Analysis of Routing Algorithm in MANETs based on SRRA

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***Abstract*— Due to limited transmission range and limited battery constraints of mobile nodes in Mobile Ad Hoc Network (MANET), routing in MANET becomes challenging especially when certain QoS requirements such as high data packet delivery ratio, low end to end delay and low routing overhead are to be satisfied. Even though a number of routing protocols have been proposed aiming to provide better network life time but none of them provide all these requirements at the same time. In this research article, we propose Stipulated Region Based Routing algorithm (SRRA) which reduces overhead, end to end delay and eliminate redundant nodes that participated during route discovery process. The proposed SRR routing algorithm provides high packet delivery ratio and throughput when compare to AODV routing algorithm. The proposed SRR algorithm is simulated in NS 2.35 and the results show that our SRR algorithm performs better than AODV routing algorithm.**

***Keywords*— SRR, AODV, MANET, Routing**

I. INTRODUCTION

Mobile ad hoc Network (MANET) [1] is a kind of ad hoc network which has many desirable features and has limited bandwidth, limited transmission range and with high mobility [2]. Mobile ad hoc network is a self organizing network which runs on battery without predefined infrastructure. Each device in a MANET is free to move independently in any direction and will therefore change its links to other device frequently. If two mobile nodes are in each other's radio range, they can send packet or a message and transmit packet directly. If two mobile nodes or not in each other's radio range, intermediate nodes can transfer the packets to intended destination. Since Nodes are highly dynamic and can move at any time in random direction, topology of MANET changes dynamically. Therefore, keeping the accurate topology to maintain efficiently is very important. When source needs to communicate in Manet, broadcasting scheme is frequently used for route discovery. Adopting a broadcasting scheme, a mobile node can collect information and gain the topology in MANET. Since mobile node has limited transmission range, a intermediate node may receive new broadcasting packet for establishing a new route between source and destination. MANET may then fill with redundant broadcasting packets as shown is Fig. 1. Therefore, a node competes for radio channels, thus collision of a packet become serious and consumes battery of mobile node.

One of the main challenges in MANETs is how to route data packets across the network while its topology is changing unpredictably due to the movements of mobile nodes. In order to obtain optimal path and shortest path between source and destination, numerous different routing protocols presently proposed for mobile ad hoc networks. Few examples of reactive, proactive and hybrid routing algorithms are Ad-hoc on demand distance vector (AODV) [3], Ad-hoc on demand multipath distance vector (AOMDV) [4], Dynamic source routing (DSR) [5], Associativity-based routing (ABR) [6], Spatial AODV (S-AODV) routing algorithm for mobile ad hoc network [7], Destination sequenced distanced vector (DSDV) [8], Optimized link state routing protocol (OLSR) [9], Wireless routing protocol (WRP) [10], Clustered Gateway Switch Routing (CGSR) [11], Spatial DSDV (S-DSDV) routing algorithm for mobile ad hoc network [12], Ad-hoc routing protocol for aeronautical mobile (ARPAM) [13] and Zone routing protocol (ZRP) [14].

The remaining part of this research article is organized as follows. Section 2 describes the literature survey. Section 3 presents the proposed work. Section 4 presents the Simulation results. Finally conclusion and acknowledgement of report is described at the end of the report.

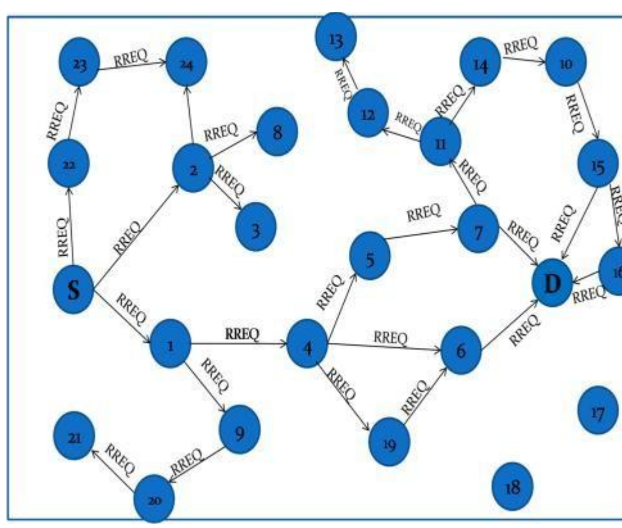

Fig . 1. RREQ Propagation Method in Mobile ad hoc network

II. RELATED WORK

Yun-Sheng Yen a, Hung-Chieh Chang et.al (2009) [15] proposed routing protocol called the RAPLF technique, which is an optimization of the classical on-demand routing protocol that is tailored to the requirements of an ad hoc network. In the RAPLF, selected mobile hosts forward the broadcast messages during the flooding process. RAPLF shows better performance which reduces the message overhead as compared to the classical flooding mechanism especially in terms of higher packet delivery rate and lower flooding overhead.

Trisha Biswas, Rudra Dutta (2011) [16] presented a novel routing technique called as Petal Routing, which increased reliability by reducing redundant transmissions of packet. The author has merged the concept of multipath routing and geographical routing to design petal routing. Petal Routing takes advantage of the broadcast nature of wireless networks to reduce the number of transmissions for multiple paths by overlapping the multiple diverse paths.

Gurpreet Singh, Neeraj Kumar, Anil Kumar Verma (2012) [17] addressed the application of Ant Colony Optimization (ACO) algorithms to solve the routing problem in MANETs and various categories of ant colony algorithms like proactive (table driven), reactive (on-demand) and hybrid (the combination of two) approaches. Since It is a challenging task to find most efficient routing due to the changing topology and the dynamic behaviour of the nodes in MANET, Author stated that an Ant Colony Optimization (ACO) algorithms can give better results as they are having characterization of Swarm Intelligence (SI) which is highly suitable for finding the adaptive routing for such type of volatile network

Manjunath M, Manjaiah D.H (2014) [12] proposed Spatial Destination Sequenced Distance Vector (S-DSDV) routing algorithm for mobile ad hoc networks. The S-DSDV is a routing algorithm is an improved version of destination sequence distance vector (DSDV). The S-DSDV optimize the nodes participate in route discovery process and composed of 3 phases i.e. identification of activity area, identification of representative node and route discovery process. The S-DSDV reduces the overhead, end to end delay and increases network life time by sending and receiving more number of packet across the network and provides the better throughput when compare to DSDV routing protocol.

Haidar safar et.al (2014) [18] proposed routing algorithm called PHAODV: power aware heterogeneous routing for mobile ad hoc network. The author says, since devices in mobile ad hoc networks (MANETs) runs on battery, the devices have limited power resources and different transmission technologies. The routing during such different characteristics makes inconvenient in a heterogeneous environment. PHAODV consider battery status of each node when building the routing table. During route discovery if there exists multiple route between two nodes, PHAODV algorithm chooses a route with least consumed route for data transmission. The author has implemented PHAODV in JiST/SWANS network simulator and compare the performance of routing algorithm with AODV, HAODV, energy aware OLSR, OTRP and with OTRPHA.

The author Ali Moussaoui, Abdallah, Boukeream (2014) [19] presented the survey of routing protocols based on link-stability in mobile ad hoc networks. The author says, The QoS (Quality of Service) routing is one of the recent most challenges for mobile ad hoc networks and addressed various QoS parameters for efficient routing protocols such as the mobility of nodes belonging the path overhead, and the residual energy of nodes constituting the path.

III. STIPULATED REGION BASED ROUTING (SRR) ALGORITHM

In this section we present a novel routing algorithm called Stipulated Region Based Routing (SRR) algorithm, consists of two phases of routing in mobile ad hoc network: Route discovery and Route maintenance.

A. Route Discovery Phase.

The first phase of SRR algorithm called as route discovery process. The route discovery process is initiated whenever a source needs to communicate with destination node for which it has no information about routes in its routing table. Consider the Fig. 2 the source $S(x_s, y_s)$, destination $D(x_d, y_d)$ and the intermediate nodes $Ni(x_{Ni}, y_{Ni})$ where i = 1, 2, 3, …n. The source node initiates route discovery process by broadcasting route request (RREQ) packet in the network.

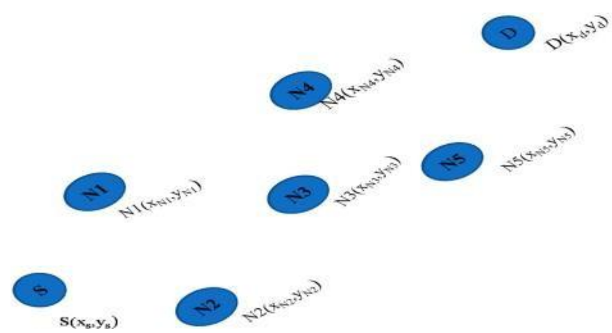

Fig. 2. Network Diagram

During broadcasting the RREQ packet in the network, the source computes the distance (D) to destination by using equation (1) as shown in Fig. 3. The intermediate nodes which receive the RREQ packet, computes the distance (d) from the line in equation 1.

$$D = \sqrt{(x_d - x_s)^2 + (y_d - y_s)^2} \tag{1}$$

$$d = \frac{|a(y_s - y_n) - b(x_s - x_n)|}{c} \tag{2}$$

where $a = x_d - x_s$, $b = y_d - y_s$, $c = \sqrt{a^2 + b^2}$

Having obtaining the distance (d) of each node from the line in equation 1, the node with least distance value from the line

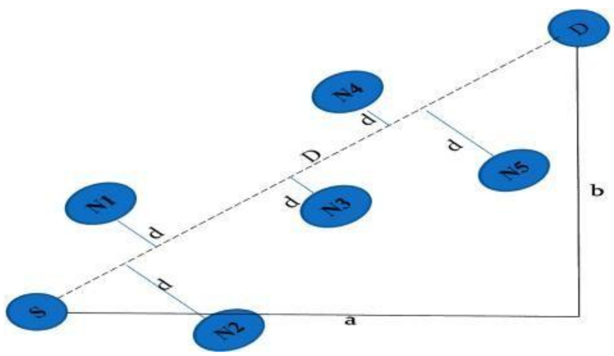

Fig.3. Distance Calculation

between S—D will accept route request packet, update the routing table, increments the hop count value by 1, update the destination address and forward the route request packet to its next nearing neighboring nodes. The process of broadcasting route request propagation continues until it reaches destination. Upon the reception of route request packet from

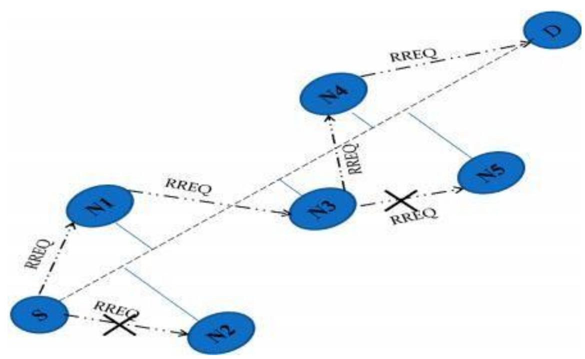

Fig. 4. SRR RREQ Propagation

source node, the destination node generates and replies with special packet called route reply packet (RREP).

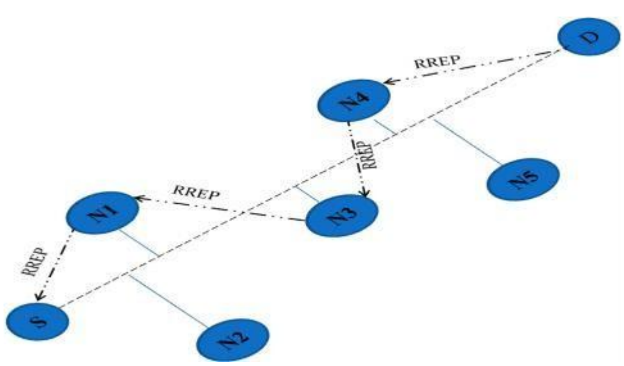

Fig. 5. SRR RREP Propagation

The route reply packet propagates back to source node through the intermediate nodes as updated in routing table. From the Fig. 3, source node S has two adjacencies node i.e node (N1) and node (N2), as the node receive the RREQ packet from the source , the intermediate node computes the distance (d) from the S—D line. The node with least distance (d) value will accept the route RREQ packet and broadcast to its next neighboring nodes. In this example the node (N1) has least value, so it accepts the RREQ packet and rebroadcast the RREQ to its neighboring nodes. The Fig. 4 and Fig. 5 illustrate the SRR RREQ and RREP packet propagation mechanism respectively. As source receive route request packet from the destination, the source starts transmitting packet to destination i.e. (S) – (N1) – (N3) - (N4) – (D) respectively.

B. Route Maintenance.

The next phase of SRR routing algorithm is called the route maintenance, which is responsible for improvement of routes during the communication. If the source node moves during an active data communication, SRR reinitiate route discovery procedure to establish a new route to the destination. When either destination node or some intermediate node moves or when broken link is detected, source node can restart the route discovery process if it still requires a route to the destination.

IV. SIMULATION RESULTS AND ANALYSIS

We simulated the routing algorithm in ad hoc wireless networks by using Network Simulator [20], version 2.35. We evaluate our algorithm in number of simulation scenarios and compare the performance of our algorithm with a well know protocol for mobile ad hoc network called Ad hoc on-demand Distance Vector (AODV). Simulation experimental setup consist of 15, 20, 25, 30, 40 & 50 wireless nodes, placed randomly in a 1000 x 1000 flat space. The simulation is carried for 160 seconds. In the mobility model, we apply the random waypoint model. The node transmission range is 250 meters.

Table – 1: Routing Protocols Values1

Packets Sent by Source							
Routing Protocol	10 Nodes	15 Nodes	20 Nodes	25 Nodes	30 Nodes	40 Nodes	50 Node
AODV	8340	5236	4534	4010	5124	4908	4540
SRR	13267	5244	5258	4476	5422	4993	4785

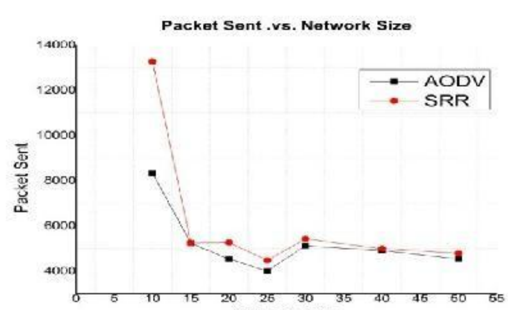

Fig . 6. Network size with packet sent

The simulation evaluation comprised of six metrics:
Packet Generated: represents the total number of packets generated by the source node.
Packet Received: represents the total number of packets received by the destination node.
Packet Delivery Fraction (PDF): represents the ratio of packet received by destination to those generated by the source.
End to End Delay: represents the average difference between the receiving and the sending time of each received packets.
Throughput: represents the total number of of packet delivered per unit time. it is measured in kbps.
Overhead: it measures the amount of control traffic in relation to the total amount of traffic that has been sent.

Table – 2: Routing Protocols Values 2

Packet Received by Destination							
Routing Protocol	10 Nodes	15 Nodes	20 Nodes	25 Nodes	30 Nodes	40 Nodes	50 Node
AODV	8321	4804	4169	3572	4484	4426	4066
SRR	13247	4798	4801	3990	4816	4513	4289

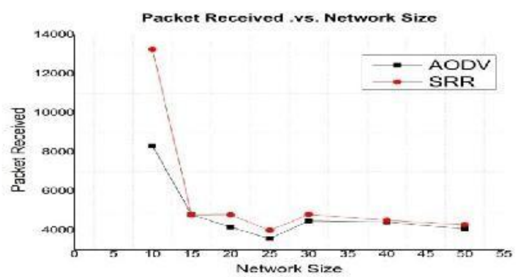

Fig. 7. Network size with packet received

Table – 3: Routing Protocol Values 3

Packet delivery Fraction (PDF)							
Routing Protocol	10 Nodes	15 Nodes	20 Nodes	25 Nodes	30 Nodes	40 Nodes	50 Node
AODV	99.77	91.75	91.95	89.07	87.51	90.18	89.56
SRR	99.85	91.5	91.3	89.14	88.82	90.39	89.63

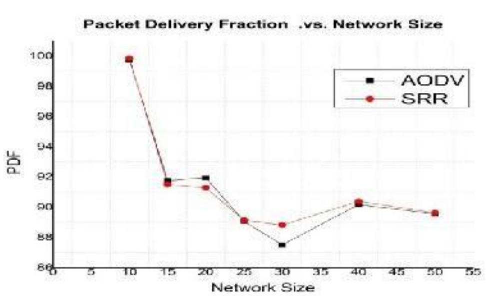

Fig. 8. Network size with PDF

The Fig. 6 illustrates the comparison of number of packets generated and sent across the network. The number of packet generated by AODV and proposed routing algorithm is tabulated in Table – 1. The proposed SRR routing algorithm generates an average of 18.40 % more number of packet than AODV.

Table – 4: Routing Protocols Value 4

End to End Delay (in ms)							
Routing Protocol	10 Nodes	15 Nodes	20 Nodes	25 Nodes	30 Nodes	40 Nodes	50 Node
AODV	369.52	171.8	160.76	164.47	153.72	148.58	150.0
SRR	247.34	164.03	157.96	165.75	147.52	153.88	158.5

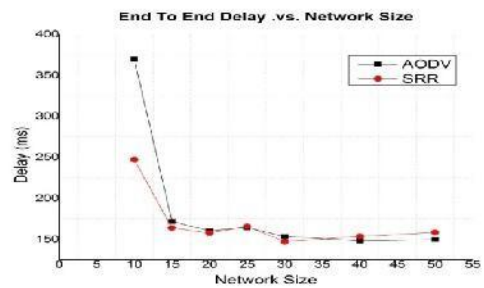

Fig. 9. Network Size with End to End Delay

The Fig. 7 illustrates the comparison of number of packets received by the destination. The number of packet received by AODV and proposed SRR routing algorithm is tabulated in Table – 2. The proposed SRR routing algorithm receives with an average of 19.53 % more number of packets than AODV.
The Fig. 8 illustrates the comparison of performance of two routing algorithms in terms of packet delivery fraction (PDF). The proposed SRR performance is good with higher PDF than AODV and results are tabulated in Table – 3. The proposed SRR routing algorithm shows better performance by increasing the average PDF to 0.131 % than AODV.
From the Fig. 9 shows the end to end delay experienced by SRR in comparison with AODV protocol. The end to end delay for SRR decreases with an average of 9.40% when compare to AODV routing protocol. The values have tabulated and depicted in Table - 4.
The graph in Fig. 10 shows the performance of two routing algorithms in terms of throughput. As the throughput in case of AODV is little low. From the graph of Fig. 10, the average throughput of SRR is 17.01 % more than AODV. The values have tabulated and depicted in Table – 5.
The Fig. 11 illustrates the comparison of performance in term of overhead. The proposed SRR reduces overhead by eliminating redundant node that participates in route discovery during route discovery process. From the graph of Fig. 11, the average overhead is 13.30 % less than AODV routing algorithm. The values of two routing algorithm is tabulated and depicted in Table – 6.

Table – 5: Routing Protocols Values 5

Throughput (in kbps)							
Routing Protocol	10 Nodes	15 Nodes	20 Nodes	25 Nodes	30 Nodes	40 Nodes	50 Node
AODV	227.5	127.95	112.16	97.69	126.6	118.78	108.6
SRR	340.55	127.53	127.52	111.24	132.74	120.45	115.7

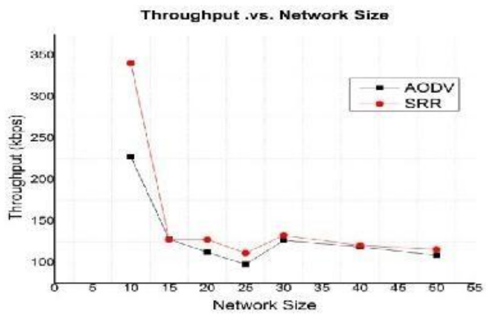

Fig. 10. Network Size with Throughput

Overhead							
Routing Protocol	10 Nodes	15 Nodes	20 Nodes	25 Nodes	30 Nodes	40 Nodes	50 Node
AODV	0.003	1.443	1.725	3.339	3.586	4.04	5.342
SRR	0.001	1.296	1.596	3.254	3.166	3.284	4.296

Table – 6: Routing Protocol Values 6

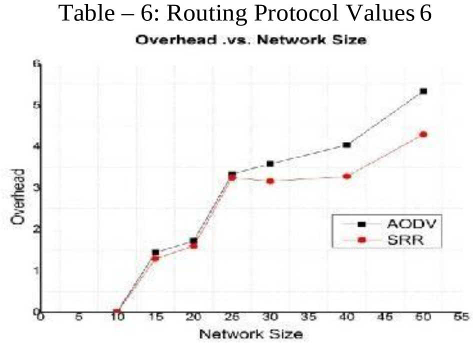

Fig. 11. Network Size with Overhead

CONCLUSION

The SRR is a routing technique for Mobile ad hoc network, focuses mainly by reducing redundant RREQ and RREP packets propagation during route discovery process. We have evaluated and compared our algorithm with AODV algorithm and obtain better results in terms of packet generation by the source, packet received by destination, data delivery ratio, routing overhead, throughput and by reducing end to end delay of a packets during data communication between to nodes.

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