# A Highly Effective and Efficient Route Discovery & Maintenance in DSR

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***ABSTRACT:***

**Mobile Ad Hoc Network (MANET) is collection of multi-hop wireless mobile nodes that communicate with each other without centralized control or established infrastructure. The wireless links in this network are highly error prone and can go down frequently due to mobility of nodes, interference and less infrastructure. Therefore, routing in MANET is a critical task due to highly dynamic environment. Many protocols were given for solving the problem of routing in MANET e.g., DSR, AODV, DSDV etc. This paper presents a protocol which eliminates the problem which occur in the DSR.protocol like the inconsistency occur due to routing information in the route cache of stale node. The proposed protocol also reduces the packet dropped, packet delay time and the message overhead in the network as compared to DSR by utilizing effective path discovery and path maintenance procedure.**

***Keywords:*** **PREQ** (Path Request)**, PREP** (Path Reply), **PUPD (**Path Updation), **PERR** (Path Error), Stale node, Path validation message.

## 1. INTRODUCTION:

Mobile Ad-hoc Network (MANET) is collection of multi-hop wireless mobile nodes which communicates with each other through wireless medium without any centralized control or infrastructure support. Such networks are characterized by Dynamic topologies, Bandwidth constrained, variable capacity links, Energy constraints, and are highly prone to security threads. The wireless link in this network are highly error prone and can go down frequently due to the mobility of nodes, inferences and less infrastructure support, and conventional routing technique for wired network is not applicable to this type of network. Due to this reason routing is more challenging issue in Mobile Ad-hoc Network (MANET). There have been a lot of routing protocols proposed for Mobile Ad-hoc Network. These protocols may generally be categorized as: Proactive (Table-Driven) Routing Protocols and Reactive (On-Demand) Routing Protocols. Proactive (Table-Driven) Routing Protocols Attempt to maintain consistent, up-to-date routing information in each node by propagating updates throughout the network. In such type of protocols, a route to every other node is always available, Incur substantial bandwidth and battery power consumption. Since both bandwidth and battery power are two trades-offs of the Mobile Ad-hoc Network, so this become a serious limitation to Table-Driven routing protocols. Some examples of the Proactive type routing Protocols are DSDV[1], DBF[2], GSR[3], WRP[4], ZRP[5]. On the other hand to overcome this limitation, Reactive (On-Demand) Routing Protocols comes into existence. This type of routing protocols does not maintain routing information at every node, but create routes only when desired by the source node.ie whenever a source has a packet to transmit, it invoke a route discovery mechanism to find the path to the destination. Some examples of On-Demand Routing Protocols are DSR [6][7], AODV[8], TORA[9], SSA[10], LMR[11]. Such networks are very useful in military and other tactical applications such as emergency rescue or exploration missions, where cellular infrastructure is unavailable or unreliable. Commercial applications are also likely where there is a need for ubiquitous communication services without the presence or use of a fixed infrastructure. This paper proposed a protocol which eliminates the problem which occur in the DSR. This proposed protocol employs a very effective and efficient path discovery and path maintenance procedure.

The remainder of this paper is organized as follows. Section 2 presents a general overview on the previous related works and their shortcomings. Section 3 presents a complete description of the proposed protocol. Section 4 present the example which shows the improvement of the proposed protocol over DSR and Section 5 presents the conclusion.

## 2. RELATED WORKS AND THEIR SHORTCOMINGS:

The protocol present in this paper modifies the route maintenance and route discovery procedure in the DSR protocol. The Dynamic Source Routing (DSR) Protocol is a Reactive routing Protocol that uses the concept of Source Routing Algorithm. In Source Routing Algorithm, the sender knows the complete hop-by-hop route to the destination. So in Source Routing Algorithm each data packet contains the complete routing information to reach its destination. In DSR each node also maintains route cache to store recently discovered paths. There are two major phases in DSR namely: The Route Discovery Phase and Route Maintenance Phase.

*ROUTE DISCOVERY:*

In Route Discovery Phase when a source node wants to send a data packet to the destination, it firstly checks its route cache. If required route is available, the source node includes the routing information inside the data packet before sending it. Otherwise, the source node initiates a route discovery process by broadcasting the Route Request (RREQ) packets. The RREQ packet contains address of both the source and the destination and a unique number to identify the request. Receiving a RREQ packet, a node checks it route cache. If the required route is present in the route cache then a Route Reply (RREP) message is send to the source, and if the node doesn`t have routing information for the requested destination, it appends its own address to the route record field of the RREQ packet. Then the requested packet is forwarded to its neighbors. Same process is applicable for other nodes. To limit the communication overhead of RREQ packets, a node processes RREQ packets that has not seen before and its address is not presented in the route record field. If the RREQ packet reaches the destination or an intermediate node has routing information to the destination, a route reply (RREP) packet is generated. When the RREP packet is generated by the destination, it comprises addresses of nodes that have been traversed by the route request packet. Otherwise, the RREP packet comprises the addresses of nodes the route request packet has traversed concatenated with the route in the intermediate node’s route cache.

*ROUTE MAINTENANCE:*

Route Maintenance process is triggered when a link breaks between two nodes along the path from the source to the destination. In this situation node who discover the route break, sends a Route Error (RERR) message backward to source to inform about the broken link. After receiving the RERR packet, the source node initiates another route discovery process. Additionally at the same time routes containing the broken link should be removed from the route caches of the intermediate nodes when the RERR packet is transmitted to the source.

*LIMITATIONS OF DSR:*

1. Scalability, since the source need to add the IDs of all nodes along the path to the destination which increase the overhead in every data packet sent.
2. When a link is broken RouteError packets need to go all the way to the source to inform it about the problem due to this it increase the packet delay time.
3. Intermediate node can use outdated routes stored in their cache.
4. As mobility increases more links are broken which cause a significant decrease in the packet delivery fraction.

## 3. PROPOSED PROTOCOL:

This protocols have two phase of operations path discovery and path maintenance. Whenever a source have to send a data it initiates a path discovery process and when the path is discovered it uses that path to send the data from source to destination. While a hop is using any source path it maintains the continued correct operation of that path. For example, if any of the node along a path moves out of wireless transmission range of the next or previous node along the path, the path can be no longer be used to reach the destination. This monitoring of the correct operation of a path in use we call path maintenance. When path maintenance detects a problem with a path in use, it uses the path maintenance procedure to recover from that problem. Section 3.1 and 3.2 describe the path discovery procedure and path maintenance procedure.

*PATH DISCOVERY:*

For path discovery source node broadcast a path request (PREQ) packet. The PREQ packet contains the source address, destination address and path record, in which is accumulated a record of the sequence of the hops taken by the PREQ packet as it prorogated through the ad hoc network during this path discovery. Each PREQ packet also contains a sequence no. which identifies a particular PREQ.

*ALGORITHM FOR PATH DISCOVERY:*

Suppose source s wants to send data to destination d, then it performs the following steps

1. Source s check its path cache for the destination d,
   now it performs the following operations.
   (a) If the path cache of the node contains the path to the destination, then it prepares a path validation message, starts a timer and send it to the path mentioned in the path cache. If the acknowledgement (ACK) of path validation message arrives before the timer expires, it means the path is valid and the node prepares a path reply (PREP) packet containing the address from source to destination and send it to the initiator.
   (b) Otherwise the node appends its address to the path header in the path request (PREQ) packet and broadcast this PREQ packet.
2. Intermediate node which receives the PREQ
   packet performs the following operations
   (a) If the pair <source address , sequence no.> for this PREQ is found in the node's list of recently seen request, then discard the PREQ packet.
   (b) Otherwise, if this node's address is already listed in the path record in the request, the discard the PREQ packet.
   (c) Otherwise, if the target of the request matches the node's own address then it prepare a path reply(PREP) packet containing the address from the source to destination taken from the path record field in the PREQ packet and send it to the initiator of the PREQ .
   (d) Otherwise, it check its own path cache for the destination d and performs step 1(a) if the path to destination d found and the acknowledgement of path validation message appears before the timer expires.
   (e) Otherwise, performs step 1(b).

*PATH MAINTENANCE:*

In this all the nodes uses hop-to-hop ACK for detecting the failure of a link between the particular nodes and the source also uses the end-to-end ACK for sending the next packets, i.e, source sending the next packet only after receiving the ACK of the previous sent packet. Any node when send the packet to the next node then the sending node maintain the copy of that packet until it ensures that the corresponding link between the two communicating node is not broken. When it ensures that the corresponding link is not broken then the sending node dropped that packet otherwise the sending node send the copy of that packet to its predecessor node and from here the predecessor node initiate the new path discovery.

*ALGORITHM FOR PATH MAINTENANCE:*

Source s send the packet according to path in PREP packet, start the timer and wait for end-to-end ACK.

1. Node i send the packet to the node j, start the timer and wait for hop-to-hop ACK.
2. If ACK arrives before the timer expires it means the link is valid, no path maintenance required.
3. Otherwise, it means the link i-j is broken, now it performs the following operations
   (a) Node i prepares the path error (PERR) message which contains the address of both nodes of the broken link and send it to the initiator.
   (b) All the intermediate nodes and the sender remove this link from their path cache.

(c) After receiving the PERR message the source resets its timer and wait for the path updation (PUPD) message.

(d) At the same time node i send the packet to the predecessor of the node i (suppose k) and k now initiate the path discovery assuming k as the source node and the destination node as d.

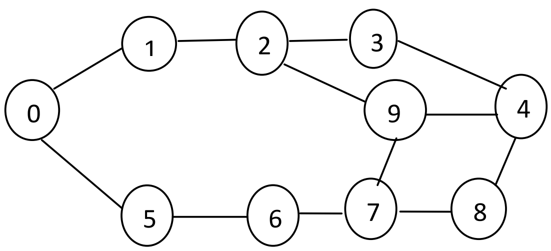
(e) When path is discovered between the predessecor of node i , i.e, k and the destination d, then node k send the packet to d via new discovered path.

(f) K send the PUPD message to the source node s.

(g) All the intermediate node as well as source node s now update their path cache according to value in the PUPD message.

4. If before expiration of the timer PUPD message arrives then the source and all the intermediate nodes update their path cache according to path in the PUPD message, resets the timer and wait for end-to-end ACK of the sent packet.
5. Otherwise, source node initiate a new path discovery.
6. If the ACK arrives before timer expires, then it send the next packet using the updated path.
7. Otherwise, step 5.

## 4. EXAMPLE:




Node 0 wants to send data to node 4. Now it performs the following operations

*PATH DISCOVERY:*

Step 1: node 0 check its path cache, no information about node 4 found.

Step 2: node 0 prepare a PREQ message and broadcast it.

Step 3: node 1 and 5 receives this PREQ, no information about node 4 is found in their path cache.

Step4: node 1 and 5 add their address to the path header in the PREQ and broadcast it.

Step 5: node 2 and 6 receives this PREQ, check their path cache, node 2 find the information about node 4 in its path cache which is 2-3-4.

Step 6: node 2 prepare a path validation message and send it to 4 via 2-3-4, start the timer and wait for ACK.

Step 7: ACK arrives to node 2 before timer expires, it means the path is valid.

Step 8: node 2 prepares a PREP message containing the address 0-1-2-3-4 and send it to 0 via 2-1-0.

Now the path was selected and the node 0 send the packet via 0-1-2-3-4, start the timer and wait for end-to-end ACK.

*PATH MAINTENANCE:*

Step 1: suppose the node 3 send the packet to node 4 and doesn’t get the hop-to-hop ACK, it means the link 3-4 is broken.

Step 2: node 3 prepares a PERR message and send it to node 0 via 3-2-1-0.

Step 3: node 0,1,2 now remove the link 3-4 from their path cache, also node 0 now reset the timer and wait for PUPD message.

Step 4: node 3 now send the packet to its predecessor node 2 and the node 2 now initiate the path discovery for the node 4 by path discovery procedure.

Step 5: suppose the path discovered is 2-9-4, now node 2 prepares a PUPD message containing the new path for the node 4 ,i.e, 0-1-2-9-4 and send it to the node 0.

Step 6: node 2 now send the packet to node 4 via 2-9-4.

Step 6: node 0 and 1 now update their path cache by receiving the PUPD message and node 0 wait for the ACK of the sent packet.

Step 7: after receiving the ACK for the sent packet, node 0 now send the next packet by the updated path.

In this example we see that it eliminates many problem which occur in the DSR. The first is that this protocol uses a path validation message to eliminate the problem of inconsistency which occur due to invalid information in the stale node. Also we see that in the case of link failure it repair the path locally and due to this the packet dropped and packet delay time also reduces in this protocol as compared to the DSR. This protocol also reduces message overhead as compared to DSR as in case of link failure DSR initiate the new route discovery from the source node by flooding the route request packet in the network which is not occur in the case of this protocol as in the case of link failure it repair it locally and so it reduces the message overhead in the network.

## 5. CONCLUSION:

This paper has presented a protocol which improves the performance of DSR by utilizing a highly effective and efficient path discovery and path maintenance procedure. This protocol eliminates the worst problem of inconsistency in DSR which occurs due to the invalid information in the cache of the stale node. The end-to-end delay also reduces in this proposed protocol as in the case of path failure it adapts a local path maintenance procedure. Also in case of path failure the packet is not dropped instead the packet can be send through some other path which was discovered through local path maintenance, due to this packet delivery fraction also increases in our proposed protocol. This protocol also reduces the message overhead which occurs in DSR, where in the case of route failure it has to again initiate the route discovery process by broadcasting the route request packet in the network.

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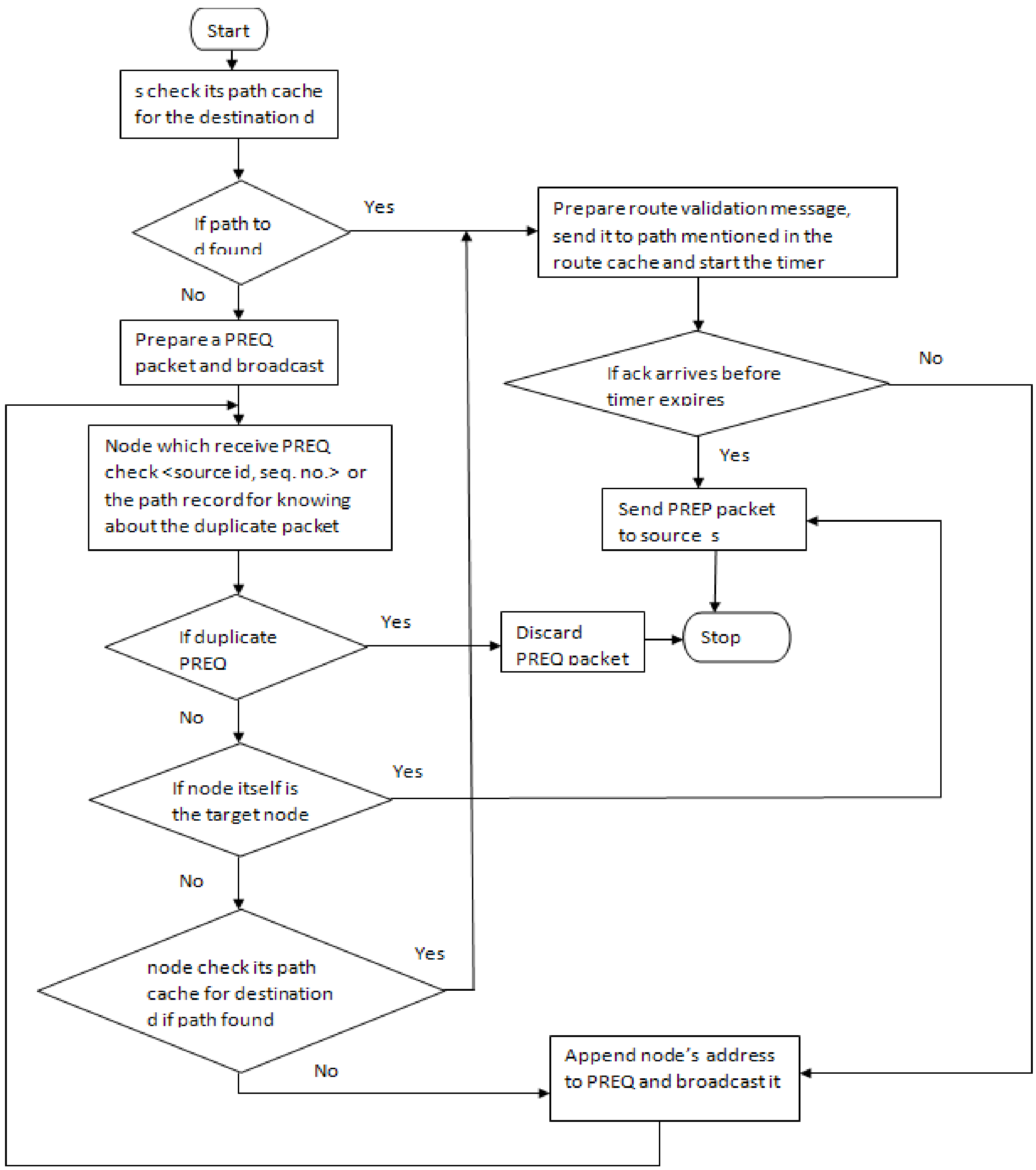
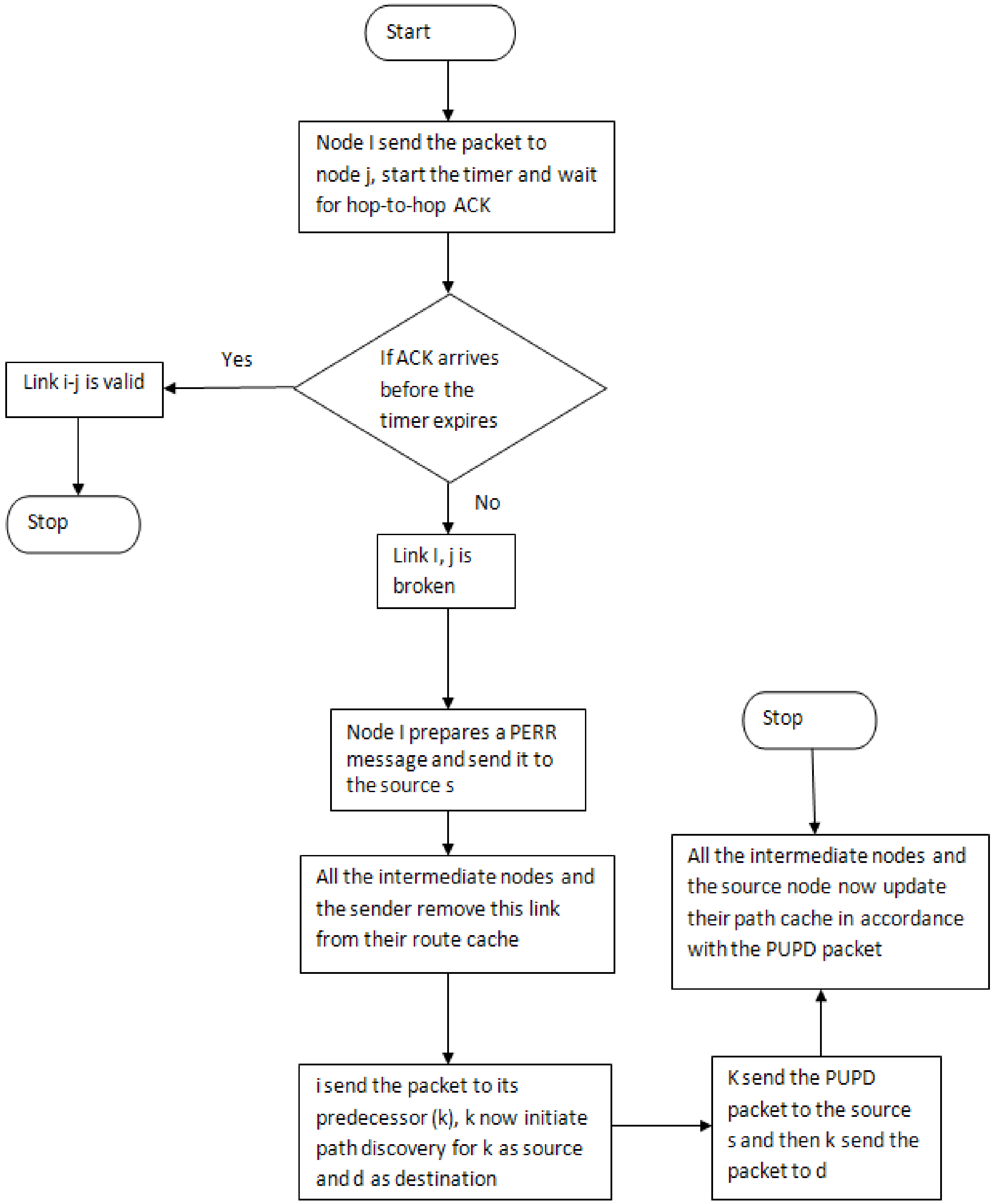
FLOW CHART FOR PATH DISCOVERY IN OUR PROPOSED PROTOCOL:



FLOW CHART FOR PATH MAINTENANCE IN OUR PROPOSED PROTOCOL:

1. PROCESSING AT AN INTERMEDIATE NODE i and j:



2. PROCESSING AT THE SOURCE NODE s: