IJCSE International Journal of Computer Sciences and Engineering Open Access
Research Paper Vol. 9, Issue.3, March 2021 E-ISSN: 2347-2693

An Improved DSR Routing Algorithm to Reduce Delay and Energy Consumption in Mobile Ad Hoc Networks

P. Revathi[1*], K. Gokul Raj[2]

[1,2]Dept. of Computer Science, Government Arts College, Kulithali, Tamilnadu, India

[*]*Corresponding Author: revathimphil19@gmail.com*

DOI: https://doi.org/10.26438/ijcse/v9i3.16 | Available online at: www.ijcseonline.org

Received: 25/Feb/2021, Accepted: 10/Mar/2021, Published: 31/Mar/2021

***Abstract*—** Mobile Ad hoc Network (MANET) is a self-configuring, dynamic, multi-hop and infrastructure less wireless network. Each node in MANET is free to move arbitrarily in any direction. A node can move randomly and may join or leave in network at any time. Each node acts as host and intermediate nodes act as routers by using multi-hop schemes. The adhoc protocols are divided into proactive, hybrid and reactive protocols. In this paper, the Dynamic Source Routing (DSR) protocol is studied. This study focuses on how to reduce the delay while transferring the data using optimized DSR routing protocol. This mechanism is used to reduce the packet loss and time delay and to reduce energy consumption in MANET. This optimizing mechanism helps to choose the best and the shortest path to transfer the data. This mechanism controls routing overhead in MANET.

***Keywords*—**MANET, QoS, AODV, DSR, Routing, Optimized

I. INTRODUCTION

The Mobile Ad hoc network is a collection of wireless mobile hosts forming a temporary network without the aid of any established infrastructure or centralized administration. An autonomous system of mobile routers (and associated hosts) is connected by wireless links and the union of which forms an arbitrary graph [1]. Thus, the network's wireless topology may change rapidly and unpredictably. Such a network may operate in a standalone fashion, or may be connected to the larger Internet. The advantage of MANET is low cost, easy to use, and no centralization approach [2-5]. But it has some limitations to provide Quality of Service (QoS) to the user. QoS contains many parameters. Therefore, QoS may vary from one application to another application. Applications like file transfer and authentication services require high reliability. Some applications like audio and video will require low reliability and high speed. The primary goal of the MANET routing protocol is correct and efficient route establishment to facilitate communication within the network and between arbitrary nodes.

Important Characteristics of MANET

- In MANET, each node acts as both host and router. Therefore, node can also be called router.
- It is a multi-hop wireless network. A base station or centralized firewall is absent here. The nodes can join or leave the network at any time, making the network topology dynamic in nature.
- Mobile nodes are characterized by low memory and power and they require a fewer resources. MANET has limitations in speed, reliability, efficiency, stability and capacity of wireless links when compared with wired network [6-8].

Figure 1.1 depicts the layout of an example MANET setup which establishes connectivity between the source and destination nodes.

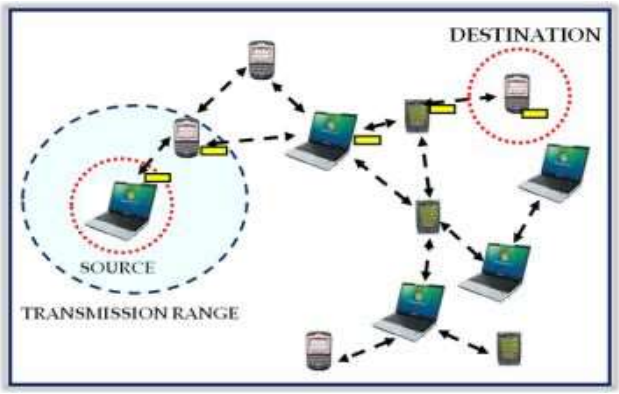

Fig. 1.1 A MANET Layout

1.2 Ad-Hoc Routing Protocols

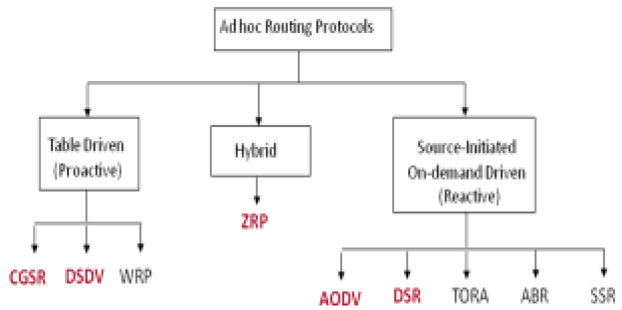

Fig. 1.2 Ad Hoc Routing Protocols

Figure 1.2 shows the three divisions of Ad-Hoc routing protocols as proactive, reactive and hybrid. In this paper the reactive Adhoc routing protocols are considered.

1.2.1 Reactive Protocol-Ad hoc On-Demand Distance Vector (AODV)

The Ad hoc On-Demand Distance Vector (AODV) is an embedded MANET protocol that works dynamically to establish and maintain routes, adapting quickly to changing link conditions. The Ad hoc On-Demand Distance Vector (AODV) algorithm enables dynamic, self-starting, multihop routing between participating mobile nodes wishing to establish and maintain an ad hoc network. AODV allows mobile nodes to obtain routes quickly for new destinations, and does not require nodes to maintain routes to destinations that are not in active communication [9]. AODV allows mobile nodes to respond to link breakages and changes in network topology in a timely manner. One distinguishing feature of AODV is its use of a destination sequence number for each route entry. Using destination sequence numbers ensures loop freedom and is simple to program. Given the choice between two routes to a destination, a requesting node is needed to select the one with the greatest sequence number [10].

Route Requests (RREQs), Route Replies (RREPs), and Route Errors (RERRs) are the message types defined by AODV. These message types are received via UDP, and normal IP header processing applies [11]. AODV uses sequence numbers to avoid routing loops and to measure the "freshness" of route information. Prior to broadcasting RREQ, RREP, and RERR packets, AODV must increase its sequence number. Each route maintains a sequence number, with higher sequence numbers indicating "fresher" routes. When multiple routes are available to a destination node, the route with the greatest sequence number is used. Packets with lower sequence numbers are ignored and dropped.

AODV uses more, but smaller routing control packets and critical concerning wireless medium properties (e.g. interference). This becomes worse for a higher load, as neighbors have to be rediscovered (congestion causes link failures).

1.3 Reactive Routing Protocol-Dynamic Source Routing (DSR)

The acronym for DSR is Dynamic Source Routing.

The DSR is a simple but efficient on-demand source routing protocol designed for multi hop wireless ad-hoc networks [12]. Two major phases: route discovery and route maintenance.

- Route discovery = used to discover new source routes across multiple network hops to arbitrary destinations in an ad-hoc network.
- Route maintenance = responsible for detecting network topology changes and keeping up-to-date information of already discovered source routes.

Route discovery and route maintenance rely on source route caches and they can contain several routes to the same destination node. Designed to work up to 200 nodes. Supports both unidirectional and bidirectional links [13]. The following figures 1.3 and 1.4 shows the Route Request and Route Reply in DSR.

1.3.1 Route Discovery in DSR

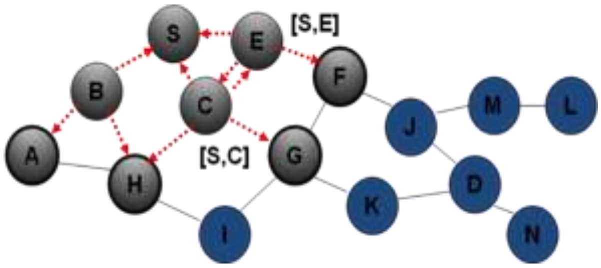

Fig. 1.3 Source Node S Spread the Route Request (RREQ) to its Neighbour Nodes Using DSR Protocol

1.3.2 Route Reply in DSR

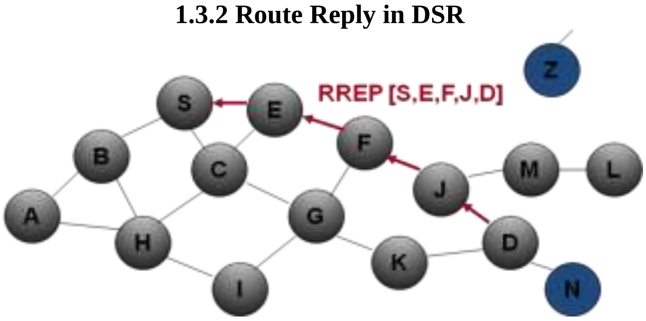

Fig. 1.4 Destination Sends Route Response (RREP) to Source Node S Using DSR Protocol

Advantages of DSR Routing Protocol

Routes maintained only between nodes who need to communicate. Reduces overhead of route maintenance. Route caching can further reduce route discovery overhead. A single route discovery may yield many routes to the destination, due to intermediate nodes replying from local caches [14].

Limitations of DSR Routing Protocol

Flood of route requests may potentially reach all nodes in the network. Potential collisions between route requests propagated by neighbouring nodes. There is increased contention if too many route replies come back due to nodes replying by using their local cache. In bigger networks, the source-routing principle can also become a problem [15].

1.4 Problem Statement

The main challenge of MANET is to provide Quality of Service (QoS). Delay is an important parameter in QoS. Varieties of protocols are available to reduce the time delay when transferring the heterogeneous data from one node to another node. This paper discusses some of the familiar routing protocol's performances and also some of the limitations of the existing routing protocols. This study focuses on how to reduce the delay while transferring the data using optimize the DSR routing protocol. This mechanism is used to reduce the packet loss and time delay and to reduce energy consumption in MANET. This optimizing mechanism helps to choose the best and the shortest path to transfer the data. This mechanism controls routing overhead in MANET.

Objectives of Study

- Calculate the speed of the path using existing transmission.
- Find the shortest path. Set the priority to all available paths using calculate speed of the path.
- Select the first priority path to transfer the data between nodes.
- Finally check the selected path's status whether path is idles or busy using calculating the bandwidth value.

This mechanism compares each path with the other and selects the best and the fastest path to transfer the data through network. The data can be transferred fast without data loss or any virus or hackers attack. The ultimate aim of this paper is to enhance QoS of the MANET. This proposed method chooses the best quality and the fastest path to transfer the data in MANET. Therefore this mechanism decreases the delay and increase performance of the network.

The paper contains of five sections. Section I explains the background of the MANET; the objectives of the proposed work, problem statement, and organization of the paper are presented. Section II presents review of literature discussing delay in MANET.Section III provides the detailed information of the proposed optimize the DSR routing protocol and its performance. Section IV presents the design flow of delay calculation for improved DSR protocol and the results are discussed. Section V presents the conclusion regarding research contribution and idea of the future work.

II. RELATED WORK

The aim of a routing algorithm is to find the best and the shortest route between the source and destination in the network. This paper discusses some of the familiar routing protocol's performances and also some of the limitation of the existing routing protocols. The related work discusses the previous works of the various authors and their findings.

YuvrajKumbharey, et al.,[1] have discussed how to reduce the traffic during route discovery by clustering nodes into groups. The advantage of this paper is to reduce the routing overhead and to improve the route discovery by RCBRP algorithm that is integrating the inter-cluster on-demand and intra-cluster label driven routing.

Iftikhar Ahmad, et al.,[2] have described AODV routing protocol to provide guarantee for real time traffic in MANET. It improves the route discovery mechanism for AODV routing protocol and the transmission ratio for real time data. Therefore, the transmission delay will be low and throughput will be high. But, it has some limitations because if the number of nodes is high, then the calculation value of the transmission ratio 'R' will be difficult.

Mamoun Hussein Mamoun, et al.,[3] have presented an effective route selection technique in DSR routing protocol for MANET. The goal of the paper is to minimize the cached Route Request (RREQ) for the Dynamic Source Routing (DSR) protocol. Best routing paths are selected to rebroadcast of Route Request packets. The research concentrates on link strength, node energy and number of hops. The limitation is that the mechanism will be difficult if more number of nodes is imperfect.

P.Calduwel Newton, et al.,[4] have presented " A Quality of Service Performance Evaluation Strategy for Delay Class in General Packet Radio Service". It evaluates the performance of data transfer with respect to delay. These techniques are used to understand and analyze the problem, and are also used for identifying the misbehaving nodes to be corrected. The limitations are that the outcomes of the analyses are theoretical, and they cannot be implemented.

Rajkumar G, et al.,[5] have explained how to reduce the time delay in MANET by using Improved Fault Tolerant Multipath Routing (IFTMR). It works effectively only when multiple intermediate nodes fail but it is not suitable for a small number of failures.

In AODV, source node broadcast the Route Request (RREQ) to its neighbours to find a route. RREQ broadcasts only when needed. It is an On-demand routing protocol [16]. In DSR protocol, each node maintains a route cache itself for quick route discovery and route maintenance [17]. When source node wants to send a data to the destination, it initially searches in the route cache to determine if it already contains a path to the destination. Therefore, the time to find the destination node will be reduced. If a path is not in route cache then the source node broadcasts the RREQ to the neighbouring nodes and then finds the destination node so that the path will be stored in the route cache of source node [18-20].

III. PROPOSED WORK

Before choosing the path, the speed of it is calculated instead of identifying the shortest path, because more transactions are done by using the shortest path. Therefore, more chances to data will be loss or theft or delay to transfer. For this reason high speed path is chosen. Suppose any traffic occurs in a particular path that path's speed will decrease. So that path will be avoided easily.

Set Priority- This technique gives the priority to the all the paths between the source node and destination node based on the path's speed. High speed path gets high priority. If any new path occurs then we compare with the shortest path and give the priority.

Check Path's Status - Suppose the high priority path is now transferring another data then it has more chances where traffic will occur. For this reason this technique checks so that high priority path should have sufficient bandwidth to transfer the data right now. If that path has sufficient bandwidth then transfers the data through that path. Otherwise, it will check the second priority path. This process is continuous till finds the path which has sufficient bandwidth to transfer the data.

Path Selection - The best and quality path can be chosen through this technique. After completing the transmission, calculate the speed of the path and maintain it in the node's table. Therefore, this optimizes DSR techniques that reduce 50% of the delay more than normal DSR protocol. The data can transfer much faster than the others. Speed of the path is calculated by using the following formula:

Speed= Number of Transferred packets /Total time (secs)

3.1 Flow Chart for improved routing algorithm

The optimizing DSR routing protocol working is as follows:

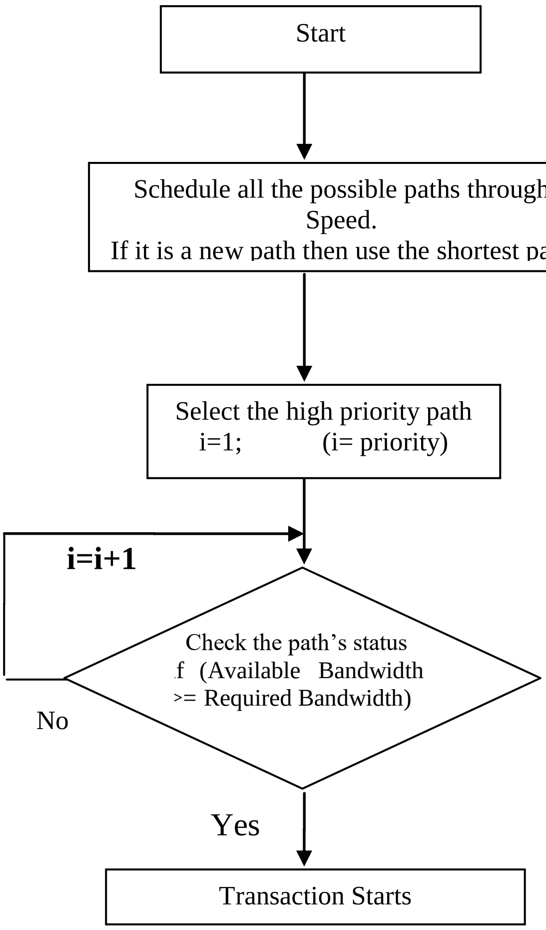

Fig. 3.1 Flow Chart for Improved Routing Algorithm

3.2 An Improved Routing DSR Algorithm

Step 1: Source node spreads the route request (RREQ) to its neighbour nodes.

Step 2: After finding the destination, list out the available path between source and destination.

Step 3: Compare each path speed through existing transaction.

Speed= Number of Transferred bits / Total time (sec)

Step 4: If a new path occurs, compare the distance to the destination.

Step 5: Give the high priority to high speed path.

Step 6: Before initiating transaction, the high priority path check its status, that is if that path has sufficient bandwidth to transfer data then transaction will start, otherwise the algorithm checks the status of second high priority path.

Step 7: After selecting the path the transaction will initiate.

```
if (Available Bandwidth >= Required Bandwidth
        (1))
    {   Select the path (1)
    }
else if (Available Bandwidth >= Required
        Bandwidth (2)
    {
    Select the path (2)
    }
    .
    .
else if (Available Bandwidth >= Required
        Bandwidth (n)
    {
    Select the path (n)
    }
```

IV. RESULTS AND DISCUSSIONS

In this section, the performance scenarios of the proposed scheme are explained by evaluating the proposed Improved DSR performance through a MANET scenario. Comparisons are also brought out among the path selection and also ranking algorithms. This section explains a MANET scenario for data transfer from one node to another node through Improved DSR. Section 4.2 presents available paths between source node and destination node. The consecutive sections concentrate on find paths speed and path's status. The following sections discussed about the comparison with existing protocol. Finally, the performance of proposed algorithm is evaluated using Java.

4.1 A MANET Scenario

Here, if S and H are considered source nodes, these nodes transfer three files to the same destination as shown in Figure 4.1.User S sends two files to destination Z and the size of is 1000 bits. User H also sends a file to destination Z, that file size is also 1000 bits in small time difference.

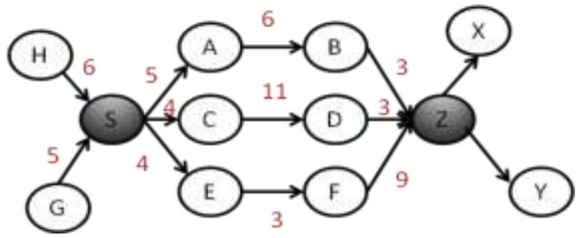

Fig. 4.1 A MANET Scenario

4.2 Find Available Paths and Its Speed

The following table 4.1 shows the available routes between S and Z.

Table 4.1 Available Routes between S and Z

Route No.	Route	Speed	Transaction time(100 bps)	Sort
1	S→A→B →Z	Nil	14	1
2	S→C→D →Z	Nil	18	3
3	S→E→F →Z	Nil	16	2

All paths' speed is Nil therefore select the shortest path. Select path 1 to transfer the data from H to Z and check that status that path have sufficient bandwidth. Now that path has sufficient bandwidth so choose that path.

Table 4.2 Available Routes between H and Z

Route No.	Route	Speed (bits/sec)	Transaction time(100 bps)	Sort
1	H→S→A→ B→Z	7.14	20	1
2	H→S→C→ D→Z	4.16	24	3
3	H→S→E→ F→Z	6.25	22	2

Table 4.3After Completing Transaction

Route No.	Route	Speed	Transaction time(100 bps)	Sort
1	H→S→A→B→Z	Nil	20	1
2	H→S→C→D→Z	Nil	24	3
3	H→S→E→F→Z	Nil	22	2

File 1 transfer to the destination. It will take 140 sec. File 2 wants to transfer the data to the destination Z. It choose path 3 therefore path 1 is not idle. Therefore File 2 transmission time is 160 sec. User H also sends a file to destination Z, that file size is also 1000 bits in small time difference. The table 4.2 shows the available routes between H and Z.

Select path 1 to transfer the data from H to Z. But that path S→A→B→Z is already transferring user S's files to the destination. Therefore the user H selects the path 3.Therefore H's transaction time is 240 sec.

4.3 Check Path's Status

```
if (Available Bandwidth >= Required Bandwidth (1))
{       Select the path (H→S→A→B→Z)
}
else if (Available Bandwidth >= Required Bandwidth (2)
{
Select the path (H→S→E→F→Z)
}
else if (Available Bandwidth >= Required Bandwidth (n)
{
Select the path (H→S→C→D→Z)
}
```

4.4 Routing Table (After Completing Transaction)

Table 4.3 and 4.4 shows the transaction time and the comparison between existing and proposed protocols. Figure 4.2 depicts the delay parameter comparison between the existing and the proposed protocols. From the table and figure, it is proved that the proposed protocol reduces the time delay into a significant level and thus the QoS is improved to a greater extent compared to the existing protocol.

4.5 Compare with Existing Protocol

Table 4.4 Compare Improved Protocol with Existing Protocol

Files	Existing Protocol	Improved Protocol
File 1	140 secs	120 secs
File 2	240 secs	160 secs
File3	400 secs	240 secs

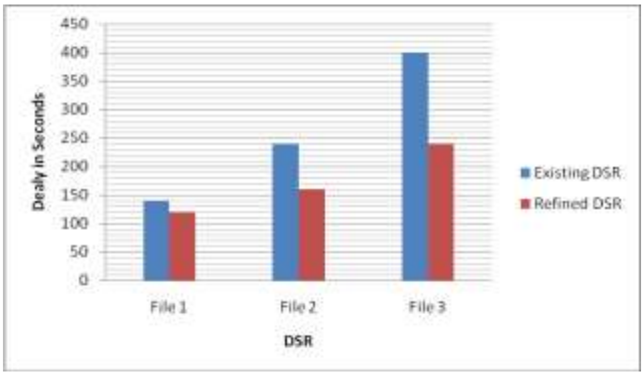

Fig 4.2 Comparing Improved DSR with Existing DSR

V. CONCLUSION

This paper presents how to optimize the DSR routing protocol in order to reduce the delay in MANET. This technique gives the priority to all the paths between the source node and destination node based on the path's speed. High speed path gets high priority. The best and quality path is chosen through this technique. After completing the transmission, the speed of the path is calculated. Therefore this optimizing technique reduces delay in time, packet loss and control routing overhead effectively. Salient Features of the proposed work is to improve the QoS because delay is one of the main attribute of QoS. This proposed work helps to choose the best path for transaction. This optimizes DSR techniques that reduce 40% of the delay more than normal DSR protocol. The data can transfer much faster than the others. No data loss or packet drop. This application can be used for military and rescue operations, Information distribution for meetings, seminars Internet/ intranet hot spots in public transportation and so on. This proposed algorithm takes some energy to calculate speed and check paths status. Future work of this work is to reduce the packet delay and reduces the energy consumption as much as possible.

REFERENCES

[1] YuvrajKumbharey, SuweshShukla and SushilChaturvedi, "Renovated Cluster Based Routing Protocol for MANET", *International Journal of Advanced Computer Reasearch,* **Vol.3, No.1, pp.206-210, March 2013.**

[2] Iftikhar Ahmad, HumairaJabeen and Faisal Riaz, "Improved Quality of Service Protocol for Real Time Traffic in MANET", *International Journal of Computer Networks & Communications,* **Vol.5, No.4, pp. 75-85, July 2013.**

[3] Mamoun Hussein Mamoun, "A Proposed Route Selection Technique in DSR Routing Protocol for MANET", *International Journal of Engineering & Technology,* **Vol.11, No.2, pp. 10-13. April 2011.**

[4] P.Calduwel Newton and L.Arockiam, "A Quality of Service Performance Evaluation Strategy for Delay Classes in General Packet Radio Service", *International Journal of Advanced Science and Technology,* **Vol.50, pp. 91-98, January 2013.**

[5] Rajkumar G and Duraiswamy K, "Time Delay Reduction in MANETs using Improved Fault Tolerant Routing Protocol", *CARE Journal of Applied Research,* **pp. 22-24, *2012.***

[6] Yuchen Fu and Quan Liu, "Research of QoS Routing Algorithm in Ad Hoc Networks based on Reinforcement Learning", *Elektronikairelektrotechnika,* **Vol.19, No.2, pp. 83-87, 2013.**

[7] Kumar Prateek, "MANET- Evaluation of DSDV, AODV and DSR Routing Protocol", *International Journal of Innovations in Engineering and Technology,* **Vol.2, pp. 99-104, February 2013.**

[8] Yang Zhang, et al., "Social-Aware Data Diffusion in Delay Tolerant MANETs", *Network Science CTA.* **pp. 1-24.**

[9] P. Chandra Sekhar, "Impact of Routing Overhead in A Real-Time MANET Environment", *Int.J.Computer Technology & Applications,* **Vol.4 (2), pp. 257-263. April 2013.**

[10] A.Boomarani Malany, et al., "A Neighbor Coverage Based Probabilistic Rebroadcast For Reducing Routing Overhead In Mobile Ad Hoc Networks", *Int. J. Open Problems Compt. Math.,* **Vol. 2, No. 3, pp. 461-468, September 2009.**

[11] V.Deeban Chakravarthy, et al., "Dynamic Hello/Timeout Timer Adjustment in Routing Protocols for Reducing Overhead in Manets", *International Journal of Emerging Technology and Advanced Engineering,* **Vol.3, pp. 302-308, January 2013.**

[12] Shoji Kasahara, et al., "Impact of Routing Overhead in A Real-Time MANET Environment", *Preprint submitted to Computer Communications,* **pp. 1-26, June 2009.**

[13] A. Pratapa Reddy, "Multipath Routing Protocol for Reducing Congestion And Delay in MANET", *International Journal of Computer Applications (0975 – 8887),* **Vol.74-No.18, pp. 1-8, July 2013.**

[14] Masaya Ito, Hiroki Nishiyama, and Nei Kato, "A Novel Routing Method for Improving Message Delivery Delay in Hybrid DTN-MANET Networks,"*IEEE Global Communications Conference (GLOBECOM),* **2013.**

[15] Shitalkumar Jain, et al., "A Study of Congestion Aware Adaptive Routing Protocols in MANET", *Computer Engineering and Intelligent Systems,* **Vol.3, No.4, pp. 64-73. 2012.**

[16] S.Santhosh Baboo, "A Hop-by-Hop Congestion-Aware Routing Protocol for Heterogeneous Mobile Ad-hoc Networks", *International Journal of Computer Science and Information Security,* **Vol. 3, No. 1, pp. 64-73. 2009.**

[17] Mehajabeen Fatima, et al., "Route Repair through Route Discovery in MANET", *International Journal of Future Generation Communication and Networking,* **Vol. 6, No. 6, pp. 169-180, 2013.**

[18] Ashish Kumar, "Energy Efficient Routing Protocol Avoiding Route Breaks based on DSR", *International Journal of Computer Applications (0975 – 8887),* **Vol.44, No.4, pp. 39-44, April 2012.**

[19] R. Senthil Kumar, "Minimizing The Route Rediscovery Process In Manet", *Journal of Theoretical and Applied Information Technology,* **Vol. 61, No. 3, pp. 496-505, March 2014.**

[20] Narinderjeet Kaur, et al., "Caching Strategies in MANET Routing Protocols", International Journal of Scientific and Research Publications, **Vol. 2, No. 9, pp. 1-6. September 2012.**