# Enhancement of Split Multipath Routing Protocol in MANET

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***Abstract:***

In the MANET, routing protocols are used to provide the specific path for sending the data packets. Multipath routing provides the multiple paths in the MANET. So, in this paper we enhance the performance of Split Multipath Routing protocols by using route update mechanism. This proposal is useful in route recovery process. In MANET for sending the data packets through alternate path takes more time in comparison with stale route that was broken. So, here we repair the broken route through route update mechanism process and reduce the delay through new updated path. In our proposal we are considering the high gain antenna terminal that adjust transmission range of each node and follow a new technique for route update mechanism. So, here we provide a heuristic approach to reduce the delay metric and increase the performance of MANET.

***Key Words:*** *MANET, SMR, Route Error message, Route recovery, Antenna gain, Route Update Request, Route Update Reply.*

## I. INTRODUCTION

The new era of communication is wireless communication, where the nodes are connected to each other in two ways. They are: infrastructure based and infrastructure less networks. In infrastructure based networks, there are fixed access points (e.g. Base Station) other hand, in infrastructure less networks no need of fixed stations. The infrastructure less networks is also called Mobile Ad-Hoc Network (MANET).

The MANET is the combination of mobile nodes (MN) and wireless communication links. They are connected to each other without the help of access point (AP) and it is shown in figure1. For efficient communication in MANET, the frequent link establishment is mandatory and it has application in disaster area, battle field etc. It requires the routing protocols to establish the connection and route data packets. For this, two types of signals are used: control signal and data signal and they are categorized according to their properties: Proactive and Reactive routing protocol.

The proactive routing protocol is table driven routing protocol. In this, routing table is updated if any change occurred in the network topology. It is well known, the mobile nodes are dynamic by nature so, proactive routing protocols are not useful over dynamic topology. In this type of network topology, mobile node position changes frequently. So, frequent route update is required. With this phenomenon more routing overheads will incurred.

In proactive routing protocols, each mobile node exchanges its routing table entry with its neighbor MNs. For example, Destination Sequenced Distance Vector (DSDV) [2], Wireless Routing Protocol (WRP) [3], Cluster-Head Gateway Switch Routing (CGSR) [4], Optimized Link State Routing (OLSR) [5], Fisheye State Routing (FSR) [6], and Source-Tree Adaptive Routing (STAR) [7] protocols are proactive routing protocols. The most recent modified version of proactive routing protocols is Secure Destination Sequenced Distance Vector Routing Protocol (SDSDV) [8].

The reactive routing protocol is on-demand routing protocol. In this, when a source wants to send a data packet then it should establish a connection. It uses the route discovery process for connection establishment and route maintenance process for the maintaining the broken links. Some of reactive routing protocols are: Dynamic Source Routing (DSR) [9], Ad Hoc On-Demand Distance Vector (AODV) [10], Flow oriented routing protocol (FORP) [11], Temporary Ordered Routing Algorithm (TORA) [12], Associativity-Based Routing (ABR) [13], Signal Stability-Based Adaptive (SSA) [14], and Location Added Routing (LAR) [15], Multi-Path Source Routing (MSR)[16], Split Multi-Path Routing (SMR)[17].

Split multi-path Routing (SMR) [17] provides the multiple disjoints paths. Thus it is too much efficient and reduces the end to end delay in MANET. Now a day's multi-path routing protocols are used to improve the performance of MANET and it is done by the using of multiple paths from source node to intermediate node.

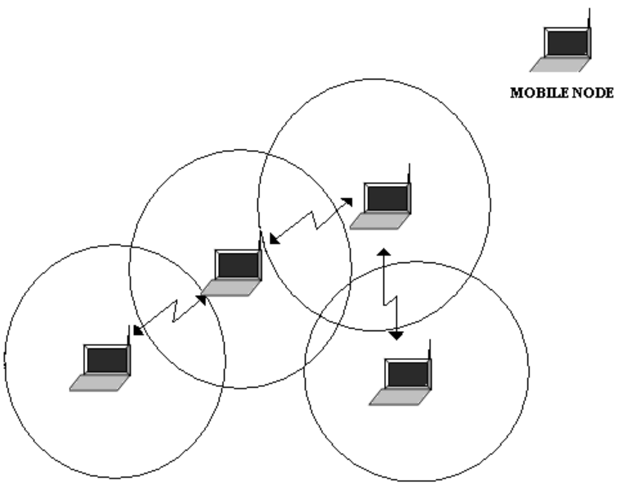


**Fig. 1: Ad Hoc Network System Architecture**

This paper is organized as follow, section I gives the introduction of the Mobile Ad- hoc networks and routing protocols. Section II is helpful to understand the background of related work about the MANET routing protocols. Section III explains the proposed version of SMR protocol. Section IV show the performance of proposed technique and at last section V concludes the paper and followed by references.

## II. RELATED WORK

In SMR, the connection establishment process starts with the flooding of route request (RREQ) packets from source node to the destination node over the entire network as shown in figure 2 (a). After arrival of RREQ packets at the destination node, it starts sending the RREP packets back to the source. Each RREP packets follow the same path of their corresponding RREQ packets. Source node receives all RREP packets and make the entry in its routing table and select the minimum hop count route for data transmission as shown in figure 2 (b) and 2 (c).

During the link break route maintenance process is used to maintain the route. In this process upstream node of broken link send a route error (RERR) message to the source node. The source node receives this message and selects the new alternate path from its routing table as shown in figure 2 (d). If the multiple routes are broken in the network then source node remove all entry from its routing table and reinitiate the route discovery process, and this will cause a large delay.

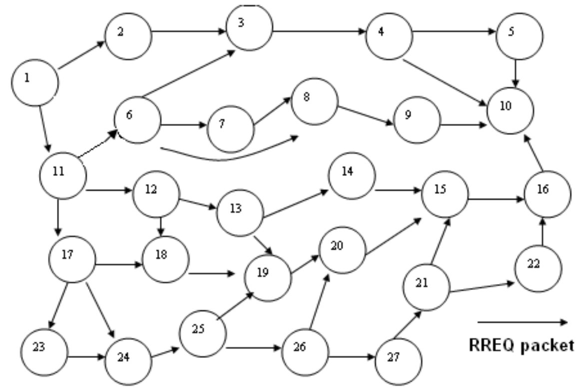


**Figure: 2 (a) Flooding of RREQ Packet from S to D Source node (1), Destination node (10)**

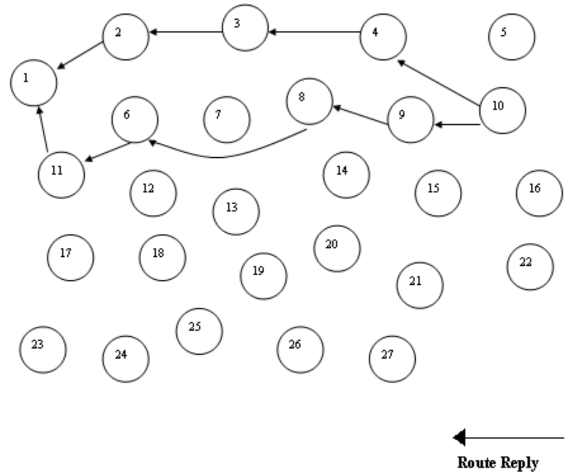


**Figure: 2 (b) RREP packets from D to S**

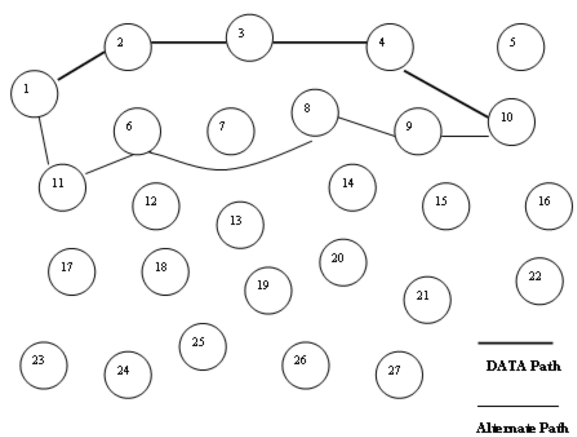


**Figure: 2 (c) Selections of multiple disjoint paths**

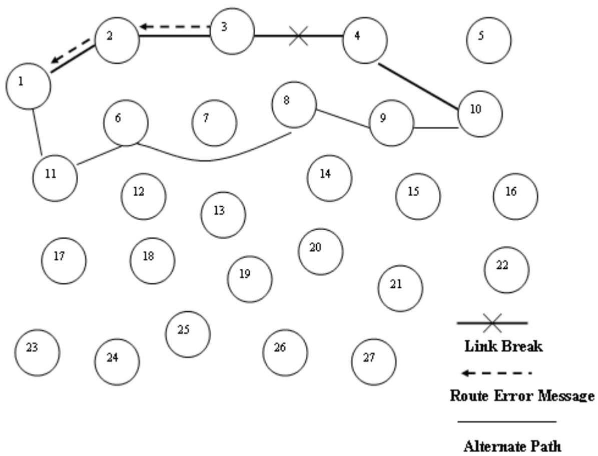


**Figure: 2 (d) Route Maintenance Process in SMR Upstream node (3)**

III. PROPOSED TECHNIQUE

In our proposed technique we tried to moderate the delay metric by using of route recovery process.

**Route Maintenance Process**

In the mobile ad-hoc network link break is the main cause of packet loss and delay of data packets. Due to this, the performance of MANET reduces frequently.

The connection establishment process is same as the SMR protocol [17] and we assume that during link break the upstream MN start to recover the broken route by route update mechanism. The upstream node increase its antenna gain and send a route error message to the source node as shown in figure 3 (a) and (b).
The source node removes the broken route entry from its routing table and selects the alternate route from its routing table for data transmission. During this process, the upstream node set up a route update request/reply to the destination node to recover the broken route. It is shown in figure 3 (b) and (c).

In the route update request/reply cycle process, the upstream node sends the route update request to the destination node. After it, upstream node update the route for source node and it sends a route update message to the source node. Source node update its routing table and send the next data through new updated route as shown in figure 3 (d). Thus, this updated route reduces the delay metric and enhances the performance of SMR routing protocol.

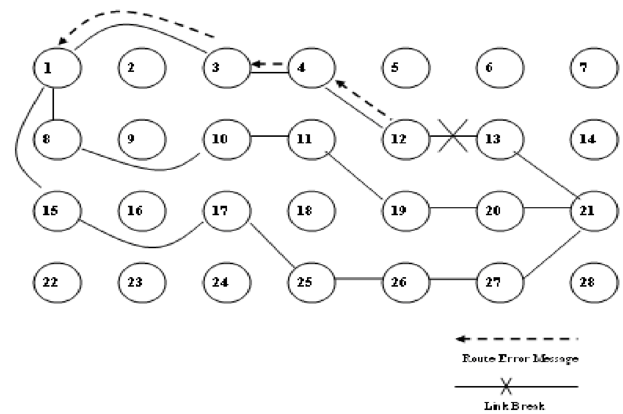


**Figure: 3 (a) Route Maintenance Process**

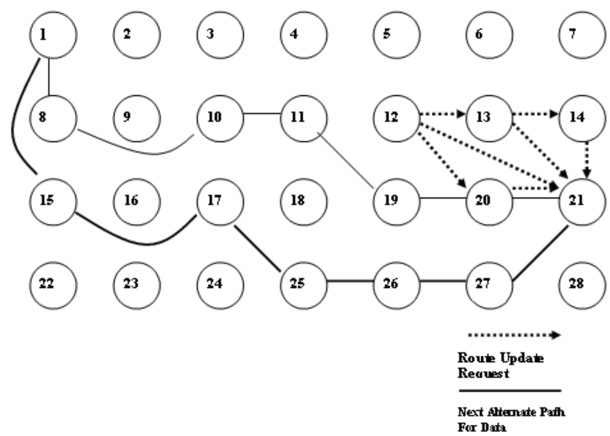


**Figure: 3 (b) Route Recovery Process**

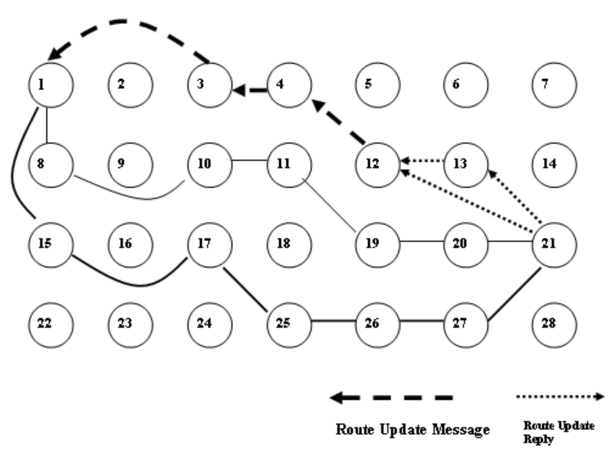


**Figure: 3 (c) Route Recovery Process**

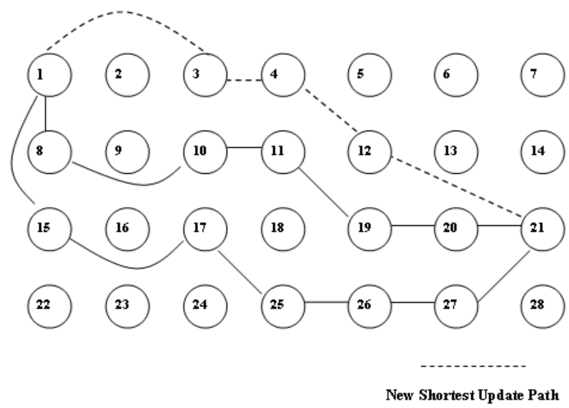


**Figure: 3 (d) Updated route in proposed SMR**

## IV. PERFORMANCE ANALYSIS

To calculate the performance analysis we have to consider some notation, which is shown in the table. It is assumed that all nodes of networks have equal coverage range and upstream node of broken link slightly increase its antenna gain. The efficiency of our proposed system is based on, transmission time, propagation time and processing time. The metric of times is in micro-seconds.

| SR No | Notation | Descriptions |
|---|---|---|
| 1 | $T_{Prop}$ | Propagation speed (Time required to travel one node to another) |
| 2 | $T_{Trans}$ | Transmission Time ( time required to inject a frame to the medium) |
| 3 | $T_{Proc}$ | Processing Time of a Node |
| 4 | N | Total Number of Nodes in the dedicated path. |
| 5 | n | Number of Nodes in the Dedicated path |
| 6 | $n_0$ | Number of Node between broken node and Source. |
| 7 | $i$ | Number of Nodes in Subnet between broken link and destination. |
| 8 | a | $K^{th}$ Number of node where link breaking is occurred. |
| 9 | j | Number of Hops between the broken link and destination |

Table 1: Symbols used for performance analysis

The total time required to transmit a data between two nodes.

$$T = T_{\text{Trans}} + T_{\text{Prop}} + T_{\text{Proc}}$$

Time required delivering a packet to the destination; the packet is passes to the N nodes

$$TD = \sum_{N=2}^{N-1} T$$

$$= \sum_{N=2}^{N-1} \left( T_{\text{Trans}} + T_{\text{Prop}} + T_{\text{Proc}} \right)$$

Time required to flooding for a single node.

$$TF = \left( T_{\text{Trans}} + T_{\text{Prop}} + T_{\text{Proc}} \right)$$

There are N nodes in the whole network the flooding will done to the all of the nodes thus the total time to flood in whole networks is

$$TF_N = \sum_{N=1}^{N-1} \left( T_{\text{Trans}} + T_{\text{Prop}} + T_{\text{Proc}} \right)$$

The Destination will reply with the reply message and for single reply total time is

$$\sum_{n=1}^{n-1} \left( T_{\text{Trans}} + T_{\text{Prop}} + T_{\text{Proc}} \right)$$

Then total time for flooding and rout reply

$$\sum_{N=1}^{N-1} \left( T_{\text{Trans}} + T_{\text{Prop}} + T_{\text{Proc}} \right) + \sum_{n=1}^{n-1} \left( T_{\text{Trans}} + T_{\text{Prop}} + T_{\text{Proc}} \right)$$

Let the Destination will established P links then total time to establishment of multiple paths the time to establish these links are:

$$\sum_{N=1}^{N-1} \left( T_{\text{Trans}} + T_{\text{Prop}} + T_{\text{Proc}} \right) + P \sum_{n=1}^{n-1} \left( T_{\text{Trans}} + T_{\text{Prop}} + T_{\text{Proc}} \right)$$

$$P = \frac{N(N-1)}{2}$$

When a link break will occur at the upstream node will sends an error message.
Thus, time required for error message is,

$$\sum_{n=1}^{(n-n_0)-1} \left( T_{\text{Trans}} + T_{\text{Prop}} + T_{\text{Proc}} \right)$$

Total delay in SMR after link break to deliver the next packet is the sum of the time to flooding the RREQ packet + connection establishment time + Error Message time + Time to transmit a data through alternate path.

$$TF_N = \sum_{N=1}^{N-1}\left(T_{\text{Trans}} + T_{\text{Prop}} + T_{\text{Proc}}\right) + \sum_{n=1}^{n-1}\left(T_{\text{Trans}} + T_{\text{Prop}}\right.$$

$$+ \sum_{n=1}^{(n-n_0)-1}\left(T_{\text{Trans}} + T_{\text{Prop}} + T_{\text{Proc}}\right) + \sum_{P=1}^{P}\left(T_{\text{Trans}} + T_{\text{Prop}} +\right.$$

$$TF_N = \sum_{N=1}^{N-1}\sum_{n=1}^{n-1}\sum_{n=1}^{(n-n_0)-1}\sum_{P=1}^{P}\left(T_{\text{Trans}} + T_{\text{Prop}} + T_{\text{Proc}}\right)$$

In the Proposed SMR protocol time required is:
Time of Flooding + Connection establishment time + flooding time in broken links (Broken Node to Destination) {connection establishment time from broken link to destination node} + Connection establishment time of flooding links {route updating time from broken node to source node} + Data transmission time through broken links.

Thus total time with the proposed SMR protocols is $TF_{NP}$ :

$$TF_{NP} = \sum_{N=1}^{N-1}\left(T_{\text{Trans}} + T_{\text{Prop}} + T_{\text{Proc}}\right) + \sum_{n=1}^{n-1}\left(T_{\text{Trans}} + T_{\text{Prop}} + T_{\text{Proc}}\right)$$

$$+ \sum_{n=1}^{(n-n_0)-1} \left(T_{\text{Trans}} + T_{\text{Prop}} + T_{\text{Proc}}\right) + \sum_{a=1}^{a-1}\left(T_{\text{Trans}} + T_{\text{Prop}} + T_{\text{Proc}}\right)$$

$$+ \sum_{j=1}^{j-1}\left(T_{\text{Trans}} + T_{\text{Prop}} + T_{\text{Proc}}\right)$$

$$TF_{NP} = \sum_{N=1}^{N-1}\sum_{n=1}^{n-1}\sum_{n=1}^{(n-n_0)-1}\sum_{a=1}^{a-1}\sum_{j=1}^{j-1}\left(T_{\text{Trans}} + T_{\text{Prop}} + T_{\text{Proc}}\right)$$

For the numerical analysis: we takes, $T_{Proc}$ = 0.001, $T_{Trans}$ =0.002, $T_{Prop} = 0.005$, N = 50, n =7, $n_0 = 5$, $i = 6, a = 1, j = 1$ . The all times are in the microseconds.

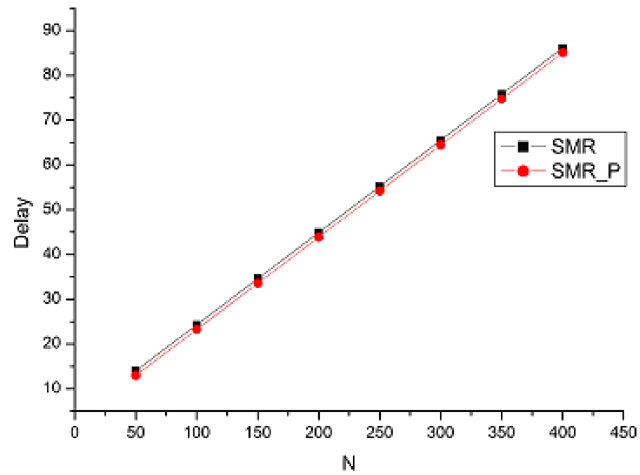


**Figure 4 (a) Delay Vs Number of Nodes**

The figure 4 (a) shows the delay on existing vs. proposed SMR where N is varying from 50- 450.

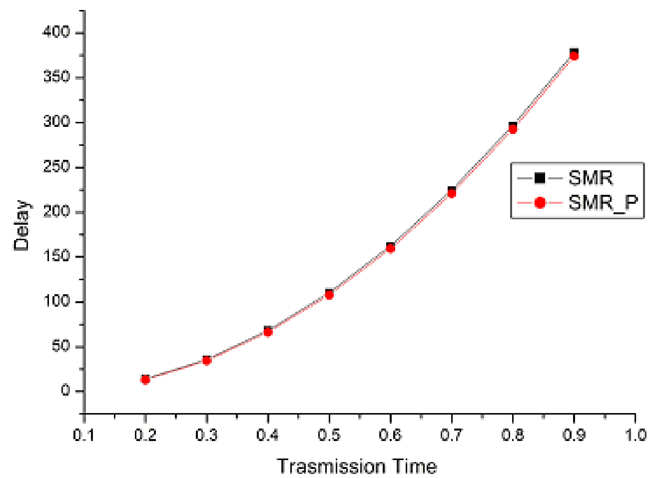


**Figure 4 (b) Delay Vs Transmission Time**

The figure 4 (b) shows the delay on existing vs proposed SMR where transmission time is varying from 0.2 to 0.9

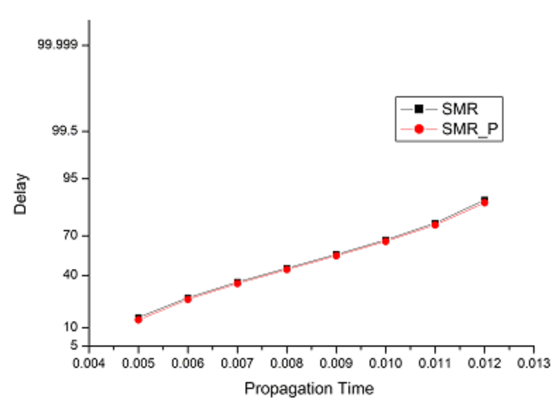


**Figure 4 (c) Delay Vs Propagation Time**

The figure 4 (c) shows the delay on existing vs. proposed SMR where propagation time is varying from 0.004 to 0.012.

## V. CONCLUSION AND FUTURE WORK

In our proposed SMR with reduce the delay metric by route recovery process that's improve the performance of proposed SMR. Performance analysis also shows the result of proposed SMR. There have many routing protocol are developed for improving the Quality of Service of routing protocol. Recently in MANET proactive routing protocol QOLSR also improve the performance this is used to reduce the delay metric and improve the throughput of QOLSR [18]. For improving the performance intelligent caching is also developed for on-demand routing protocols [19]. In MANET Quality of Service support is improved, in terms of bandwidth and end to end delay that is in Ad hoc QoS on-demand routing (AQOR) [20]. In AODV an efficient technique is developed that is used to determine the best reliable and prolong life time of MANET [21]. Some routing protocols are developed for enhancing the performance of routing protocols by the using of stable zone and caution concept [22]. In this paper we enhance the performance of SMR routing protocol. In future we try to improve the throughput of proposed SMR. In proposed technique we use the route recovery processes that utilize the antenna gain and route update mechanism, which was taken during the link break in SMR for MANET. In this paper we use the Route Update Request (RUREQ) and Route Update Reply (RUREP) for route update mechanism at the broken link node. So we reduce the delay metric and recover the broken link.

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