AODV Local Route Discovery to Control Congestion Problem in MANET

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Abstract—MANET stands for mobile ad-hoc network. It is a continuously self-configuring, infrastructure less network of mobile devices which are connected to each other without the use of wires. In MANET as devices are free to move independently in any direction, hence its links to other devices may be change frequently. A node can change its position very frequently and hence a routing protocol is required that quickly adapts to topology changes. AODV is one promising and popular routing protocol in MANET. But traditional AODV not deal with the problem of unreliability of nodes. In this paper a new Local Route discovery (LRD) approach with traditional AODV has been proposed. A node will start to drop the packet if it is unable to forward it properly, if a node drop a the packet most of the time instead of forwarding them then these node is not a reliable node and may be the cause of large delay, high packet lost and waste of resource utilization. To avoid such situation proposed AODV_LRD mechanism checks the reliability of each node on the basis of packet delivery ratio. If any node of detected path becomes unreliable then it applies a local route discovery process, to find other reliable node on the network to obtain reliable path. In this proposed mechanism a node not need to inform the sender for establishing the path but it renovate the new route in network from the same end where the node becomes unreliable, it means proposed AODV_LRD mechanism providing the route establishment capability to each node in network. Transmission through reliable path on the network increases the efficiency of the whole network. It is also helpful in reducing the congestion problem occur inside the network

Index Terms—Congestion, MANET, Reliability, Local Route, AODV, Routing.

I. INTRODUCTION

Reliability is the ability to perform a specified operation continuously despite the effects of malfunctioning and damage. Mobile Ad hoc Network (MANET) is designed to overcome the natural limitation of wired backbone networks and infrastructure-based wireless networks. A mobile ad-hoc network is an independent group of mobile users which communicate over unstable wireless links [1, 2]. In those situation where temporary network connectivity is required and in the areas where no prefixed infrastructure can be developed mobile ad-hoc network are very useful, such as disaster relief where existing infrastructure is damaged, or military applications where a tactical network is required. Reliability is very important factor for the designing of wireless network, especially for MANET which has no centralized control and every communication depends on the packets forwarding of intermediate devices. Each device can move freely and they also work as a router. Therefore routing functionality, for transferring information from source to a destination, will have to be integrating into the mobile nodes Due to dynamic topology MANET is weak in the continuity of communication compared to traditional network. To become ensure about the reliability of MANET is very difficult [3]. The reliability analysis generally refer to the terminal reliability, means the ability that partial or all the devices remain connected between two selected nodes, on the assumption that there is failure of link and node. All network activity like delivery of the messages and searching the topology must be executed by the nodes themselves. Hence reliable routing is one of the most important issues in MANET. To route the traffic properly each device continuously maintain the required routing information. Since the hosts are mobile, the network topology may change rapidly and unpredictably over time. The ad hoc wireless networks offer unique benefits and versatility for certain environments and certain applications [4].

- The preexisting fixed infrastructure and base stations are not being required to such networks.
- Such networks not operate under the limitations of a fixed topology.
- Since all nodes are allowed to be mobile, the composition of such networks is time varying.
- Addition or removal of any of nodes is very easy in it as it required only interaction with other nodes which comes in the communication range, no other agency is involved.

The situation of congestion [5, 6] occurs in a network if the load on the network (the number of packets being sent through the network) is greater than the capacity of the network (the number of packets the network can handle). Thus, network congestion can cause to severely increase the delay and packet loss and reduce network throughput. Congestion in a network signifies that a node at any interval

became congested and started to lose packets. The main objective of congestion control is to minimize the delay and buffer overflow caused by network congestion and hence enable the network to perform better.

II. ROUTING CONCEPT IN MANET

To provide the communication within the network between these nodes, a routing protocol [7, 8] is used to discover routes between nodes. The purpose of such an ad hoc network routing protocol is to determine the route between a pair of nodes so that messages may be delivered in an efficient manner and reach at correct destination within limited time.

A. Routing Protocols Classification

There are several routing protocols have been designed for ad- hoc mobile networks. All of these protocols have been face the typical limitations of these networks, like high power consumption, low bandwidth, and high error rates. Routing protocol for MANET are mainly classified as:

1) Table driven (proactive) routing protocol

Proactive routing protocols are also called as table driven routing protocol determine the topology of the network by interchanging the topological information among the network nodes. It is based on an underlying routing table update procedure in which after a fixed interval routing information are propagated. Each node in the network has one or more possible route to any possible destination this routing protocols try to maintain consistent, recent routing information at each node. To full fill these aim each node in the Network maintain one or many routing tables to contain recent routing information to all possible path at any given time.

2) On demand (reactive) routing protocol

The reactive routing protocols also called as on demand routing protocol are based on some type of query-reply dialog. Reactive protocols try to maintain the path between the source nodes to the destination node only when the need arises. Whenever source node has to send some data to the receiver node these protocol generate efficient routes for that the demand of route is first done by the source, as the name suggests. When a node needs a path to a destination, it start a route discovery process within the. This process is completed once a route is found or all possible route permutations have been examined. After that there is a route maintenance procedure to keep up the valid routes and to remove the invalid routes. So these protocols have no need of periodic transmission of topological information of the network. Ad- Hoc on Demand Distance Vector (AODV) is the example of reactive routing protocol.

3) Hybrid routing protocol

Often reactive or proactive feature of a particular routing protocol might not be enough; instead a mixture might yield better solution .the mixture of both protocols called Hybrid protocol which take the advantage of both reactive and proactive protocol but may require additional hardware such as GPS separated or integrated into the communication devices. Zone Routing Protocol (ZRP) is the example of hybrid routing protocol.

III. ROUTING PROCEDURE OF AODV ROUTING PROTOCOL

Ad hoc On Demand Distance Vector (AODV) [9] is come under the category of reactive routing protocol. AODV is multi hop routing protocol which enable the selection of intermediates node between the mobile nodes who want to establish path. AODV is based upon the distance vector algorithm. To find a path and maintaining links between the participating nodes various types of messages have been propagated like RREQ, RREP and HELLO message. A Route Request packet is broadcasts from a node to all its neighbors when a node wants to try and find a route. This RREQ packet is propagates and forwarded by all the intermediate nodes through the network until it reaches the destination or the node with a fresh enough route to the destination. A node which has the shortest path among the entire neighbor node from the destination node made the route available by uncasing a RREP back to the source. In this way a route is identified. Then to check the status of nodes or maintaining path this algorithm uses hello messages (a special RREP) that are broadcasted periodically to the immediate neighbors. These Hello messages are one kind of local advertisements which show that the node is continuously present. This message is broadcasted to all neighbors selected in routes to mark the routes as valid. If any node not sending Hello messages then it is the indication for the neighbor nodes that this particular node is move away and now not participating, in this case neighbor node assume that the link is broken hence it send a link failure notification to the affected set of nodes.

VI. LITERATURE SURVEY

The T. Senthilkumaran & V. Sankaranarayanan et-al [1] proposed a method for detecting congestion and controlling upon the congestion in ad hoc networks. Their work is based upon the calculation of approximate queue length in advance. For this purpose they calculate the average queue length at the node level. Network characteristics like congestion and route failure need to be detected and remedied with a reliable mechanism. To solve the congestion problem, a novel dynamic congestion estimation technique has proposed that could analyze the traffic fluctuation. By the assessment of average queue length, a node is able to find that there is some probability of congestion so it sends a warning message to its neighbors. When neighbors received the warning message they try to search some alternative congestion-free path to the destination. If any other path is available then predecessor nodes start further communication through alternative path. in network. So this dynamic congestion estimation procedure tries to provide a reliable communication within the MANET by controlling upon the congestion in ad hoc networks. Proposed DCDR uses a non-congested path discovery mechanism to prevent network congestion, hence packet loss rate is decreased, by which end-to-end delay is reduced so throughput is improved.

Reeta Bourasi & Prof Sandeep Sahu et-al [10] proposed a new technique to detect the packet dropper nodes in the network by using a reliability factor. In MANET each node has limited resources like limited battery power; a packet dropper node is that node in the network which may not cooperate properly in network operations to save their resources. Such nodes are called selfish or misbehaving nodes and these nodes are also the reason of congestion. Dropping of data packet not only affects the network connectivity, but also can widely waste the network resources. To handle this situation a scheme based on MAC-layer acknowledgements is used to detect the packet dropper nodes. To eliminate such nodes from the network its reliability is evaluated during the packet transformation. In this work the field of reliability factor is increased on the basis of acknowledgement received from the receiver, and all senders making decision to send a packet through a node having higher reliability factor. By including the reliability factor field at packet header it is possible to identity the packet dropper nodes because such nodes not forward the packet to the next hop but instead of this they drop the data packets hence they not receive the acknowledgement from the next node and so its reliability factor field is never increased. Hence on the basis of nodes reliability factor a packet dropper node can be detected and also can be isolated from the network this is not only improving the performance but also increasing the throughput of the network.

G.Vijaya Lakshmi, Dr. C.Shoba Bindhu et-al[11] overcome the congestion problem in mobile ad hoc network a queuing model is suggested in the current work. A queuing system consists of one or more servers that provide service of some sort to arriving customers. Customers who arrive to find all servers busy generally join one or more queues (lines) in front of the servers, hence the name queuing systems. The queuing mechanism is developed based on the probability distribution in different range of communication. The queuing mechanism hence improves the network metrics such as overall network throughput, reduces the route delay, overhead and traffic blockage probability. The approach is generated over a routing scheme in ad hoc network.

Majid Ahmad & Durgesh Kumar Mishra et-al [12] define and formulate an efficient reliability calculation technique for large scale MANET. Terminal-pair reliability is defined as the probability of successful communication between any two (selected) terminals in a network, so consequently terminal reliability depends on the participating terminals and also the connecting link. To calculate the reliability there method uses an exponential growth factor. As the number of nodes increases in the network, computation of reliability becomes unfeasible. To deal with the calculation of reliability in large scale mobile networks in this work a reliability calculation scheme has been proposed. In the proposed approach critical links within a network is identified. The proposed scheme takes critical nodes as the calculation assumptions and thus this method should be able to limit reliability calculation complexity within practical reach.

Ramratan Ahirwal , Ganesh Lokhande and Yogendra Kumar Jain et-al [13] give a suggestion to avoid congestion in MANET environment by estimating the bandwidth .In the proposed approach acknowledgement time intervals for bandwidth estimation in TCP flow is find out by monitoring the time spacing between received acknowledgements (ACKs) at the sender node. On the basis of this parameter available bandwidth of the connection between the sender and destination is find out. If available bandwidth is less than the actual data size then the data size is decreased according to available bandwidth so it works as a congestion avoidance mechanism. In this approach at the same time if other sender node also try to communicate with any destination through same available path which is used by previously senders then new sender

node and all other previously communicated sender node sends data according to available bandwidth of the intermediate nodes which will increase the network performance and provides congestion free communication.

Xibin Zhao,Zhiyang You,and Hai Wan et-al [14] presents a method for reliability analysis in MANET. They proposed that the number of neighbor nodes of each node is also a most important factor which has a great impact upon the node reliability in MANET .in their work they also analyzed the effect of the movement of node on the node reliability on a real MANET platform.It is also proved in this work that in the wireless network each node has limited capacity and limited resources,so if number of users increases too much then the throughput of the wireless network granted to each user decrease to zero as the throughput will influence the transmission capacity of the wireless network, and it will affect the terminal reliability of MANET. Congestion means arrival of excessive amount of packets at a network which leads to many packet drops. Then it will result in the unreliability of node. When a node keeps communications with many nodes which is called neighbor nodes come under the communication range of that node then there will always the chance that at the same time many neighbor nodes send their data packets to the same node, so there will be excessive amount of packets arriving at these nodes become the reason of packets drop. Hence congestion is related to the density of the node in some area, and it will influence the terminal reliability by reducing the node reliability. For each node, more neighbor nodes, mean more link connections between the nodes and their neighbors which result in the unreliability of node, so in this paper, when modeling the node reliability, focus is upon deducing the relationship between the number of link connections and the node reliability.

Srinivas Sethi & Siba K. Udgata et-al [15] proposed an Optimized Reliable Ad hoc On-demand Distance Vector (ORAODV) scheme that offers quick adoption to dynamic link conditions, low processing and low network utilization in ad hoc network. The proposed protocol (ORAODV) is designed for finding the optimal route and delivery of reliable packet. A new concept of Blocking Expanding Ring Search (Blocking- ERS) is used in it to avoid network wide broadcasting. The Blocking-ERS method not start its route search procedure from the source node,but every time a rebroadcast is required. The rebroadcast can be initialized by any appropriate intermediate nodes on behalf of the source node which acts as a relay or an agent node. Retransmission of data packet in ORAODV provides satisfactory performance in term of packet delivery ratio (PDR), normalizing routing load (NRL) and delay for different network density in term of number of node, various mobility rates.

Robin Choudhary & Niraj Singhal in [16] proposed the existing solution in loss classification and control the congestion areas are based on the network parameter such as Route Request Time (RRT), Retransmission Time Out (RTO) bandwidth and number of nodes are used for communication between sources to destination in MANET. These techniques are totally depending on the receiving ACK and sending ACK for each receiving packet. The most existing technique does not getting differentiate between the link of failure with other type of failure. This paper studies problem deeply by determining whether link failure loss occurrence or not.The link failure and network partitioning which mainly created by a failure such as mobility and battery depletion has negative on MANET. To solve this problem a novel approach, which uses velocity change and change angle in spherical coordination system to classify and control the congestion before packet lose in MANET is proposed.

VII. PROBLEM IDENTIFICATION

MANET is based upon the nodes mobility model that uses dynamic topology which is the composition of many configurations, and each configuration has its existence probability. Transformation of data in ad-hoc environments exhibit less network performance because link breakage is most frequent due to nodes movement which is the main reason of route failures in MANET. There are many routing algorithms, but these have problem of congestion which decreases the overall performance of the network. In a self- organized network, nodes are autonomous they may free ride and may not cooperate properly in network operations to save their resources. Such nodes are called selfish or misbehaving nodes and their behavior is termed selfishness or misbehavior. If such types of unreliable nodes are use for further communication they having a strong impact on transport layer protocols such as TCP, which are highly sensitive to packet losses.

VIII. PROPOSED SCHEME TO REDUCE CONGESTION IN MANET

In this proposed work to increase the network performance, local route discovery concept is used with traditional AODV routing protocol. To control the congestion problem a reliability factor field has been included which is used to measure weather the node is

likely to be congested node. Inclusion of reliability factor makes it possible to detect the packet dropper nodes and by selecting different route we are able not only to improve the performance but also increasing the throughput of the network. To select a reliable path from source to destination in traditional AODV a local route discovery mechanism has been applied on the intermediate nodes. Each node which is selected by AODV for the transmission of data packets keeps track of its reliability according to its 'reliability factor' while transferring data. Whenever a node communicates with another node in the network, it maintains reliability factor with the help of data receives and forward base. Here the term reliability factor is estimated according to the delivery result. If a node has correctly forwarded the packet its reliability factor is positively updated and if it drops the packet its reliability factor will be decreases. It means the reliability of the network will be affected by the packet loss of any node on the path, and the performance of the node can be calculated by this reliability factor. To estimate the reliability of a node we put a threshold value and after arriving of each N no of data packets on the node value of reliability factor will be checked. If reliability factor become less then the threshold it indicate that this node is not so reliable and it is likely to be a congested node so it will send a reliability status packet to all its neighbors node to search any other alternative route to forward the data packet. In response only the predecessor node calls for a local route discovery process to find a new route to the destination.

A. Assumptions:

The main purpose of this work focuses on the node reliability which is the resource constrained and have dynamic MANET environment. In order to focus on the key factors and simplify the analysis, we list the assumptions as follows:

(1) The nodes which become source nodes and destination node during simulation are known.

(2) Every node is of the same type and with the same situation like they have same queue length and same mobility model.

(3) Every node transmission range is same, and if any node come in the wireless transmission range of other node then they are considered to be connected).

(4) The mobility of node is the random waypoint mobility model.

(5) There is only two possible state of every link i.e. the link is either exists or does not exist.

Proposed Algorithm:

Equation: if rl > = threshold,

(node is reliable no action required) Else node is unreliable

{Apply local route finding mechanism to find secondary path}

Steps of Algorithm:

In this section we design proposed algorithm and provide reliable communication to mobile ad-hoc network and calculate packet delivery ratio, throughput and routing load of the network.

Initialization:

Step1: Mobile Node: n Intermediate I: € n Reliability factor: β Transmitter: T Receiver: R

Path reliability parameter: α

Step2: Routine Protocol: AODV

Step3: T node search R node using AODV

Step4: get shortest path T to R node

Step5: send data from T to R

Step6: if (I receive data && Forward data)

Calculate β = (forward / receives) If (β ==1)
{
Increment α by 1
}
Else if (β == 0)
{
Decrement α by 1
}
Step7: check α value for reliability path or not
If (α == 0)
{
Call local route repair
}
Else {path is reliable} Step8: generate output trace file

Step9: pass trace file to PDR calculation module

```
Step10: if (field = S && data == tcp || udp)
{
Send++;
}
If (field == r && data == tcp||udp)
{
Receives++
}
Step11: calculate PDR = (Receives/Send)*100; Step12:
Generate PDR output file
```

Step13: Display PDR graph and compare with existing algorithm.

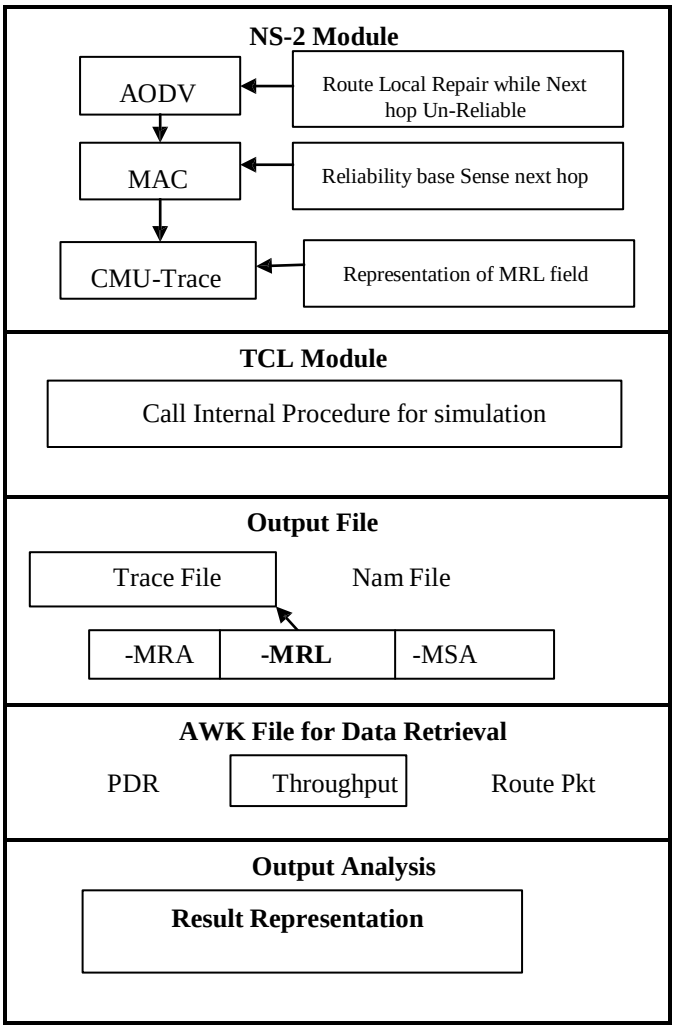

Figure 1: Working Architecture

IX. WORKING ARCHITECTURE

Here we represent proposed working architecture for reliable communication with congestion aware base data forwarding mechanism in mobile ad-hoc environment, in this architecture we divide our proposed module in subsection, here first step of network simulator updating module, that section we inbuilt local route repair method on the bases of node reliability value, if any node reliability greater than threshold than that is right path else we re-search route with the help of local route call method, next MAC layer we extra filed added MRL (MAC Reliable Value) and that filed utilized to identifies current time value of reliability. Next subsection is TCL (tool command language) here we call all the required method to simulate network behavior and after that generate result file name as trace and NAM (network animator file). Trace file pass to awk (abstract window tool kit) and analyze the behavior of the network on the base of network parameter packet delivery ratio, route load etc.

X. SIMULATION CONFIGURATION

Network Simulator Version 2 also known as NS-2 [16]. NS-2 is an event driven packet level network simulator developed as part of the VINT project (Virtual Internet Testbed) [1]. This was a collaboration of many institutes including UC Berkeley, AT&T, XEROX PARC and ETH. Version 1 of NS was developed in 1995 and with version 2 released in 1996. Version 2 included a scripting language called Object oriented Tcl (OTcl).

The network consists of 50 nodes in a 800 *800 m terrain size. The radio range is 250 m with bandwidth 512 kbps. The MAC layer is based on IEEE 802.11 (WiFi) distributed coordination function. The channel propagation model we used was the 2- ray ground reflection model. An interface queue at the MAC layer could hold 50 packets before they were sent out to the physical link. Link breakage was detected as feedback from the MAC layer. The routing protocols we used are AODV. The data flow used constant bit rate (CBR) and File Transfer Protocol (FTP). The maximum speed of the node is 10 m/s and the simulation time is 100 seconds.

A. Performance Metrics

We considered the following important metrics in this evaluation:

1) Packet Delivery Ratio (PDR):

The ratio of packets received between the destination and the number of packets sent by the source.

2) End-to-end delay:

The delay a packet suffers from leaving the sender to arriving at the receiver.

3) Routing overhead:

The total number of control packets transmitted during the simulation time. For packets sent over multiple hops, each transmission over one hop is counted as one transmission.

4) Throughput:

This is the measure of how soon an end user is able to receive data. It is determined as the ratio of the total data received to required propagation time.

XI. RESULT DESCRIPTION

Simulations results are evaluated on the basis of considered simulation parameters of protocols and performance of protocol is measured through metrics.

A. Routing Load Analysis

This graph represents the routing load analysis in case of normal AODV routing and proposed reliability based routing. The routing packets are required to established connection in between sender and receiver. In this graph the routing packets in case normal AODV routing about more than 3200 packets are deliver in network but in case of proposed reliability based scheme about only 1990 packets are deliver in network in a given simulation time.

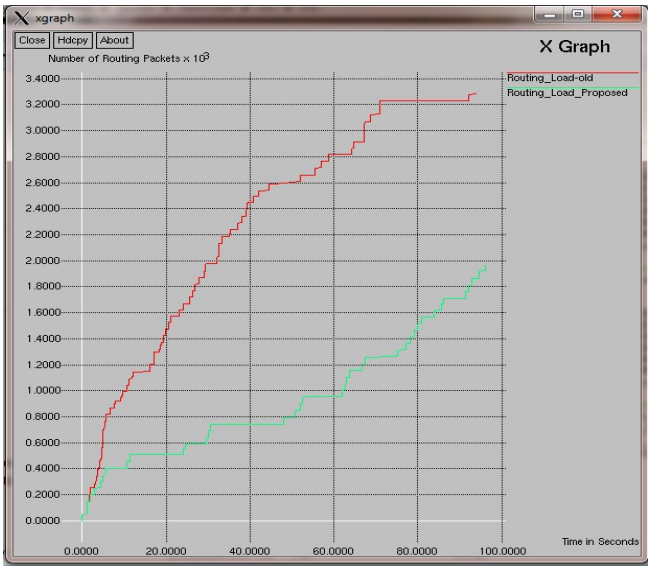

Fig. 1 Routing Load Analysis

The proposed scheme is reduces the flooding of packets in network.

B. PDR Analysis

The PDR analysis in case of normal AODV and proposed AODV is mentioned in this graph. Here the percentage ratio of normal routing and proposed reliability based routing is mentioned. The PDR in case of normal AODV routing is about 84 %and in time between 40seconds to 60 seconds it is about 89%. The PDR incase of proposed AODV-LRD reliability scheme the PDR is about 91 % and in time between 40 to 60 seconds the PDR is reaches to 97%. It means the reliability based routing are improves routing capability of AODV protocol.

Fig. 2 PDR Analysis

C.UDP Received Analysis

Fig.3 UDP received Analysis

The UDP packets received in case of proposed and normal AODV routing is mentioned in this graph. The packets received in case of proposed AODV-LRD reliability scheme is about 4000 and in case of normal AODV routing the packets are only received about 3550. The performance in case of proposed scheme improves the end to end deliver of data packets.

D. Overall Summarized Analysis

The overall performance in case of normal AODV and proposed AODV is mentioned in table 1. The performance in case of normal AODV is better but after modified it in to AODV-LRD reliability scheme the performance is enhanced.

Table 1 Overall Performance

Parameters	Old Scheme	Proposed Scheme
SEND	8976	9288
RECV	7560	8361
ROUTINGPKTS	3282	1964
PDF	84.22	90.02
NRL	0.43	0.23
DROPRTS	149	76
No. of dropped data	1416	927

XII. CONCLUSION WITH FUTURE ENHANCEMENT

Congestion in a network signifies that a node at any interval became congested and started to lose packets. A MANET network is to be defined as a network which will keep on stretching as the hops are added on. As MANETs support multi-hop communication, making it easy to realize a scalable network. Multi-hop communication but has certain challenges like the routing burden on intermediate nodes. The congestion possibility is occurring due to load on network. The proposed reliability based scheme is check the reliability of nodes on the basis of mobility of nodes. The link is break then in AODV the LRD is repair the link and the reliability of link is maintained. The proposed scheme is reduces network congestion by ways of reducing the unnecessary flooding of packets and finding a congestion free path between the source and the destination. The proposed AODV_LRD uses a new reliability based approach for detecting congestion dynamically. It uses a non- congested path discovery mechanism to prevent network congestion, and hence packet loss and end-to-end delay are reduced and throughput improved that also improves the routing performance.

In future we also modified the Local Route method on the basis of range of mobile nodes. The nodes that are slow in mobility and rage to neighbor or requestor node is less selected for routing.

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