Multipath Strategies and Link Based Resource Optimized Routing in Manet

M.Ilango, A.V.Senthil Kumar

Abstract- A MANETs (Mobile Ad Hoc Network) is a prearranged form of cellular nodes besides any infrastructure. The finest route determination in MANETs is a difficult task to progress the routing performance. A multipath strategies and link based resource optimized routing (MSR-OR) method is proposed to choose the best route for proficient data packet communication in MANETs. The MSR-OR Technique is used Selective Re-transmission method to minimize high channel contention causing redundant a RREQ through combining both neighbor coverage and selective methods. The Selective Re-transmission method reduces the number of retransmissions and therefore optimizes resource utilization for data transmission, which in resulting improved packet delivery ratio with lower energy utilization. The functioning of MSR-OR Technique is deliberate as far as energy utilization, end to end delay (E-E-D), packet delivery ratio, and network lifetime (NLT). The simulation result shows that the MSR-OR Technique is improves the packet delivery ratio with minimum NLT for data transmission.

Keywords: optimal path, data packet, MANETs, Selective Re-transmission method, routing overhead.

I. INTRODUCTION

MANETs is a group of cellular nodes with passion framing a system without the aid of any network communications. The aim of ad hoc network routing protocol is to constituted correct and efficient route between source and destination. Routing is the process of selecting best path in a system. Packet exchanging system, routing coordinates packet sending through middle hub. The routing procedure usefully directs forwarding on the basics of routing table which maintain record of the route to various destinations. Multipath routing is a technique that allows using more than one physical path for data transfer between source and destination. Multipath routing maintains a constant connection between nodes.

If any node is failure in path automatically it identifies alternate path to that network. Non linear differential optimization routing [13] in MANET technique is focused on optimal path on network for data transmission; in case of any interrupt occur between the optimized routes, there is no feasible way to retransmit the prior node. The proposed method to choose the best path for data transmission used selective retransmission method; in case of failure occur in the route data packets are immediately transfer to an alternative node on that network. The retransmission method reduces the number of retransmission (i.e., selective retransmission) and optimized resource utilization for efficient data transmission.

To overcome the aforesaid existing issue in MANETs, Multipath Strategies and Link Based Resource Optimized Routing Technique is proposed. The research objective of MSR-OR method is formulate as follows,

Revised Manuscript Received on January 15, 2020

M.Ilango, Research Scholar, Hindusthan College of Arts and Science, Coimbatore.

Dr.A.V.Senthil Kumar,Director of MCA, Hindusthan College of Arts and Science, Coimbatore.

- To reduce resource utilization such as energy, average E-E-D, Selective Re-transmission Method is used in MSR-OR Technique.
- Selective Re-transmission Method reduce high channel contention causing redundant a RREQ and number of retransmissions controlled by neighbor coverage and multipath methods.
- To selective retransmission data packets transfer through the optimal path of the network and improve the packet delivery ratio.

II. RELATED WORKS

The proposed author describes multicast routing protocol using dependable nodes choice was presented in [1] to identify optimal path based on different parameter and attain higher packet delivery ratio. The adjacent node using rebroadcast protocol [19] in that network to diminish the retransmission routing overhead and improve the packet delivery ratio, reduce the rebroadcast duplicate data. Probabilistic [8], Deterministic [7], Non Linear[10] and Stepwise Regression [9] improves the energy, bandwidth, packet delivery ratio and delay time but difficult to choose optimal path. Indrani Das et.al [11] the author proposed multipath traffic splitting the network, provides a guarantee delivery of a data within the different path using Burke's theorem. Jiazi et.al [12] the author proposed multipath optimized routing implemented by Dijikstra's cost function algorithm to discover the best forwarding route recovery and loop detection to a packet delivery in sink node. it gives more performance, when data loading rate is increased and reduce the energy consumption. Prabha R and Ramaraj N [14] extended by link estimation algorithm to obtain the optimal solution, balance the load across the network on the performance metrics. G. Sathishkumar and K Vignesh [15] intend by ant colony optimization approach using ACO-DARP protocol to focus on the delay time of route discovery.

MANET mostly focus on forwarding link technique [3] and reduce the number of retransmission, though, efficient routing is remaining nodes are not active and improve the performance. Siuliroi et.al [16] suggests the multipath routing load balancing in multipath between source to destination node and improve the E-E-D performance. Hind Alwain and Anjali Agarwal [5] suggest multipath routing methodology for secure dependable data delivery using energy consumption by stirring the path selection process on the network. The drawbacks of this method are encrypted packets transferred from one node to another node. Alaa Azmi et.al [2] intend the multipath in MANET that depicts average path signal on the network. The performance metrics are satisfied on basis of average path selection, the demerits of the method are single route can evaluate all the metrics but not consider higher residual energy. Haripriya et.al [4] consider dynamic probabilistic routing algorithm to avoid the duplicate packets delivered in the network.

Swati Lipsa et.al [18] surveying about analysis of multipath routing alternative path and concurrent path routing, the alternative path method focus on transmission delay, packet loss rate, routing overhead and NLT, in concurrent routing method following metrics are reliability, delivery ratio and delay time of packet. Sonia Waharte and Raouf Boutaba [17] proposed by finding optimal route on network, if it is failure occur on any node in that path, automatically choose alternative route in a network and disjoint the failure route. The drawbacks of the existing system, there is no possible retransmission from current node of failure. P.Periyasamy and E Karthikeyan [13] presented, it avoids link failure occurrence of a network and evaluated the QoS using the metrics of path link quality estimator and path node energy estimator. Hui Xia et.al [6] advised to test by relative steadiness metric and neighborhood strength metric to estimate the link stability of a network. Based on the topological structure, forwarding packets of a link may change one another.

III. MULTIPATH STRATEGIES AND LINK BASED RESOURCE OPTIMIZED ROUTING

A Multipath Strategies and Link Based Resource Optimized Routing Method are designed with the goal of choosing direction for dependable data packets communication in MANETs with the optimized useful source exploitation. Initially, MSR-OR Technique efficiently optimizes the resource utilization of versatile hubs by using Selective Re-transmission method. The Selective Re-transmission method lessens the high channel contention causing the redundant RREQ in MANETs for data transmission. This in turn helps for reducing the more usages of resource such as energy, and delay for reliable data packets transmission in MANETs. After that, MSR-OR Technique picks the ideal way between the nodes from source and destination. The MSR-OR Technique used to upgrade the packet delivery ratio in MANETs.

A. Selective Re-transmission Method

Let consider the MANETs is the structure of layout '$G(V,E)$' in which 'V' speaks to the cell hubs and 'E' is means the hyperlinks between cell hubs. The quantity of versatile hubs in MANETs is described as'$MN_i = MN_1, MN_2, MN_3 \dots MN_n \in V$ that position inside the communication range$'R'$. The comunicatted of data packet from source to destination in selective manner.

A mobile node in MANETs selectively transmits a data packet with its neighborhood. The proposed MSR-OR Technique employs Selective Re-transmission Method for discovering the routing paths in MANET. Besides, the proposed MSR-OR Technique reduces channel contention and collision among the neighboring nodes in MANETs. Therefore, the performance of routing is improved which in turn helps for improving packet delivery ratio and reducing extra usages of resource such as energy, lifetime and delay. The following diagram shows the number of mobile nodes that randomly dispensed in MANETs.

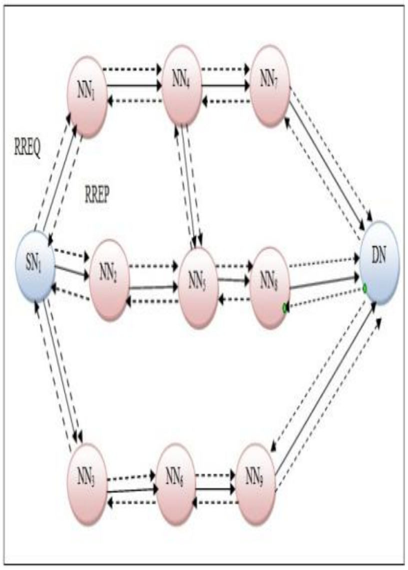

Figure 1 Selective Re-transmission Method

Figure 1 shows that, the source node (SN) selectively transmits a data packet via middle nodes in the network to destination node. The Selective Re-transmission Method employs the concurrent knowledge of neighbor node information to discover a route for data packet transmission in MANETs. This method performs transmission of data packets with the support of neighbor node and neighbor coverage.

The Selective Re-transmission Method is utilized in MSR-OR Technique to find out the coverage of neighbors in network. During the data packet transmission, the source node transmits RREQ message to neighboring mobile node to create path between source to destination node. The neighboring mobile node in networks receives the RREQ message and then sends the reply message (RREP) for source node. The MSR-OR Technique to reduce the unnecessary rebroadcasting of the RREQ to the neighboring mobile node for data packet transmission. Let consider source node '$Source_{Node}$' sends the route request'$RREQ$' message to the neighbor's nodes ($\text{neighbor}_{\text{node}}$) in MANETs which is formulated as follows.

$$Source_{Node} \rightarrow RREQ \sum_{i=1}^{n} \left(\text{neighbor}_{\text{node } i}\right) \quad (1)$$

$$Destination_{Node} \rightarrow RREQ \sum_{i=1}^{n} \left(\text{neighbor}_{\text{node } i}\right) \quad (2)$$

After that, neighbors nodes sends RREP message to source node which is mathematically expressed as

$$\sum_{i=1}^{n} \left(\text{neighbor}_{\text{node } i}\right) \rightarrow RREP\ (Source_{Node}) + RREP\ (Destination_{Node}) \quad (3)$$

In MANET, the neighboring node for each source node is chosen arbitrarily that resulting in reduced collision and also the channel contention (i.e. the all mobile nodes in MANET utilize an identical radio channel without pre-coordination). In MSR-OR Technique, the all mobile nodes in MANET make the cooperative communication and employ the diverse channel for packet forwarding which in turn assists to evade the channel contention. The Selective Re- transmission Method determines the neighbor coverage of source and destination node which is demonstrated in Figure 2.

Retrieval Number: D8785118419/2020©BEIESP
DOI:10.35940/ijrte.D8785.018520

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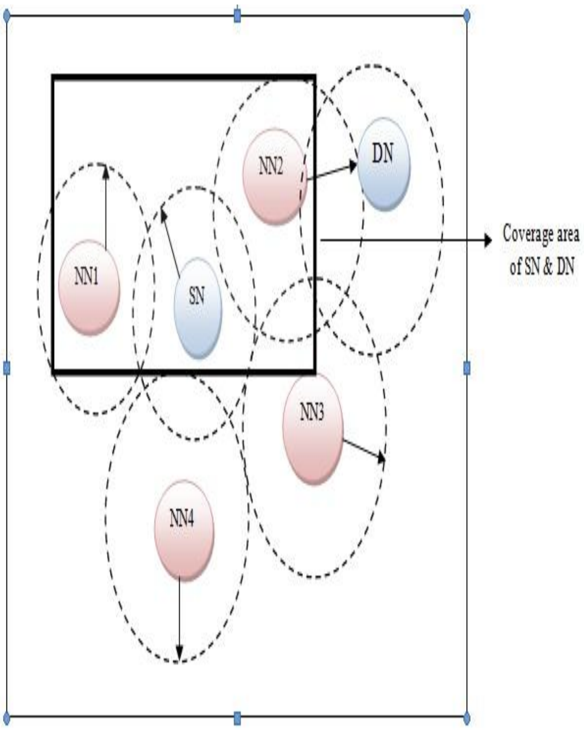

Figure 2 Neighbor Coverage of Source Node & Destination Node

From the Figure 2, the rectangle block shows the neighbor coverage area of source and destination node. While a neighboring node gets an RREQ packet from the source node, it finds the neighbour by using the radio frequency range. Subsequently the RREP packets are comunicatted to source node from the neighboring node. From the above figure, the source node covers the neighbouring nodes $NN1, NN2$ and destination. The un-covered neighbour nodes gets RREQ packets until it explore the neighbour for broadcasting the data packet when varying the distance and the coverage gesture of the neighbours. Hence, the neighbour lists maintain the information about un-covered node in network. From that, the covered neighbouring nodes node $NN1$ and $NN2$ only involves the uncovered neighbouring node waits for getting the radio signal. The uncovered neighboring list is precisely represented as,

$$\text{uncovered list } (n_i) = N(n_i) - [N(n_i) \cap N(n_j)] - \{Source_{Node}\} \quad (4)$$

From the equation (4), uncovered lsit (n_i) indicates the set of uncovered neighbor in network, $N(n_i)$ and $N(n_j)$ are the neighbors set of node $node_i$ and $node_j$ respectively. Here, $Source_{Node}$ refers the source node that transmits an RREQ packet to node neighbor's nodes in the network. Owing to the broadcasting individuality of RREQ packet, node n_i obtains the unnecessary RREQ packets from its neighboring nodes. As a result, the Node n_i adjust the scope of uncovered list (n_i) depends on knowledge of the neighboring node. The MSR-OR Technique reduces the redundant rebroadcast delay by means of avoiding network collision and contention. Every node in network evaluates the rebroadcast delay while receiving the RREQ and broadcasting RREP packets. The rebroadcast delay $(Rebroadcast_{Delay})$ is determined by using following formula,

$$Rebroadcast_{Delay}(n_i) = 1 - \frac{|N(n_i) \cap N(n_j)|}{|N(n_j)|} \quad (5)$$

From the equation (5), $Rebroadcast_{Delay}(n_i)$ is the rebroadcast delay of set of nodes. Consequently, delay ratio of the node is mathematically represented as,

$$Delay_{Ratio}(n_i) = Max_{Delay} * Rebroadcast_{Delay}(n_i) \quad (6)$$

From the equation (6), $Delay_{Ratio}(n_i)$ denotes the delay ratio of the node (n_i) and Max_{Delay} represents the maximum delay whereas $Rebroadcast_{Delay}(n_i)$ indicates the rebroadcast delay of the set of node. The Selective Re-transmission Method is utilized in MSR-OR Technique to evaluate neighbor coverage knowledge. The mobile node (n_i) receives the redundant RREQ packets from the other node $(node_j)$.Therefore, uncovered neighboring list (uncovered list (n_i)) is adjusted as follows,

$$\text{uncovered list } (n_i) = \text{uncovered list } (n_i) - [\text{uncovered list } (n_i) \cap N(n_j) \quad (7)$$

After adjusting the uncovered neighboring list, the request RREQ packet from the neighbors' node n_j is eliminated. In MSR-OR Technique, the rebroadcasting possibility is determined depends on the connectivity factor and ratio of the coverage. The rebroadcasting possibility is mathematically expressed as,

$$Rebroadcasting_{\text{selectively}}(n_i) = Con_F(n_i) * Cov_R(n_i) \quad (8)$$

From the equation (8),$Rebroadcating_{\text{selectively}}(n_i)$ represents the rebroadcasting possibility of the node whereas $Con_F(n_i)$ is a connectivity factor and $Cov_R(n_i)$ denotes coverage ratio. Thus, connectivity factor $Con_F(n_i)$ is mathematically defined as follows,

$$Con_F(n_i) = \frac{No.of\ nodes\ additionally\ covered\ by\ rebroadcast}{total\ no.of\ neighbors\ of\ node\ (n_i)} \quad (9)$$

Subsequently, coverage ratio is mathematically formulated as follows,

$$Cov_R(n_i) = \frac{N_C}{|N(n_i)|} \quad (10)$$

From the equation (10), $N_C = 5.18 \log n$ [23] where n is the quantity of mobile hubs in the MANET. If the result of re-broadcasting possibility is more than 1, then the possibility is set to 1. The selective retransmission method in MSR-OR Technique employs the neighbor coverage for broadcasting data packets which in turn assists to reduce the number of retransmissions. Thus, MSR-OR Technique efficiently reduces the more usages of resource such as energy, lifetime and delay for data packets transmission in MANETs. Therefore, MSR-OR Technique optimizes the resource utilization. If node gets redundant RREQ packets, the uncovered neighboring node is changed and therefore minimizes the high channel contention. The selective retransmission method measures rebroadcasting is to forward the packet. The algorithmic process of the selective retransmission method is shown in below,

//Selective Retransmission Algorithm

Input: No. of mobile nodes, Source node, Destination node', Neighboring Nodes

Output: Reduce routing overhead for data transmission with optimized resource utilization

Step 1: Start

Step 2: For each versatile hubs

Step 3: Source node communicates a RREQ packet to Neighboring Nodes and the neighbour node transmits the RREP packet to Source node

Step 4: Ensures the hub gets RREQ packet

Step 5: Compute the uncovered neighboring list using (4)

Step 6: Compute rebroadcast delay and delay ratio using (5) and (6)

Step 7: If node (n_i) acquires redundant RREQ packet from its neighbor (n_j)

Step 8: Alter the uncovered neighboring list using (7)

Step 9: End if

Step 10: Compute the rebroadcasting selectively using (8), (9) and (10)

Step 11: If $Rebroadcating_{\text{selectively}}\ (n_i)\ \leq (0,1)$ then

Step 12: transmit RREQ packet to destination

Step 13: else

Step 14: discard RREQ packet

Step 15: End if

Step 16: End for

Algorithm: Selective Retransmission Algorithm

By using the above algorithmic process, the selective retransmission method possibly selects the path between sources to destination.

IV. SIMULATION SETTING

The MSR-OR Technique are applied in NS-2 simulator with the system assortment of 1200*1200 m size. The range of cell hubs picked for performing reproduction is 500. The consequences of MSR-OR Technique are contrasted in opposition to with current NLDRO-QAR Technique. The reproduction parameters utilized for leading tests is proven in under Table 1.

Table 1 Simulation parameters

Simulation factor	Value
Protocol	AODV
Node density	50, 100, 150, 200, 250, 300, 350,400,500
Simulation time	100s
Pause time	10s
Mobility model	Random Way Point
Transmission range	300m
Network area	1200m * 1200m
Data packets	9 – 90

V. RESULT AND DISCUSSIONS

In this part, the outcome examination of MSR-OR Technique is assessed. The demonstration of MSR-OR Technique is contrasted and existing NLDRO-QAR Technique. The exhibition of MSR-OR Technique is assessed alongside the measurement for example energy utilization, packet delivery ratio and E-E-D, and NLT.

A. Energy Consumption

In MSR-OR Technique, the energy usage is determined utilizing the vitality pushed by solitary versatile hub concerning the all out portable hubs in MANETs. The vitality use rate is resolved in wording Joules (J) and planned as,

$$Energy\ \text{Consumption}\ = \frac{Energy_{DP}}{Total_{DP}} \quad (11)$$

The energy usage of steering process is obtained by the condition (11). '$Energy_{DP}$' Represents the proportion of vitality expended for single data packet and total energy devoured for every one the data packets '$Total_{DP}$' in the system. While the vitality usage is lower increasingly proficient the system is said to be.

Table 2 Energy Consumption

Number of Mobile Nodes	Energy Consumption (J)	
	NLDRO-QAR Technique	MSR-OR Technique
50	0.06	0.06
100	0.07	0.08
150	0.09	0.10
200	0.11	0.09
250	0.14	0.14
300	0.15	0.14
350	0.17	0.16
400	0.19	0.17
450	0.22	0.21
500	0.24	0.23

Table 2 portrays the effect of power utilization for data packet transmission relies upon contrasting number of versatile hubs in the range between 50 and100. From the table 2, the power utilization of proposed MSR-OR method is lower while contrasted with existing NLDRO-QAR Technique.

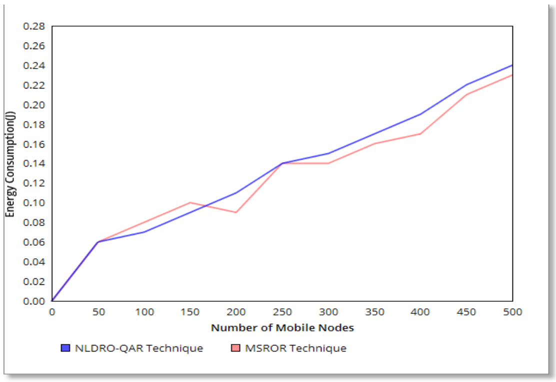

Figure 4 Energy Consumption

Figure 4 indicates the effect of energy utilization for data packet transmission between portable hubs. As uncovered in figure 4, proposed MSR-OR method gives improved energy utilization to data packet transmission in MANETs when contrasted with existing NLDRO-QAR Technique. Moreover, while expanding the quantity of sensor nodes, the energy utilization is likewise expanded. Be that as it may, similarly energy utilization utilizing proposed MSR-OR Technique is lower. This is a direct result of utilization of selective retransmission method in MSR-OR method in which it efficiently reduces the high channel contention causing redundant a RREQ. This in turn helps for reducing the number of retransmission which resulting in minimum energy consumption.

B. Average end to end delay

In MSR-OR Technique, the average E-E-D measures the time devoured for information to be comunicatted over a system. The average E-E-D is estimated as far as milliseconds (ms) and precisely planned as,

$$\text{average end to end delay} = \text{Receiving time of packets} - \text{sending time of packets} \quad (12)$$

The average E-E-D is gained by condition (12). While the average E-E-D is lower, the system is said to be increasingly competent.

Table 3 Average end to end delay

Number of packets	Average end to end delay (ms)	
	NLDRO-QAR Technique	MSR-OR Technique
9	3.8	3.7
18	8.2	8.1
27	12.9	12.6
36	15.6	15.3
45	19.1	19.0
54	26.4	26.1
63	29.8	29.6
72	33.2	33.0
81	35.7	35.2
90	39.5	38.9

The similar outcome examination is exhibited in Table 3. From the table 3, it is distinct that the average E-E-D is lower utilizing proposed MSR-OR method while contrasted with present NLDRO-QAR Method.

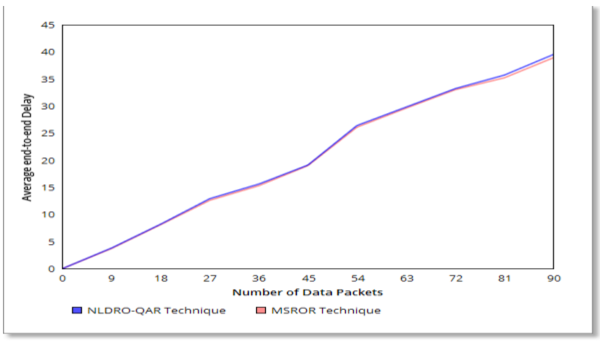

Figure 5 Average end to end delay

Figure 5 portrays the effect of average E-E-D against disparate quantity of information in the extent of 9-90. As uncovered in figure 5, projected MSR-OR Method gives better average E-E-D for data packet transmission in MANETs and contrasted to existing NLDRO-QAR Method. Additionally, while rising the group of data, the delay time is also improved. But moderately average E-E-D using proposed MSR-OR Method is lower.

C. Measurement of Packet delivery Ratio

In MSR-OR Method, packet delivery ratio is characterized as the proportion group of information recognized by the goal to the all out quantity of data packets sent. The packet delivery ratio is determined as far as rates (%) and defined as pursues,

$$\text{Packet Delivery Ratio} = \frac{\text{Number of packets received}}{\text{Total number of packets sent}} * 100 \quad (13)$$

The packet delivery ratio is obtained by the equation (13). While the packet delivery ratio is higher, the method is said to be more effective.

Table 4 Packet Delivery Ratio

Number of packets	Packet Delivery Ratio (%)	
	NLDRO-QAR Technique	MSR-OR Technique
9	89.55	90.12
18	90.12	90.98
27	90.95	91.24
36	92.36	92.40
45	93.11	93.26
54	94.85	94.93
63	96.24	96.34
72	97.90	97.92
81	98.35	98.39
90	99.49	98.45

The after group effect of packet delivery ratio depend on various group of information in the extent of 9-90 is case in table 4. Table 4 shows that, the packet delivery ratio utilizing proposed MSR-OR Method is greater when contrasted with current NLDRO-QAR.

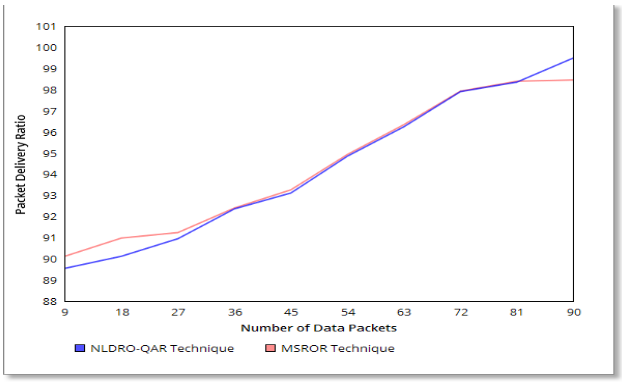

Figure 6 Packet delivery Ratio

Figure 6 displays the effect of packet delivery ratio versus distinctive group of data in the range somewhere in the range of 9 and 90. As demonstrated in figure 6, packet delivery ratio is better in proposed method when compared to existing NLDRO-QAR Method. Besides, while raising the group of data, the packet delivery ratio is improved. But nearly packet delivery ratio utilizing proposed Method is higher. This is because of utilization of selective retransmission method in MSR-OR Method where it lessen the high channel contention causing redundant RREQ packets efficiently for reliable records transmission to improve packet delivery ratio.

D. Network Lifetime

In MSR-OR method, the NLT is found out by the quantity of sensor nodes in the system. The NLT is determined regarding rate (%) and planned as,

$$Network\ Lifetime = \left(\frac{S_{addressed}}{Total_S}\right) * 100 \quad (14)$$

The NLT is acquired utilizing the total number of portable hubs '$Total_S$' in the system and routing tented to for the mobile node '$S_{addressed}$' in MANETs by the condition (14). While the NLT is higher, progressively fit the strategy is said to be.

Table 5 Network Lifetime

Number of Nodes	Network Lifetime (%)	
	NLDRO-QAR Technique	MSR-OR Technique
50	90.29	90.35
100	90.98	91.08
150	92.62	92.76
200	93.21	93.28
250	95.11	95.23
300	95.99	96.01
350	97.46	97.47
400	97.57	97.59
450	98.23	98.27
500	99.45	99.46

The comparative result analysis of NLT in NLDRO-QAR method and MSR-OR method is primarily based on quantity of cellular nodes taken in the choice between 50 and 500 is in Table 5. Hence, NLT using proposed MSR-OR Method is greater when contrasted with present method.

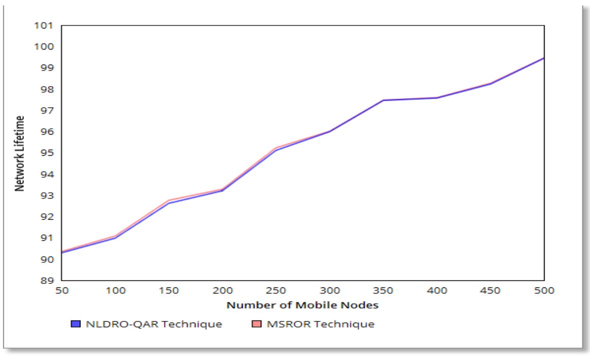

Figure 6 Network Lifetime

Figure 6 exhibits the impingement of NLT versus different variety of cellular nodes in the range of 50-100. As proven in figure 6, proposed MSR-OR mechanism gives better NLT as compared to NLDRO-QAR Method. In addition, while raising the number of cell nodes for data packet communication, the NLT is also gets increased. But comparatively, the NLT using proposed MSR-OR method is greater contrasted with present method.

VI. CONCLUSION

An effective MSR-OR Method is created to choose the best route for effective data packet transmission in MANETs. The primary target of MSR-OR Method is to accomplish link and resource streamlined routing in MANETs. The resource optimized routing is achieved by using Selective Re-transmission method that reduces high channel contention causing redundant a RREQ. Therefore, MSR-OR Method optimizes the usages of resource such as energy, NLT and delay for reliable data packets transmission in MANETs and is performed to choose the optimal route path in network which in resulting improved packet delivery ratio with minimum energy utilization. The effectiveness of MSR-OR Method is estimated as far as energy consumption, average E-E-D, packet delivery ratio, and NLT contrasted and existing strategy.

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AUTHORS PROFILE

M.Ilango, received MCA in department of computer application from Velalar College of Engineering and Technology, Erode. He is currently pursuing Ph.D degree in department of computer science from Hindusthan College of Arts and Science, Coimbatore. His research interest is Mobile Ad Hoc Network in Networking.