodes load will vary and depends on their cluster. DSR-LLF will be helpful to improve the solutions in discovery of route, route maintenance and the overall performance of DSR.

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