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Comparative Performance of PRO-AODV, DFRR, CPRR algorithm based on Link Failure Route Rectification problem in Mobile Sensor Network

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Abstract - ***Mobile Ad hoc Networks (MANET) is an autonomous or independent system of mobile nodes connected by wireless communication links. Every node operates not only as an end station, but also a base station to forward data packets. In random topology the nodes are free to move and frequently change their positions. Ad hoc On-demand Distance Vector (AODV) is a reactive routing protocol; which is all routes are discovers only when needed and to find the shortest route between communication nodes. Link failure is a major issue of the current ad hoc wireless network due to node mobility, node energy loss or drain to battery power. In this paper work has been made to compare the performance of three prominent methods support of AODV routing protocol for MANET: Proposed AODV Routing (PRO-AODV), Divert Failure Route Recovery (DFRR), Check Point Route Recovery (CPRR) Methods. PRO-AODV and DFRR methods was designed to avoid a link failure route recovery process based on node sequence number and in advance node signal strength connection in highly dynamic ad hoc network. CPRR method conquers of node low energy, node monitoring and blocking kind of process to rectification in active communication. In this method sensor activities on actor nodes and maintain routes, link failure route recovery process to measure help of static, dynamic sensor nodes and Network Topology Management (NTM) for optimal connection in Wireless ad hoc sensor Networks (WASN). The performance comparison between different three methods are analyzed using varying time intervals in NS-2 Network Simulator carefully evaluating and implementing efficient routing establishment process.***

Key Words: *MANET, PRO-AODV, DFRR, CPRR, NTM, WASN, NS-2.*

1. INTRODUCTION

Mobile wireless sensor network (MWASN) [1] consists of sensor actions on mobile nodes in geographical area. Sensor node has wireless communication capability and some level of intelligence for sensing processing and networking of the data. Some applications of mobile wireless sensor networks is to detect and gain as much information as possible about enemy movements, explosions, and other phenomena of interest. Mobile wireless traffic sensor networks to monitor vehicle traffic on highways or in congested parts of a city. Wireless surveillance sensor networks for providing security purpose in shopping malls, parking garages, and other facilities.

Mobile ad-hoc network [2] is a collection of wireless mobile hosts forming a temporary network without any centralized administration. In MANET each node acts as a host as well as a router with an arbitrarily topology movement. The random topology changing of demands very efficient routing scheme and leads to evolution of various routing protocols. Ad-hoc On-demand Distance Vector (AODV) [3] routing protocol is a reactive routing technique constructs routes only on-demand basis. This reactive routing protocol determines a route only when it is required. It does not update and maintain the routing information continuously.

The performance evolution of AODV routing algorithm with the reference of two techniques of link route repair. The Proposed AODV routing protocol from route recovery and route discovery point of view. The Divert Failure Route Recovery (DFRR) [4] method solution for link failure of route recovery process to avoid a complete link breaks down due to the node mobility. The main objective of DFRR method is to predict the signal strength to determine a link status before it becomes invisible and find out a new route to the destination to divert the current link into a route with a strong transmission network area. In this paper, we propose a check point route recovery (CPRR) mechanism with the support of AODV routing protocol and sensor activities on nodes based on energy efficient among node link failure is not much more. The CPRR mechanism is used to detect the energy drain in a node, the static, dynamic sensor node finds the nearest node whose energy level is high and has the lowest number of links. The links of actor node which replaces the failure node is maintained with the help of Network Topology Management (NTM).

The remainder of the paper is organized as follows. Section 2 described overview of MANET and WSNs and Improvement of Link failure route recovery process described in section 3. Simulation environment model in section 4 and Discussion and Comparison results in section 5. Finally, the conclusion in section 6.

2. Overview of MANET and WSNs

A mobile ad hoc network (MANET) consists of a set of devices connected by wireless communication links. Each device is an end system and also a router. Devices communicate with each other in a peer-to-peer way via wireless links.

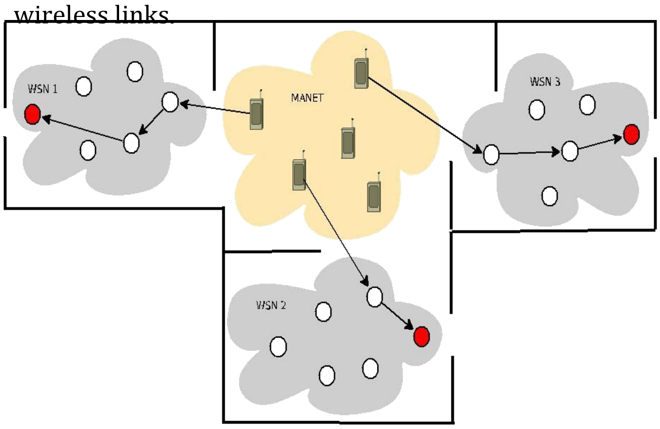

Fig-1: Communication between MANET to WSN nodes

An MANET has the following characteristics. Devices can move, join the network, and leave the network freely. There is no wired infrastructure and the network is set in an ad hoc way. In Figure 1 describes Communication between devices are realized by wireless signals which are broadcasted. The network is self-organized and there is no centralized administration. A routing path may have multiple hops (wireless links). MANET technology is used to create a network anywhere and anytime without a fixed infrastructure to support mobile users in the network. MANET has a wide range of applications such as rescue operations, military, home networks, and conferencing.

A sensor network consist a set of sensors distributed in an area and one or multiple devices called sinks. Sensors collect information and transmit the collected data to sinks. Usually the transmission is realized by wireless communication. In this lecture note, we assume that the transmission is wireless. As shown in Figure 2 Multihop wireless transmission may be needed and sensors act both as an end system and a router. Compared with MANET, sensors are usually static after they are deployed while the nodes of MANET.

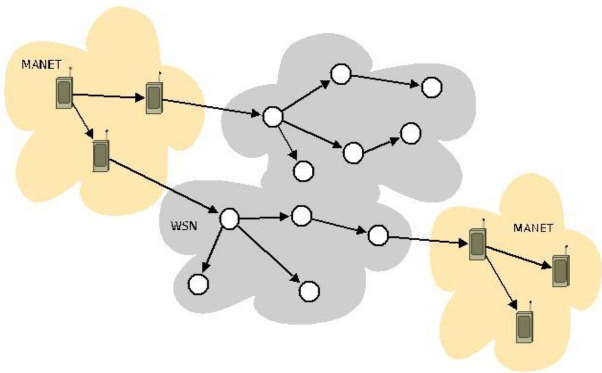

Fig-2: Flooding through multiple networks

Sensors are usually very simple devices with limited energy resource while MANET nodes (e.g., laptops) are more powerful and have less energy constraint. Sensor networks often have an administrative control while MANET usually does not have a central authority. Life-time is usually important to sensor networks while MANET usually requires more bandwidth.

3. Improvement of Link Failure Route Recovery process

3.1. Divert Failure Route Recovery Method

This algorithm is to enhance a link failure of AODV Protocol by developing DFRR mechanism [7] to avoid a complete link breakdown due to the node mobility. This protocol is supposed to eliminate the route regenerating by the source upon link failure on the way to the Destination. The random topology moving automatically in network area the link between current node and intermediate node is going to be broken due to the movement of the intermediate node is to be out of the mobility transmission range. In this method for link failure route handling and it will be obtained through prediction of signal strength of an active route and divert route the date by the current node into a new route. The DFRR method could function as an alternative solution for Ad hoc mobile network.

The main function of detection model works to detection signal strength function to study the link state prediction method through the signal strength. The computing signal strength picks up the signals from that table and measures the status of signal power and this status will be used to determine the circumstance of the current connection. The new route constructor model present three functions find strong link function, create new path function, and forward Data. The find strong link function will be taken if the current link signal status is less than the signal threshold. If this requirement is fulfilled, the current node monitors all available signals among neighbor nodes of the current node to find the node that has a stronger signal according to the current connection signal strength. The create-new path function will construct a new route and divert the data into the new route. Finally, when a new route is finalized, the forward data function will transfer the data through the new route.

3.2. Pro-AODV Route Recovery Method

AODV standard handles the link failure problem [6]. As Figure 3 describes, after the link is broken intermediate node sends an Error message to the sender. Then the sender will rebroadcast again a new route request throughout network. Results in congestion, delay, overhead and so on. In the standard AODV protocol, upon a link failure, the node that detects the link failure sends an error message packet back to the source, the source then will initiate a new route discovery [7].

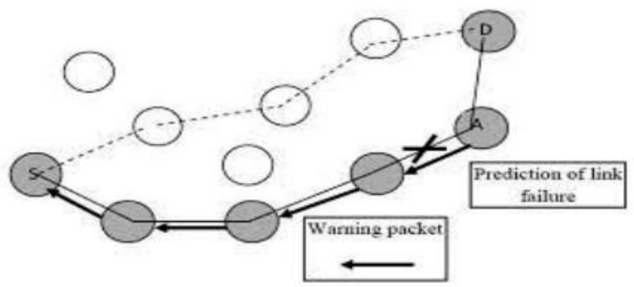

Fig-3: AODV based on Link Failure Prediction

The distance, where the link failure is happen, is far from the source. Whatsoever, to re-establish a new global route discovery from the source, it clearly causes a significant overhead, network congestion as well as high bandwidth utilization. In view of the oversized transmission delay in AODV routing protocol, we put forward a improved AODV routing protocol, that is, a mechanism of link failure forecast is introduced into the process of data transmission, this kind of improved routing protocol is PRO-AODV (AODV based on Link Failure Protection) routing protocol.

3.3. Check Point Route Recovery (CPRR) Method

Check Point Route Recovery Algorithm (CPRRA) is one of the effective recovery methodologies to autonomously reposition a subset of the actor nodes to restore connectivity. The contemporary recovery methods either impose high node relocation of overhead or extend of the inter-actor data routes. The main objective of this paper is to detect the energy drain in a node, before the energy of that node is completely drained. The CPRR method calculates the energy level of each node by sending Heart beat messages. Actor nodes will periodically send heartbeat messages to their neighbors to ensure that they are functional, and also report changes to the one-hop neighbors. Missing heartbeat messages can be used to detect the failure of actors. Once a failure is detected in the neighbor hood, the one-hop neighbors of the failed actor would determine the impact that is whether the failed node is critical to network connectivity. This can be done by executing Check point recovery algorithm. Basically, a cut vertex F has to be on the shortest path between at least two neighbors of F. The CPRR serves the shortest path of all nodes.

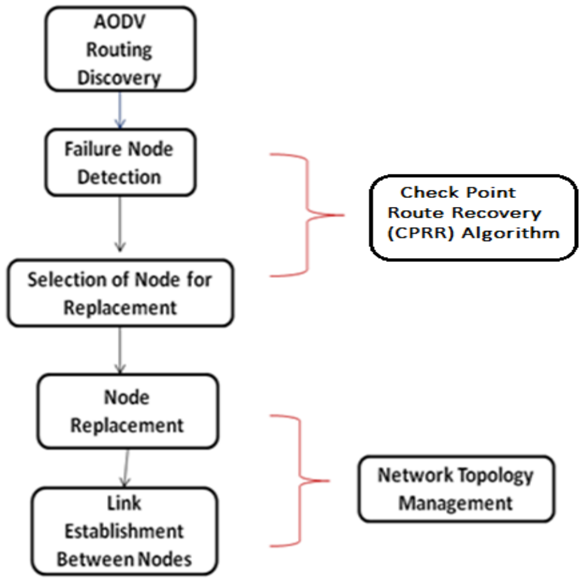

Fig-3: Check Point Route Recovery Algorithm Analyzer.

Once there is a delay in request data packet or missing of data packets, then the Static nodes detects the energy drain in that intermediate node which drops or delays the data packets the failure node will be occurred. The Static node after detecting the energy drop in that intermediate node intimates the dynamic node. The Dynamic sensor node which is in mobility searches for a node which is nearest to the failure node. The Dynamic node finds a node whose energy level is high and who has lesser links when compared to other nodes. When the dynamic node replaces the failure node with another node, that node takes all the back up from the failure node. The Dynamic node selects a node whose energy is high and who has lesser links. The Dynamic node replaces the node with the failure node after taking backup.

A node is selected for replacement only if that node is nearest to the failure node. The node which is selected for replacement should have high energy and should be nearest to the failure node. The selected node for replacement should have lesser links. The Static node monitors whose energy is about to drain. If the static node detects energy loss in a particular node then it informs the dynamic node that a particular nodes energy is about to drain. The static node intimates the dynamic node using signals. This process handles in CPRR algorithm and remaining work maintains The Network Topology Management (NTM) shown above figure 3.

The Network Topology Management (NTM) helps maintain the link between the nodes. It maintains the link between the nodes when energy loss is detected in a node. During replacement there are possibilities for direct links between nodes to break NTM helps maintain the link. It maintains the link between the nodes without affecting the packet transmission. The selection of the node for replacement is based on priority which has less number of links connected to it with higher energy level. Based on this the nodes are replaced and back up is taken. The failure node selects a node which has lesser links connected to it. Once it regains its energy it returns back to its normal position. This process takes place continuously.

4. Simulation Environment Model

In this section, the simulation evaluations in NS-2[8] Network Simulator and Linux Mint (17 version) operating software will conducted to perform an experiments and results analysis on the performance ability of CPRRA algorithm with the discussed mechanism. We designed and implementation our test bed using Network Simulator to test the performance of both (AODV, DFRR) routing protocols, simulate and compare various performance metrics.

4.1. Simulation Network Model

The simulations have been performed using Network Simulator 2 version 2.35 a software that provides scalable simulations of wireless ad hoc sensor network and open source software. In our simulation node energy power transmission details and parameter has shown in Table 1.
Define option for simulation environment various distribution in wireless transmission network area. The total simulation time is 300 second.

Table 1: Simulation Network Specification

Parameter	*Value*
Simulation Area	500 * 500 m
Number of nodes	30
Routing Protocols	AODV
Pause time	2m/sec
Simulation Time	300 sec
Packet Size	512 bytes
Traffic Type	CBR
Mobility	Random
Max connection	20

4.2. Performance metrics

In this section, the performance of CPRR mechanism results is evaluated using NS-2 [9] and compared with DFRR and Pro-AODV. First we describe four parameters is calculated then the performance comparison of the three mechanisms discovery approaches. Simulation of results is discussed with comparison results. To evaluate the performance of different quantitative metrics. They are

4.2.1 **Packet Delivery Ratio:** The ratio between the number of data packets sent and number of data packets received at destination.

Packet Delivery Ratio = No. of Packet received/ No. of Packet Sent * 100

4.2.2 **End-to-End Delay:** The Max/Min time taken for data packets to reach the next node.

End-to-End Delay = Packet transmission time taken source node -destination node

4.2.3 **Average Delay:** The time difference between the packets received time, sent time and total time taken for the packets received by all nodes.

Average Delay = Total E2E Delay / No of Packets received

4.2.4 **Throughput:** Ratio of the packets delivered to the total number of packets sent.

Throughput = Total received packets / simulation time

5. Discussion and Comparison Results

The comparison for every parameter metrics result is difference on DFRR, PRO-AODV, CPRR methods. The characteristics of different performance metrics at node pause time in different methods is shown in Table2-5.

5.1. Simulation Network Environment

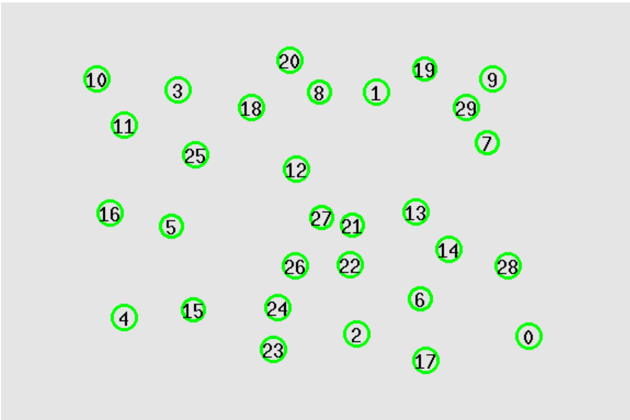

Fig 5.1. 30 nodes created from 0 to 29 places at random distance.

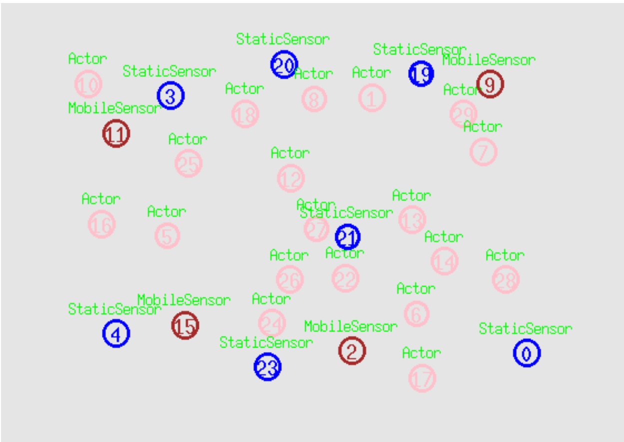

Fig5.2. pink, blue and brown color nodes represent actor node, Static node, and Dynamic nodes.

Table 2: Comparison for Packet Delivery Ratio results

PAUSE TIME	DFRR	PRO-AODV	CPRR
2	54.9296	23.2233	60.1449
4	74.0541	66.1214	75.4348
6	68.5131	81.1787	87.5375
8	77.0642	81.6985	88.8768
10	81.6479	83.2654	94.3466
12	85.7605	87.8564	92.0954
14	88.9664	94.5614	96.5456

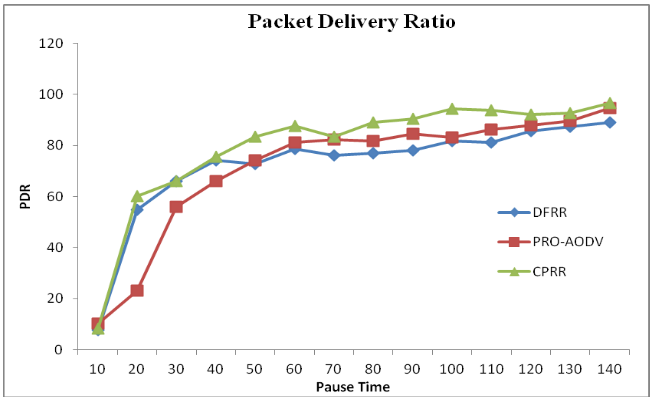

Fig.5.3. Packet transmission in PDR Vs Time

In fig 5.3, with increase in node pause time packet delivery ratio decrease in DFRR and Pro-AODV while it increases in CPRR method, So in terms of packet delivery ratio, CPRR is better results.

Table 3: Comparison for End to End Delay results

PAUSE TIME	DFRR	PRO-AODV	CPRR
2	0.35227	0.23981	0.03404
4	1.25739	1.12589	0.90206
6	0.17056	0.23568	0.12805
8	1.08192	0.98654	1.71798
10	0.61216	0.35648	0.005865
12	1.16477	0.76582	0.245709
14	0.89654	0.52348	0.12698

The Delay time in packet transmission is represented in delay graph plotted as delay time versus time per milli seconds.

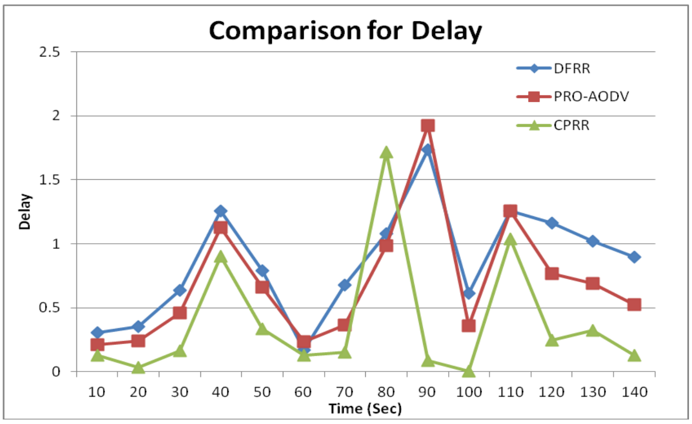

Fig 5.5. Packet transmission in Delay Vs Time

In figure 5.5 and 5.6 shown, if node pause time increases, end to end delay and average delay also decreases in CPRR method while compare with DFRR and Pro-AODV methods. It means delay and average delay in between source node to destination node the less time taken in CPRR better than DFRR and Pro-AODV methods.

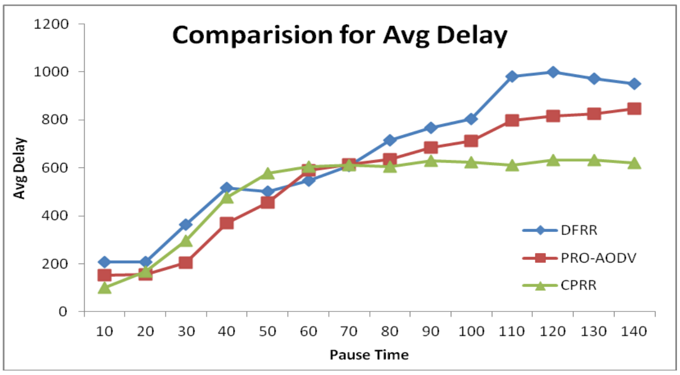

Fig 5.6. Packet transmission in Avg Delay Vs Time

Table 4: Comparison for Average Delay results

PAUSE TIME	DFRR	PRO-AODV	CPRR
2	206.363	154.369	168.675
4	516.863	368.156	477.122
6	546.342	589.756	604.166
8	713.987	635.128	605.866
10	802.524	712.563	622.493
12	999.126	815.467	631.368
14	950.041	846.245	619.335

Table 5: Comparison for Throughput results

PAUSE TIME	DFRR	PRO-AODV	CPRR
2	46.4524	52.6894	55.0695
4	39.8486	49.3654	5.2821
6	95.6799	112.4585	33.7352
8	15.0843	46.5872	70.3954
10	26.6594	21.5468	27.6179
12	127.8542	78.9652	156.2496
14	14.0113	22.4826	37.5818

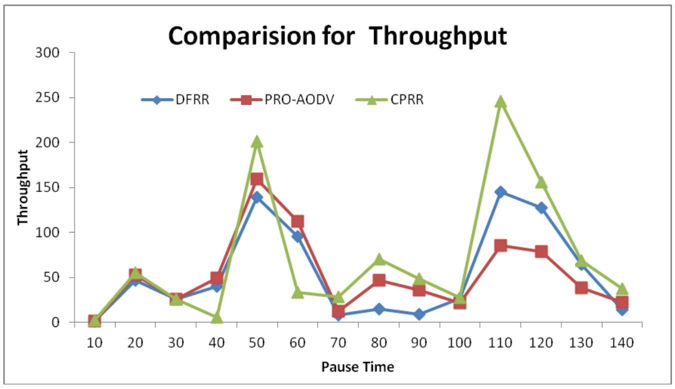

Fig 5.4. Packet transmission in Throughput Vs Time

As seen in figure 5.4, with increase in node pause time, the throughput decrease in DFRR and Pro-AODV while it increases in CPRR method.

In shown below data packets sent and receive details of difference between DFRR and CPRR methods, and also comparison performance on dropped data packets, packet delivery ratio.

Divert failure route recovery method generates the results to analysis from dfrr.tr (trace out file) with the support of Perl script language.

Data packet sent : 1432
Data packet received : 1274
Packet dropped : 158
Packet Delivery Ratio : 88.9664804

Improved PRO-AODV route recovery method generates the results to analysis from aodv.tr (trace out file) with the support of Perl script language.

Data packet sent : 2136
Data packet received : 1986
Packet dropped : 150
Packet Delivery Ratio : 94.5614

Check point route recovery method generates the results to analysis from cprr.tr (trace out file) with the support of Perl script language.

Data packet sent : 3273
Data packet received : 3028
Packet dropped : 245
Packet Delivery Ratio : 96.5456

The performance of CPRR method Packet delivery ratio and data sent and receive analysis comparisons is better than DFRR and PRO-AODV results.

6. Conclusion

In this research paper, the prevention of node failure is done using AODV routing protocol, Pro-AODV, DFRR, Check Point Route Recovery (CPRR) algorithm. These three methods are combined together to find a best shortest route recover for optimal network establishing in MANET. The failure node is replaced with the node whose energy level is high. This is done with the help of CPRRA.

NTM maintains the path between the nodes without breaking for better communication between the nodes, and the link is established even after the replacement of the node without affecting the packet transmission. The NS-2 simulation results show that the improved protocol and CPRR algorithm can reduce the average end-to-end delay effectively, and also can increase throughput, packet delivery ratio in the overall performance. The simulation environment generating better results while combining check Point Route Recovery (CPRR) Algorithm with other DFRR and PRO-AODV algorithm, and also other algorithm such as Ant colony algorithm. Thus this result in a Reliable, Robust and energy-efficient communication between the nodes.There is a scope for improving in finding the best route and energy efficiency of the node.

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BIOGRAPHIES

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