

Reliable Route Discovery using Link Break Prediction Multicast Routing in MANET

Bhavana Verma, Shivank Kumar Soni, Chetan Agrawal

Abstract— In MANETs, there are several crucial problems like energy consumption, QoS (Quality of Service), exposure to attacks, link stability, etc. that require to be addressed for improved communication. 'Link Stability' or 'Reliable path' is important because radio links are likely to be unreliable due to node mobility. To extend the link stability, we need to solve the problem of link breakages in the networks. Because these link breakage problem causes high data loss and delay. In order to resolve these problems, the concept of link breakage prediction has appeared. In this dissertation, we have proposed a link breakage prediction algorithm. It works on RSS-Distance based multicast methodology under the multicast communication. In which the nodes calculate the link breakage time and further warns the other nodes regarding the link breaks within the route. Based on this information, a new route discovery is initiated much sooner than the route breakage. The performance of the proposed link breakage prediction algorithm is compared with previous ODMRP and MORALISM. As it reduces packet drops, the average end-to-end delay. It also provides the best feasible path that reduces the packet loss and improves data packet delivery ratio within the network. The Proposed technique shows an improvement in the Quality of Service.

Index Terms— MANET, Route Stability, AODV, MORALISM, RSS, Link breakage, Mobility

1 INTRODUCTION

MOBILE Ad hoc Network (MANET) is another form of multi-hop communication networks without any type of infrastructure. In MANET's - ad hoc network refers that, the nodes form a network on the fly. All MANET nodes have the same functionalities, rules, specification, can operate as a host and a router at the same time, and can randomly move without any restrictions. The above characteristics make MANETs an ideal candidate to extend the cellular networks coverage, to recover from disasters, and to use them as communication networks among soldiers in the battlefield or among the researchers during the conference.

Normally, MANETs are likely to be used for communication between the groups, where multicast protocols are more appropriate as compared to unicast protocols because it improve the efficiency of the wireless link in MANETs. Multicast protocols are more applicable, when an application demands to send multiple copies of messages from multiple sources to multiple receivers. As it reduces the communication cost by sending a single copy of the data to multiple recipients instead of sending multiple copies by using multiple unicasts. Thus, it minimizes the link bandwidth, processing, and transmission delay [1].

The routing protocols play a crucial role in both link failure detections and fixing these failures. Ad-hoc wireless routing protocols can be categorized into three different category [2, 3] specifically proactive, reactive and hybrid routing protocols. Proactive protocols maintain all the routing information to reach each mobile node within the network. It also referred to as the table driven protocols. Destination Sequence Distance Vector routing protocol is an example of the proactive category. Reactive

sometimes-alternative routes when required. In general, Reactive routing protocol searches for a route when there is a need to send packets to the destination. In addition, the mobile nodes try to discover alternative new mobile nodes as well as paths to the destination. Hybrid protocols combine the features of both the reactive and the proactive routing protocols. Zone routing protocol belongs to this category.

The big challenge in MANETs is the link failures, which are frequent events in this kind of networks as compared to wired communications. Node mobility, limited energy resources, fading, Channel interference, dynamic obstacles, applications' bandwidth demands are the causes of link failures in MANETs. Link failures interrupt the communication till the failure is detected and fixed; which causes severe performance degradation especially compared to other kinds of communication networks. Based on that, studying link failure detection and network recovery are interesting and important research topics to investigate. The first step to solve the link failures' problem and mitigate their impacts in MANETs, is the link failure detections. By implementing a fast and an accurate mechanism to detect link failures, and a powerful reconfiguration scheme to recover from the link failures, we proposing a "RSS-Distance based multicast methodology under the multicast communication using AODV routing protocol" and metrics greatly enhance the MANETs' performance.

In this paper, RSS-Distance based multicast methodology under the multicast communication using AODV routing protocol is proposed Reliable Route Discovery. The remaining sections of this paper are arranged as follows: Section II illustrates the related works for link stability from the literature. Section III explains proposed methodology Link Prediction Routing Scheme. Section IV discusses the simulation results through graphs. The final section concludes this work with future development.

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routing protocol such as AODV searches for the route or

2 LITERATURE SURVEY

In this section, the previous work description is mentioned. These works are provides the some thought about new work in MANET.

In 2017 by Mina Ghafouri vaighan, Mohammad Ali Jabraeil Jamali introduced "A multipath QoS multicast routing protocol based on link stability and route reliability in mobile ad-hoc networks". In this title, they propose a more steady and more dependable in multi-path quality of service multicast routing protocol (SR-MQMR) for mobile ad-hoc networks [4]. In this, they first used the signal strength of nodes to choose the most stable nodes. Then, using the two conditions of route expiration time and the number of hops, they selected a route, which had low delay and high stability.

In 2017 by Gaurav Singal, Vijay Laxmi, Manoj S Gaur, D Vijay Rao, and Riti Kushwaha proposed "QoS-aware Mesh based Multicast Routing Protocols in Ad-Hoc Networks: Concepts and Challenges". They present a study of various QoS techniques and existing enhancement in mesh based MRPs [5]. Mesh topology based MRPs are classified according to their enhancement in routing mechanism and QoS modification on ODMRP protocol to improve performance metrics. This paper covers the most recent, robust and dependable QoS and Mesh based MRPs, categorized based on their operational features, with their advantages and limitations, and provides comparison of their Performance parameters.

In 2017 by N. Sureshkumar and S. Bhavani introduced "Design And Development Of Fuzzy Based Reliable Scheme For Energy Efficiency In MANET". In this research work, they designed and implemented the Reliability based Stable Scheme (RSS) to attain maximum throughput [6]. Link reliability and node reliability calculated based on capacity and mobility metrics. In this, they developed reliability model to attain utmost performance. Based on the analysis using simulation tool, the proposed work achieves better outcome than existing schemes in terms of jitter, throughput, packet delivery ratio and Network reliability.

In 2017 by Abdelkabir Sahnoun, Ahmed Habbani and Jamal El Abbadi proposed "EEPR-OLSR: An Energy Efficient and Path Reliability Protocol for Proactive Mobile Ad-hoc Network Routing". In this title, they consider the proactive MANET protocol OLSR to increase the network lifetime [7]. They proposed a novel multiple metric routing schemes for MANET, based on energy efficient and path reliability metrics, integrating it to standard OLSR, named Energy Efficient and Path Reliability OLSR (EEPR-OLSR). In which they examine cross layer parameters that predict the probability that an active link between two nodes and it showed the positive impact on the network lifetime.

In 2017 by Sujata V. Mallapur, Siddarama R. Patil and Jayashree V. Agarkhed stated "A Stable Backbone-Based on Demand Multipath Routing Protocol for Wireless Mobile Ad Hoc Networks". In this title, they constructed a stable backbone-based multipath routing protocol (SBMRP) [8]. In which, initially the

nodes with high remaining bandwidth, left over power, link quality and low mobility are designated as candidate nodes. Then multiple paths are established between source and destination through these candidate nodes, thus forming a routing backbone. Therefore, the candidate nodes become multi-path enabled nodes that can transfer data using multipath links. If any candidate node in the path tends to fail due to deficient of bandwidth, energy or link quality, alternate path through another candidate node is established before path breaks. Simulation result shows that SBMRP was able to locate more stable paths then AODV, AOMDV and RSQR.

In 2017 by Faheem khan, Sohail Abbas, Samiullah Khan implemented "An Efficient and Reliable Core-Assisted Multicast Routing Protocol in Mobile Ad-Hoc Network. "In the title, firstly the proposed method selects the core within the receiver group based on multiple constraints like battery capacity and location [9]. As a result, a more stable core is selected with minimum core failure. Secondly, to enhance the reliability and decrease the delay, they introduced the idea of the mirror core. The mirror core takes the accountability as a main core after the failure of the primary core and has certain advantages such as maximum reliability, minimum delay and minimizing the data collection process.

In 2016 by Chandra Prakash Sharma, Savita Shiwani developed "Link Quality Driven Multipath Routing for Mobile Ad Hoc Networks". In this title, they propose a multipath route discovery algorithm, which considers the quality of an intermediate link as a metric for its insertion in the possible routes chosen between a source-destination pair [10]. They can use the secondary route without a new route detection process due to this the network overhead caused by a route discovery process will be avoided. The proposed LQMR routing protocol is applied in the trail version of network simulator called exata. The simulation results are taken on various network scenarios that are made with varying network loads and network mobility to check the effectiveness of our proposed method. Various presentation metrics are used to assess the simulation results gained such as end-to-end network delay, network routing overhead and packet delivery ratio. The performance metrics asses and analysis show that the proposed LQMR protocol greatly improves the performance of data transmission in MANETs while effectively handle the topology changes caused by the network mobility.

In 2015 by B.Thenral, K. Thirunadana Sikamani introduced "Enhancing Link Stability of Multicast Routing Protocol (ELSMRP) In Wireless Mesh Networks". The objective of this work is to increase the lifetime of the route and to reduce the need for route maintenance [11]. The proposed protocol is based on On-demand Multicast Routing Protocol (ODMRP). This mechanism finds the stable route against route failure and movement of mobile node by altering the mechanism of both route discovery and data multicasting. The proposed routing protocol extends the route lifetime; decrease the use of route maintenance mechanism; reduces end-to-end delay and control overhead.

3 AODV PROTOCOL

(Ad-hoc on demand Distance Vector)

3.1 Introduction

AODV protocol (Ad-hoc on demand Distance Vector) [12, 14]. AODV is a reactive routing protocol based on the distance vector algorithm. where path between two nodes is calculated when needed (i.e. when a node wants to send data packets it initiates Discovery Phase to find a new path, uses it during the transfer phase, and it must maintain it during utilization (Maintenance Phase).

A set of control packets such RREQ (Route REQuest), RREP (Route Reply), RERR (Route Error), RRepAck (Route Reply Acknowledgment) and Hello messages (Hello) are used in discovery and maintenance process.

In AODV protocol, a routing table is associated for each node to store information as Destination address, active neighbors list, hops number to reach the destination, TTL after which an entry in the table becomes invalid, and so on.

The use of sequence numbers eliminates the formation of infinite loop, limiting control packets transmission (i.e. overhead phenomena) and allows the use of fresh paths in node mobility case, as they help to ensure routing information consistency and coherence [12, 13].

3.2 Discovery Phase

Every time, a node wishes to transmit, it checks its routing table for any valid road to desired destination. If isn't the case, it lunches the discovery phase. This operation is initiated by broadcasting RREQ control packet specifying parameters such as sequence number to be used to indicate fresh roads, pair (ID packet and IP source address) to check if request is already treated by node or not (problems of duplication) and TTL (Time To Live) (number of hops) that is assigned to the initial value TTL_START [14].

If no response is made after RREP_WAIT_TIMEOUT period, the same RREQ is rebroadcast by source node but with a TTL incremented by TTL_INCREMENT (more hops, and therefore more chance to find a road) and waiting period for response has longer time than the previous one [13, 14].

When an intermediate node receives a request (RREQ), it checks its routing table for availability of path to the destination and if so, a reply packet (RREP) is returned to source telling him how to reach the destination. Otherwise it increments hop count and rebroadcasts RREQ packet. Before sending, node stores source IPs and node from which a first copy of application is received, he will use it to construct reverse path to be traversed by the RREP packet in unicast [13].

When the RREQ packet reaches the destination node, the latter constructs a RREP packet and forwards it in reverse, using previously saved IPs and at each passage by node in reverse path, field "hop count" of this packet (RREP) is incremented (distance in number of hops) [13].

3.3 Maintenance Phase

In order to maintain consistent roads, periodic transmission of HELLO message (which is a RREP with TTL equal to one) is performed. If three HELLO messages are not received consecutively from neighboring node, the link in question is considered as failing. Paths failures are generally due to nodes mobility in Ad hoc Network. If unsuccessful, the source node tries to find another path and decrements the attempts number (RREQ_RETRIES) by one [13].

4 PROPOSED LINK PREDICTION ROUTING SCHEME

In proposed method location information of nodes is received by sender to send data at accurate position of destination. The all nodes are maintaining the location information and these nodes are also update the location information according to the change of link is network. The proper location information is necessary for finding the node location. The link stability in MANET is necessary for sending data packets properly. The location identification is reduces the cost of flooding packets and the proper RSS is better, if the propagation of signals are better. The nodes mobility is slower, than it is also possible the link stability in between the sender and receiver is also strong. After this survey, a new proposal is possible to provide better results and this proposal is:-

1. First the routing protocol in MANET is flooded the route request and receive route reply.
2. The route request and route reply is also possible to maintain the record of mobile nodes location, mobility speed, direction, signal strength and energy.
3. The weak RSS (Received Signal Strength) is not possible to provide the strong link in between sender to receiver, so that the selection of successor node is higher signal strength with near distance and contain higher energy.
4. The route selection is also based on the minimum mobility and having maximum RSS.
5. The criteria of minimum mobility are on first priority always.
6. On demand multicast routing protocol (ODMRP) provide on-demand procedures to dynamically build routes and maintain multicast group membership whereas node in mobility zone.
7. Then based on that the simulation results of routing performance are evaluating in all aspect of network parameters.

4.2 Proposed Algorithm:

Algorithm: RPLBP Multicast routing for MANET

Input: K: mobile nodes

S: source nodes $\in K$

M: $\{m_1, m_2, \dots, m_{n-1}, m_n\}$ group of multicast nodes $\in K$

Q: $\{q_1, q_2, \dots, q_{j-1}, q_j\}$ mediator nodes $\in K$

d: effective distance between two nodes i.e. q_1 to q_2

rss: receiving signal strength

α : rate change

PL: path length initial 0

e_i : energy of i th node

e_{th} : energy threshold 10 joule

s_i : speed of i th node

rt_i : routing table ($e_i, d_i, rssi, s_i$) of i node

R_p : AODV

M_p : ODMRP

z_n : network range 550m²

Output:

PDR, delay, overhead, prediction overhead, route failure

Procedure for Route Initiation:

$S \in K$ call (AODV)

AODV form route packet (S, M, AODV)

If q_m is in z_n & $e_m > e_{th}$ & $q_m \neq M$

than $PL \leftarrow PL + 1$ $rt_m \leftarrow q_m (e_m, d_m, rssi, s_m)$

calculate q_m direction with respect to predecessor

store direction(q_m)

Else If q_m is in z_n & $e_m > e_{th}$ & $q_m = M$ & $rt_m \geq 1$

than Select rt_m with q_m

(high e_m , near d_m , high $rssi$, low s_m)

store direction(rt_m)

found m_j as multicast coordinator

m_j execute M_p

join m_n for data receiving

Else M out of range

End if

Procedure for Link Failure Prediction and Re-Joining:

$P_i \rightarrow j$ Stable Path from S to m_j

time = time + α (change time)

If q_u not in z_n & q_u eliminate from $P_i \rightarrow j$

than Local route repair execute

Route search packet in direction of m_n

find q_k node to join break link $P_i \rightarrow j$

insert $rt_k \leftarrow q_k (e_k, d_k, rssi, s_k)$ in route table

new path $P_i \rightarrow j$ established

reform m_n node for data receiving

Else if q_u in z_n & q_u of $rssi$ low & q_u of du greater than Estimate their update location by $\alpha(rssi)$ & $\alpha(du)$

If $\alpha(rssi)$ & $\alpha(du)$ decreases in each step time than Alter message sends to predecessor node

Local route repair execute

Repair disjoint path

reform m_n node for data receiving

Else monitor s_i of q_u and direction

End of Else

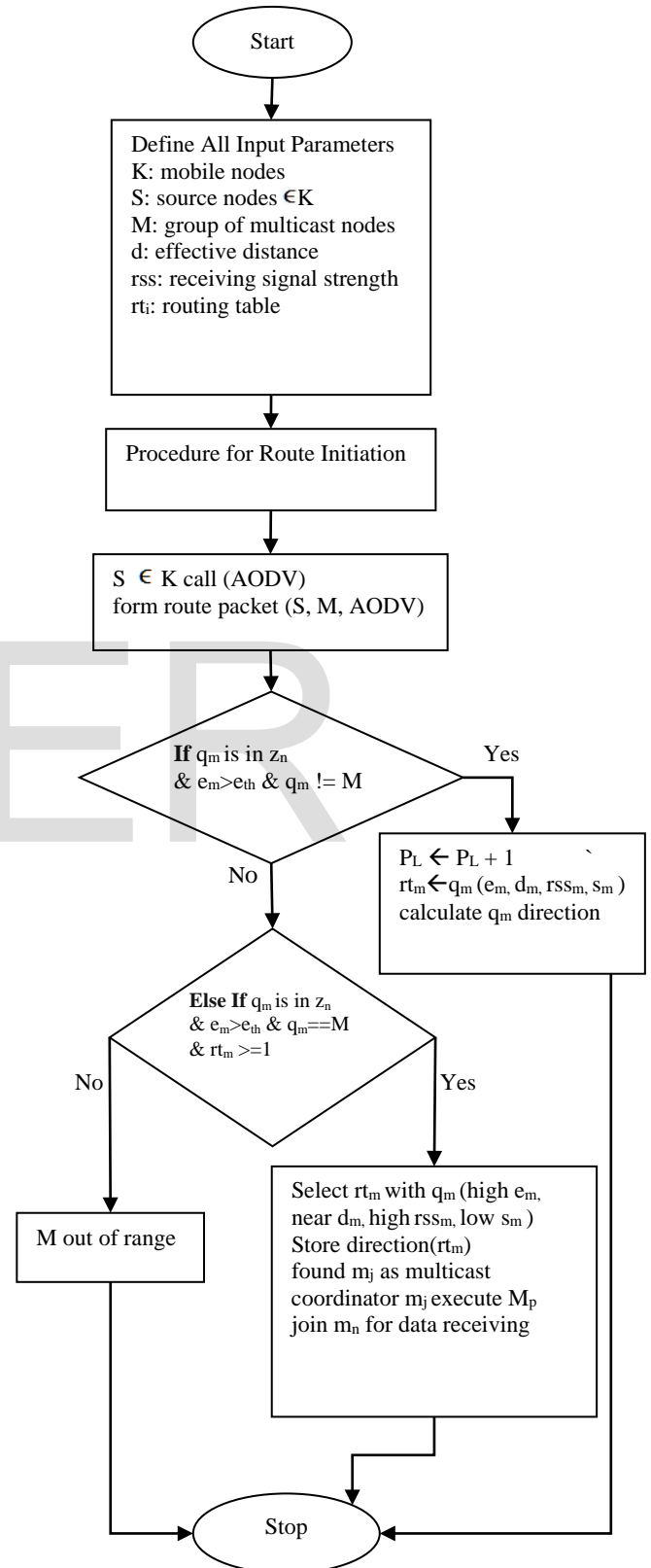
$P_i \rightarrow j$ Stable Path from S to m_j monitor

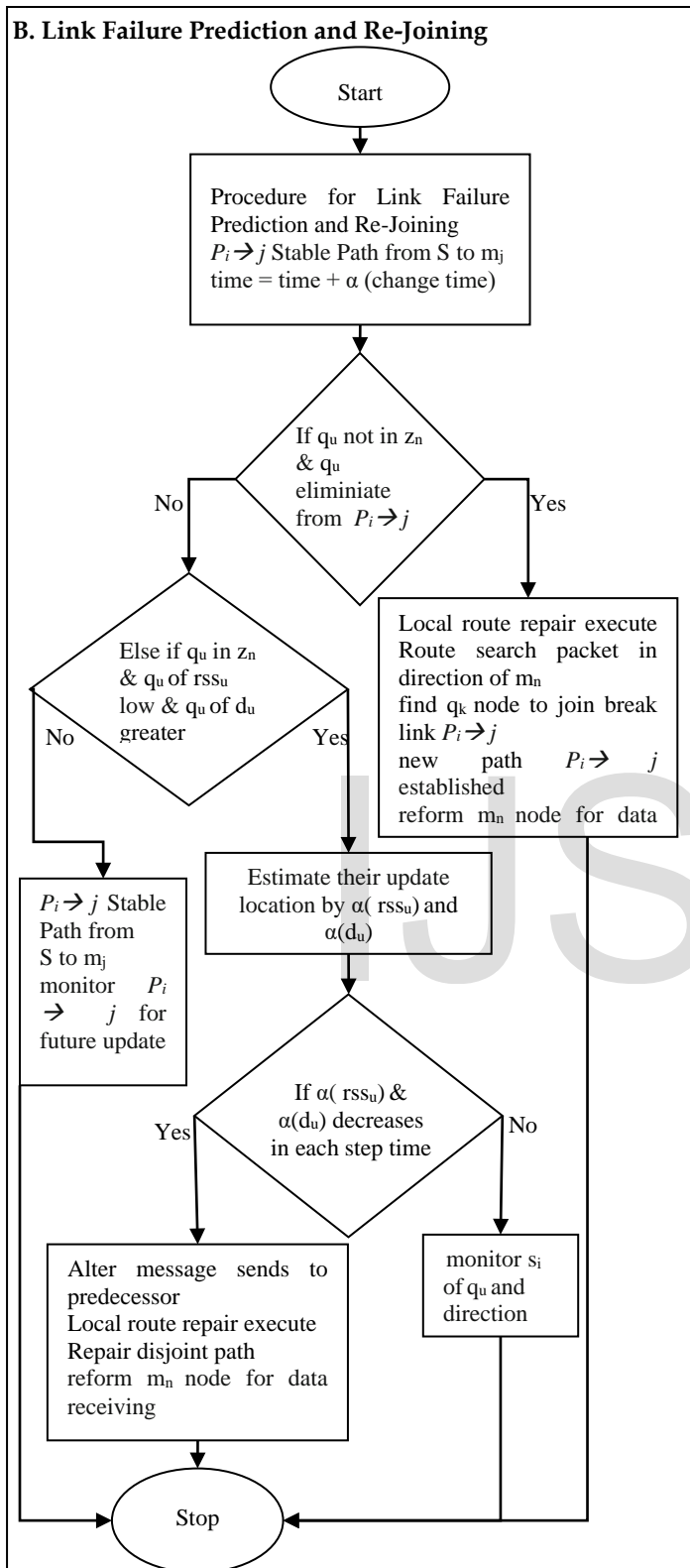
$P_i \rightarrow j$ for future update

End if

4.2 Proposed Flowchart

A. Procedure for Routing Initiation





In this flow chart shows that how the link breakage are prediction and establishing new link if link are failure. That flow chart split into two parts in first part shows the initial link establishment process using AODV routing and ODMRP based multicasting approach. In the second step predict the

link failure possibility using receiving signal strength, location and energy based approach.

5 SIMULATION PARAMETERS

The simulation parameters are playing the very important role in simulation and because of that the whole network scenario is dependent. Parameters are completely decided on the basis of protocols used in simulation. The parameters are considered in this simulation are mentioned in table1. According to these parameters the simulation of attacker and prevention scheme is simulated and measures the performance of dynamic network. The simulation of protocols are done in NS-2 [15] simulator.

TABLE 1 PERFORMANCE PARAMETERS

Number of	50
Communicatio	550 m2
Routing	AODV
Mobility	Random way point
Multicasting	ODMRP, MORALISM, RSS-
Transport	TCP ,UDP
Traffic type	CBR , FTP
Multicast	10 (Varying)
MAC Standard	802.11
Antenna Type	Circular
Number of	20
Node Speed	Random
Energy Model	Used

6 RESULTS AND DISCUSSION

The results of three modules like ODMRP, MORALISM and proposed RSS-Distance based multicast protocol is measured in dynamic network.

Data Success Delivery Ratio:

The multicasting routing approach is more efficient then the unicast routing approach because more than one receiver receive data from single sender. The number of data packets sends in network is good in quantity is represent the better bandwidth availability in network. The proper data receiving is improves the performance because every performance is based on the better data delivery in any network at routing layer. In this graph proposed RSS-Distance based multicast is provides maximum performance as compare to MORALISM and normal ODMRP multicast routing in MANET. Actually, the performance of network is measured at receiving end in network. The link between the nodes maintained efficiently to predict the link break possibility and manage the loss of data. The difference in packet receiving is very high that shows the better performance.

Data Success Delivery Ratio			
Mobility Speed (km/h)	ODMRP(%)	MORALISM (%)	Proposed (%)
3	75.35	84.75	92.3
9	71.55	80.81	89.03
12	63.18	78.96	82.64
18	56.91	67.07	79.29

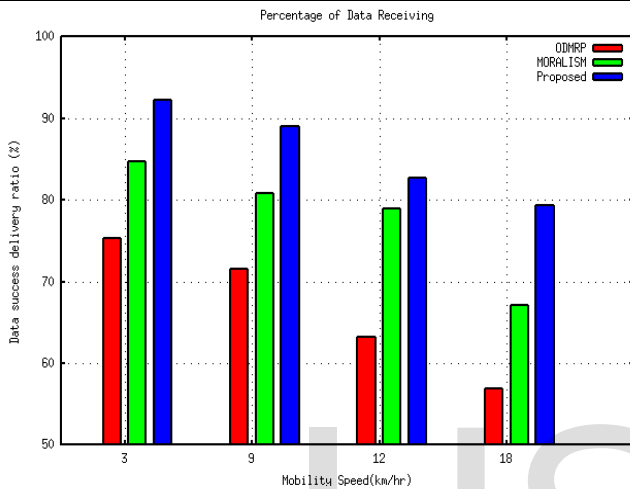


Fig.1 Data Success Delivery Ratio Performance

Average End to End Latency:

Latency refers to delays in transmitting or processing data across a network from source to destination. The average delay in network is increase in network because of link breakage quickly in MANET. The nodes functioning are completely depending on the limited battery power of nodes or node energy. In this graph the delay is counted of MORALISM, ODMRP protocol and proposed RSS-Distance based multicast provides the better performance in decentralized network. The proposed scheme is reduces the loss data because of that the overhead in network is reduces and the delay is network is also reduces. The Received Signal Strength of nodes are better that shows the strong connection possibility with receiver and the loss of data is also less in network.

Average End to End Latency			
Mobility Speed (km/h)	ODMRP (msec)	MORALISM (msec)	Proposed (msec)
3	8.75	6.39	4.6
9	9.2	5.83	5.69
12	9.53	7.61	6.79
18	10.86	7.46	6.04

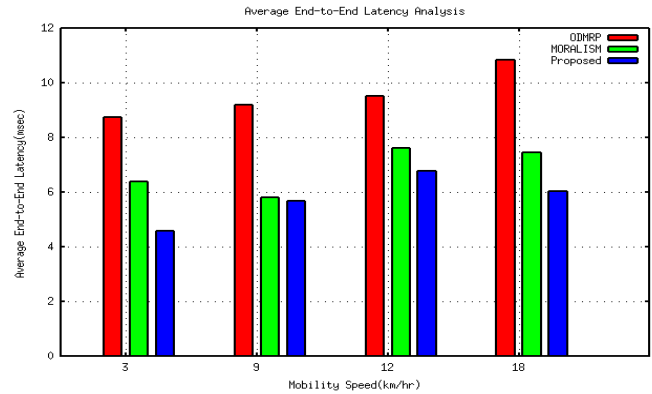


Fig.2 Average End-to-End Latency Analysis

Routing Overhead Analysis:

In mobile wireless network the sender/s are first send the route request in network to identified the destination. In multicasting routing the all receives are sending the conformation of data delivery. In this graph the multicasting routing approach in MANET with coding scheme is improve routing the performance and reduces the overhead that shown in given graph. In this graph, more overhead shows the possibility of link breakage and packets jamming possibility. The more overhead is shows the load in network is not handled by previous MORALISM protocol efficiently. The proposed approach is provides the better-multicast communication in MANET.

Routing Overhead Analysis			
Mobility Speed (km/h)	ODMRP (%)	MORALISM (%)	Proposed (%)
3	13.5	14.94	11.76
9	14.45	15.56	12.62
12	14.94	16.71	13.69
18	15.13	18.47	14.93

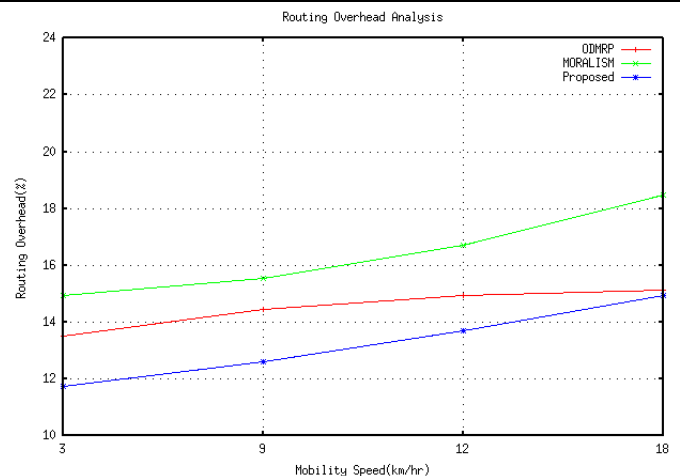


Fig.3 Overhead Analysis

Prediction Overhead Analysis:

The nodes are freely moves in network with random speed, their distance from each node is change continuously, and the RSS value is vary according to distance. In dynamic link the connectivity between the nodes is the big problem. The destination is not directly available for sending data packets. In this graph the packets flooding in MORALISM and ODMRP protocol is high, because of that, the overhead prediction is also high but in proposed scheme the overhead is less that shows the fine receiving of packets at detonation. The multicast routing approach is efficient for delivering same messages to multiple destinations but in low overhead cost that is only possible in proposed scheme in MANET.

Route Failure Analysis			
Mobility Speed (km/h)	ODMRP (%)	MORALISM (%)	Proposed (%)
3	4.73	2.01	1.81
9	6.68	3.41	2.53
12	9.7	4.19	3.63
18	15.58	5.28	4.14

Prediction Overhead Analysis			
Mobility Speed (km/h)	ODMRP (%)	MORALISM (%)	Proposed (%)
3	3.67	13.7	3.2
9	3.62	14.62	3.26
12	4.57	15.46	3.28
18	5.28	17.91	3.27

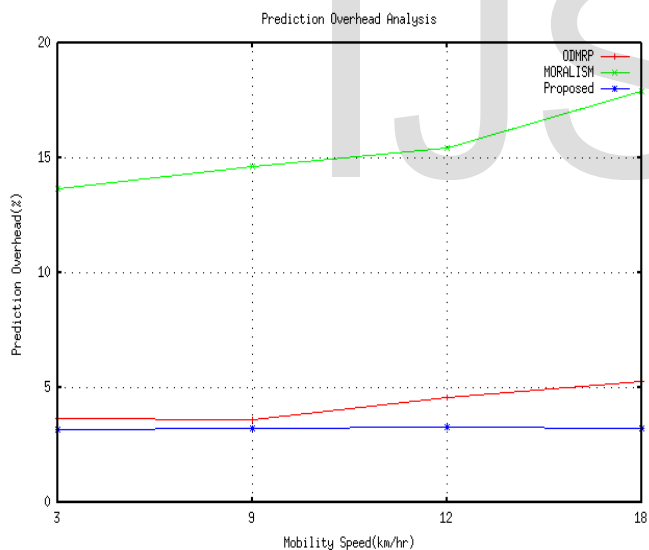


Fig.4 Overhead Prediction Analysis

Route Failure Analysis:

The route failure problem is common in dynamic network because nodes are continuously moves with different mobility speed. The route is break if the existing node is goes beyond the coverage area of communication and the problem is that the route establishment is again initiated form the sender. The proposed RSS-Distance based multicast methodology is reduces the route failure possibility in network. The route failure chances are also enhance after enhancing the mobility speed but less then MORALISM and ODMRP in network.

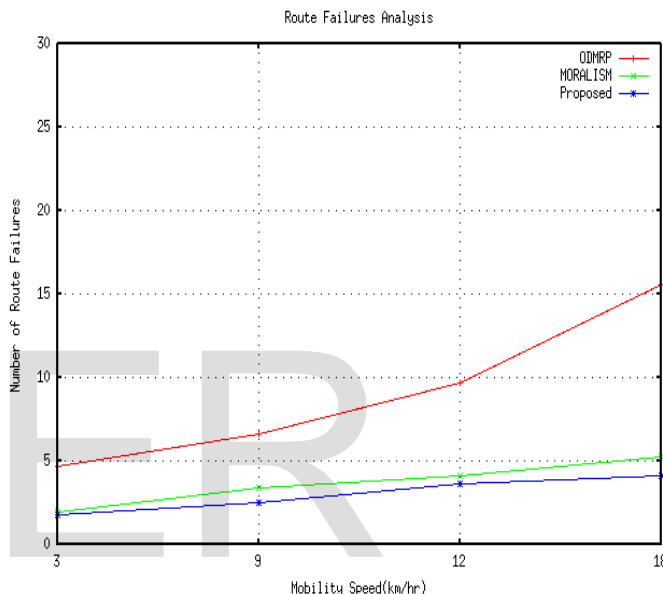


Fig.6 Route Failure Analysis

7 CONCLUSION AND FUTURE WORK

The multicast routing is MANET is sending the bundle of messages to multiple destinations through ODMRP protocol. Consecutively to diminish the retransmission cost, we have proposed an RSS-Distance based multicast link break prediction mechanism to improve multicast routing performance and assign more storage availability by reducing the data multiple copy of messages. The selected message to the alternative node and these mobile nodes are balance to handle the load on network effectively. As well, the prominence of each message is dynamically clear according to strong link establishment in MANET. The performance of proposed RSS-Distance based multicast link break prediction scheme, MORALISM and ODMRP performance is compare in terms of different metrics like PDR, hop count, and end to end delay to gain an nearby into their overall efficiency with respect to the network surroundings situations. The proposed RSS-Distance based multicast routing that has efficient bandwidth consumption, high delivery ratio and more packets of receiving and this smart algorithm that can select best pathway and handle buffers in an efficient way. It should also

contain other network consideration mentioned in the result analysis that shows smooth functionality under exigent situation and exploit connections in much intelligent routine. The proposed RSS-Distance based multicast protocol is estimate the nodes existence in link by its strong and weak RSS by reduces the message copies and reduces the packet dropping. The load in the network due to mobility is handled by proposed scheme is more efficiently as compare to existing MORSLISM and ODMRP protocol. The performance metrics are showing the better results in different node density scenario.

As future, we intend to investigate the In future we proposed the novel congestion control link prediction scheme to reduce congestion by rate control technique in each node and every communication the nodes priority are change according to load and in dynamic topology the load on the nodes is also vary according to transmission.

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