Research Paper

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Implementation of Hybrid Zonal Routing Protocol with Neighbor Coverage for reducing Routing Overhead in MANET

Engineering

KEYWORDS : Mobile Adhoc Networks, Broadcasting, Routing Overhead, NCPR, ZRP, latency.

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ABSTRACT

- Mobile Adhoc Network (MANET) has been the research area since past few years. It is a network where all the nodes are assembled together without any centralized server. Broadcasting is very efficacious and rudimentary data dissemination mechanism where each source node forwards the packets towards destination via nodes present in the network. Broadcasting in MANETs posses various challenges due to varied and random characteristics of medium as well as due to fluctuations in strength of a signal and propagation with respect to time and environment bandwidth congestion, packet collision problem. In this paper, we have implemented the combined work of Zonal routing protocol with neighbor coverage based probabilistic rebroadcast protocol (NCPR), where NCPR is used for route discovery mechanism in order to reduce routing overhead problem as well as the latency. On combining NCPR with ZRP the number of retransmissions are significantly decreased thus improving the routing performance.

INTRODUCTION

MANET is emerging as the research area since past few years. Likewise many advances are made in wireless communication technology. Ad hoc wireless networks are established in order to make communication possible in the areas where there is no or very less communication infrastructure [1] or sometimes where the existing infrastructure is inconvenient to use. Another type of wireless network is access point where base stations are used which provides connectivity between two nodes. Alternate name for Mobile Ad hoc network is mobile mesh network comprising of nodes which are also called as mobile computing devises. The nodes are independent for moving everywhere in the network because of which the network topology in MANET is always changing. MANETs have various application areas such as alarm signal, paging a particular host, disaster relief, battlefield and rescue etc.

With this assembly of various nodes, the mobile Adhoc Network (MANET) may suffer link breakage and cessation of end to end delay due to dynamic nature of the topology [2]. Communication in MANET is possible without any use of central server. In many cases the nodes within the range can communicate directly with other nodes through wireless links, while those are outside the range needs routes for communication where the nodes are free to move in the network. Many times direct communication is not possible in single hop communication so multihop communication is used where source node directs the packet to the destination through the various intermediate nodes. In battlefields the communication always takes place between mobile or static nodes and doesn't depend on fixed infrastructure, thus MANET is the only option to support network operation. Frequent link breakages may occur in MANET due to free moving nature of nodes within the network. This causes disturbance in the whole network thus causing many problems.

In MANET, broadcasting has the high importance [3] for routing the information discovery. Also it is seen that number of rebroadcast can effectively reduce broadcasting. In broadcasting each and every source node broadcasts the message to all the other nodes. Various protocols such as Adhoc on demand distance vector (AODV) [4], dynamic source routing (DSR) [5], location aided routing (LAR) and zonal routing protocol (ZRP) are used for establishing the routes to destinations. As AODV and DSR are on-demand routing protocol they help in improving the salability of MANET by reducing routing overhead [6]. Broadcasting poses many challenges in MANET due to node mobility. The very basic approach of broadcasting is blind flooding in which every node in broadcasting forwards the packets just once in the network. This is simple and guarantees a high reachability. Storm problem is caused due to redundant retransmission of RREQ packets which caused contention and collision [7] particularly in dense network. Multifarious schemes, such as probabilistic broadcast or non deterministic and deterministic broadcast are proposed to alleviate the broadcast storm problem. Nondeterministic schemes reduce the network congestion by reducing the number of retransmissions.

Broadcasting techniques are partitioned into four groups: [8] simple flooding method, probability based method, area-based method and neighbor-knowledge based method. In simple flooding method node blindly rebroadcast the received packet to the destination until it is reached. In probability based method, certain probability is allocated to the node. As soon as the node receives the packet it forwards the packet to the next node. Some transmission range is assumed to be common in area based method where a node rebroadcasts only if sufficient new area can be covered with the retransmission. Additional coverage concept is used to rebroadcast in Area coverage based method. Neighboring nodes information is used in Neighbor-knowledge based method to decide whether to broadcast the packet or not. In [9] it can be seen that the neighbor knowledge based method performs better than area based and area based method performs better than probability based method.

The routing protocols used in MANET are categorized in two ways [10]:
Proactive Routing Protocol
Reactive Routing Protocol
Hybrid Routing Protocol

Proactive routing protocols are also named as table driven routing protocol. Every node maintains the network topology information in the form of routing tables. These tables exchange the information periodically. Whenever the topology is updated the whole network is aware about it. Possible changes in the network topology can be found by flooding the network. Proactive routing protocol has minimum initial delay while high routing overhead is the disadvantage of this protocol. Optimized link state routing (OLSR) and Destination sequence distance vector (DSDV) are well known examples of proactive routing protocols.

Another type of routing protocol is reactive routing protocols. These protocols are used only when there is any need of route establishment. Route discovery is initiated by flooding the whole network with RREQ packet. Bandwidth required for maintaining routing tables is very less as compared to proactive routing protocols. Unlike Table driven routing protocol, on-demand routing protocols execute the path finding process. Whenever the path is required by the node, routing information is exchanged in order to communicate with the destination node. Ad hoc on demand (AODV) and dynamic source routing (DSR) are reactive routing protocol. Above mentioned protocol helps in improving the scalability in MANET.

Hybrid Zonal Routing Protocol combines the advantage of both proactive as well as reactive routing protocol. Each node creates its own zone so there can be many overlapping zones of the nodes [11].

The ZRP is also divided into two categories
Intra-zone Routing Protocol (IARP): This is used when the zones of source and destination are same. The Neighbor discovery protocol is executed by each node in order to know its current neighbors.

Inter-zone Routing Protocol (IERP): If IARP cannot find the destination then IERP is executed. The zones of source and destination are different. It is a reactive type of protocol that enables the discovery of destination. This protocol makes full use of routing zones to do intelligent query spreading.

VARIOUS ROUTING PROTOCOLS WITH NEIGHBOR KNOWLEDGE METHOD:
Author proposed the Probabilistic Rebroadcast Protocol with neighbor knowledge for reducing the routing overhead in MANET. For optimizing the broadcasting storm problem advantages of both probabilistic and neighbor knowledge method are combined. In this paper author proposed a new scheme which effectively calculates the rebroadcast delay for forwarding the RREQ packets. This paper gives idea of how the number of rebroadcast can be minimized by making full use of the neighbor coverage knowledge [12].

Author indicated that performance of neighbor knowledge method is better than area based, and the performance of area based is better than probability based method. This protocol focuses on achieving the high reachability and reducing the number of rebroadcast. In Probabilistic method, fixed probability is assigned to all nodes so the problem arises in setting the rebroadcast probability. This protocol is based on the shadowing effect which reduces the number of rebroadcasting packets. If the source node and the neighbors are far away from each other then the retransmission probability is high else it is low. The coverage area can be determined from the distance of the sender and the receiver. This approach can considerably reduces the number of rebroadcast with mobility and no mobility, collision packets as compared to flooding. Rebroadcasting probability is calculated from the coverage area.

Author proposed a comprehensive probabilistic method for route discovery. In fixed Probabilistic based scheme rebroadcasting of packet is based on predetermined fixed probability 'P'. Since the topology of MANET is always changing the node density also varies so there is need for proper adjustment of forwarding probability. This paper descries the algorithm which dynamically determines the forwarding probability by considering the covered neighbors and local node density. In this performance of DRP-AODV and FRP-AODV is done using AODV as base routing protocol. In low and medium dense network the overhead is reduced by 56 percent in DRP-AODV when compared to conventional AODV in low and medium dense network. Under the same network condition the overhead is reduced by 30 percent when compared to FRP-AODV [14].

Author has described scalable broadcast algorithm [15]. This approach utilizes the data broadcasting and local neighbor discovery to reduce the unnecessary rebroadcasting and the routing overhead of the network. It is seen the overhead is reduced by 60 percent some by using this algorithm when compared with flooding. Also the packet delivery ratio is decreased with increasing network size and also end to end delay is reduced.

PROPOSED SYSTEM
In Proposed System, NCPR is used for Route Discovery Process. Hybrid combination of NCPR and ZRP helps in reducing the unnecessary rebroadcasting of Packets by using proper neighbor coverage knowledge thus minimizing the overhead and latency problem.

When NCPR and ZRP both are clubbed together each and every node in the network creates its own neighborhood individually which is called as routing zone. In such cases the zones can overlap. This zone is called as proactive zone where each zone collects information about its neighbors. When the destination node is within the zone then the message is transferred directly otherwise the message is send firstly to the border node and then the border node checks whether the destination is present or not, if the destination is present the message is then transferred to it. So the time taken to transfer the message from source to destination is low in this. Neighbor discovery protocol is executed by each and every node to know its current neighbors.

Whenever the route is to be established for sending any information from source to destination the source node very firstly checks whether the destination node is in its zone or not. But if there is any link breakage while transmitting the packet, neighbor knowledge based technique is used as broadcasting technique instead of standard flood search. As NCPR being reactive protocol helps in reducing the number of rebroadcast thus reducing the broadcast storm problem by using neighbor coverage knowledge. Working of NCPR deals with the calculation of rebroadcast delay and rebroadcast probability. This offers the combined advantage of two structures.

Neighbor Coverage Knowledge
Probabilistic Rebroadcast
The first part deals with calculation of rebroadcast delay. Rebroadcast delay determines the order of how the neighbor knowledge is spread. Delay is calculated with the help of uncovered neighbor set. The neighboring node receiving the RREQ packet can calculate the Delay by comparing the neighboring list of itself with previous node neighboring list Rebroadcast Delay makes full use of neighbor knowledge for avoiding channel collision.

The second part deals with the calculation of rebroadcast Probability which combines the knowledge of neighbors which are not covered connectivity metric and local node density of nodes. By composing coverage ratio and factor of connectivity, probability of rebroadcasting can be calculated where coverage ratio gives the relationship between nodes covered by single broadcast to that of total neighbors and connectivity factor which is the relationship of connectivity in network and the given node's neighbors.

Various steps involved in minimizing the number of rebroadcast which reduces the routing overhead problem are as follows:

Firstly the source node sends RREQ packet to all its neighbors.

Each and every neighbor receives the RREQ packet and calculates the uncovered neighbor set (UCN) and Rebroadcast delay. UCN is calculated by comparing the neighboring list of receiving node and its pervious node. This determines how many of its neighbors are not receiving the RREQ packet. Then timer is set according to the delay.

UCN is adjusted as a node may receive a duplicate RREQ from its neighboring node and the packet is then discarded. This procedure continues unless the timer expires.

Once the time expires, rebroadcasting probability is checked if it is less than or equal to 0, 1 then the node having minimum delay will broadcasts the RREQ otherwise the node discards the RREQ.

SIMULATION RESULTS

To evaluate the performance of the proposed system network simulator 2 (ns2) is used. The performance of routing Protocol is evaluated based on various parameters such as a) Normalized Routing Overhead, b) Throughput, c) End to End Delay and d) Packet Delivery Ratio.

The simulation results are dived into three modules:

First module shows the graphical representation for NCPR protocol with respect to packet delivery ratio and end to end delay.

Second module shows the comparative graph for end to end delay for both NCPR and ZRP.

Final module shows the hybrid combination of both NCPR and ZRP with various metrics such as Routing Overhead, Throughput, End to End delay and Packet delivery ratio. A comparative analysis is made with NCPR and ZRP.

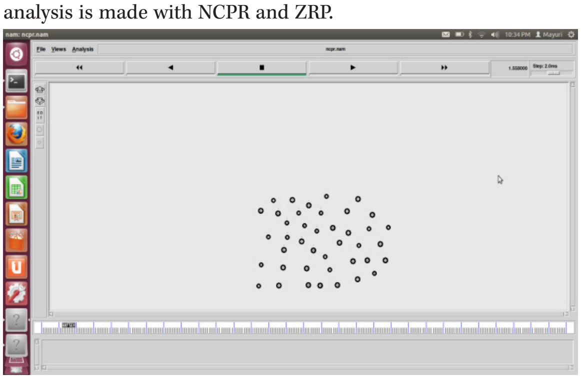


Fig1. MANET structure

Fig 1 Shows the MANET structure where nodes are created. There are total 41 nodes created in order to understand the working of implemented system.

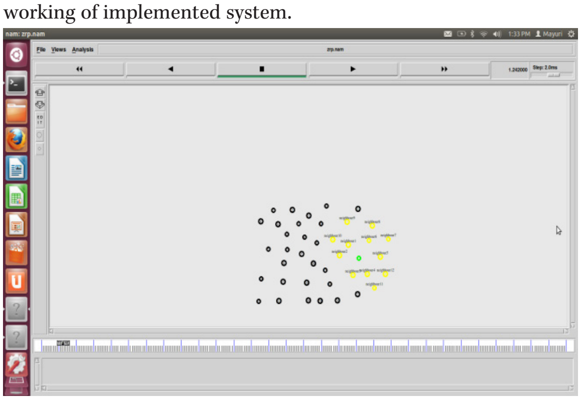


Fig2. Neighbors of green colored node

Fig 2 Shows each and every node creates its neighborhood. Every node maintains the information about its neighboring node. This helps to know how many neighbors of the node have not been covered during forwarding of packet. The yellow colored nodes indicate that they are the neighbors of the green colored node and each node maintains information about its neighboring node.

Fig3. Snapshot shows source and destination

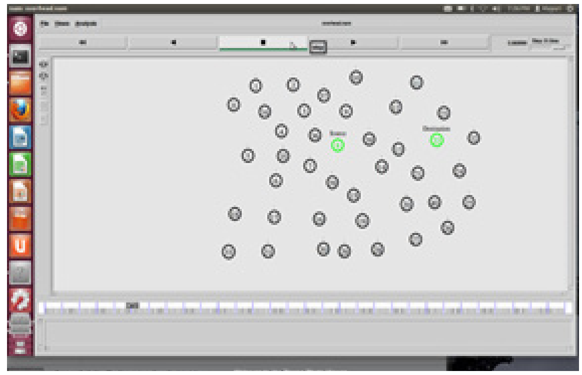


Fig4. Graph showing packet delivery ratio with different traffic load for NCPR

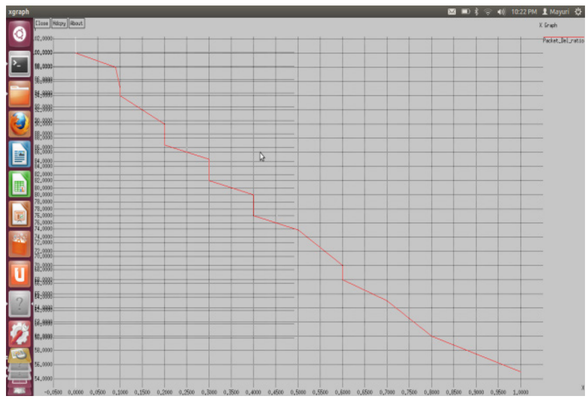


Fig5. Shows the ghaph of end to end delay with different traffic load for NCPR

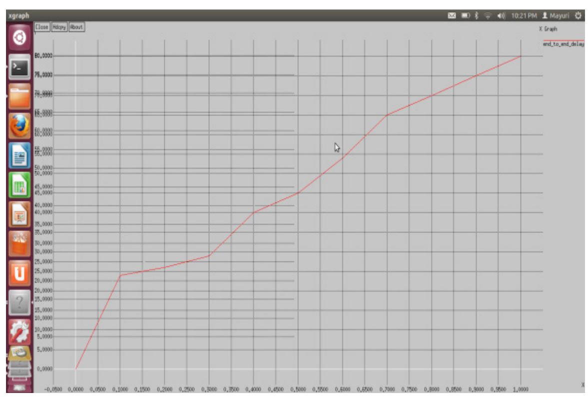
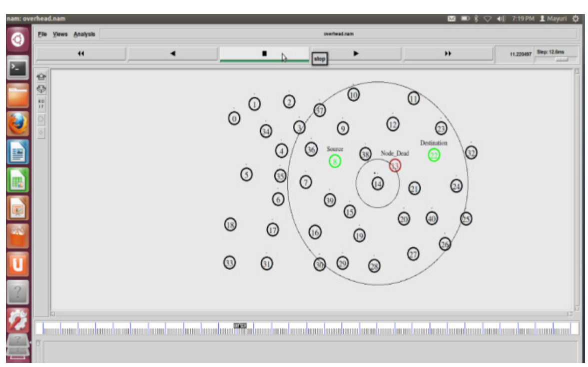


Fig 6. Shows alternate route to destination as node 13 is dead



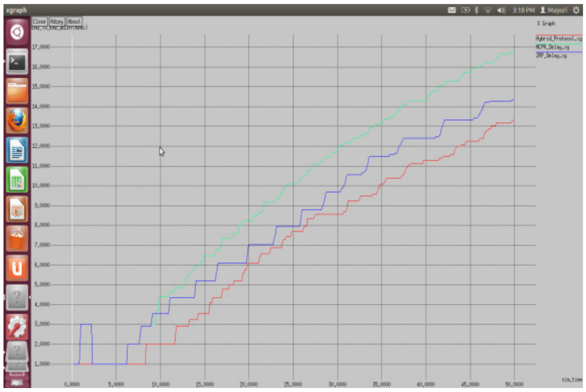


Fig7. Shows Average end to end delay for NCPR, ZRP and Hybrid combination of NCPR with ZRP

Fig8. Shows Routing Overhead for NCPR, ZRP and Hybrid combination of NCPR with ZRP

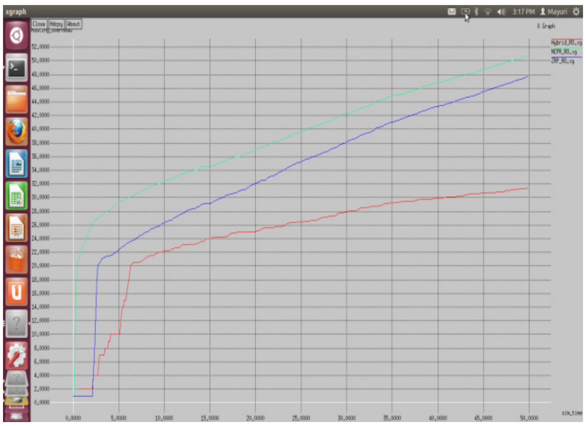


Fig 7 shows the comparative graph for average end to end delay and routing overhead respectively. Average End to end delay is the time difference between when data packet is send from source and time when packet is received by the destination. In Hybrid protocol, End-to-End delay is decreased by about 5.94% when compared to NCPR. In ZRP, delay is minimized up to 2.1% when compared to NCPR.

Fig 8 shows the comparative graph for Routing Overhead. It is the total number of packets transmitted during the simulation time. In Hybrid protocol, overhead is reduced by 15% when compared to NCPR. In ZRP, overhead is reduced by about 6.84% when compared to NCPR.

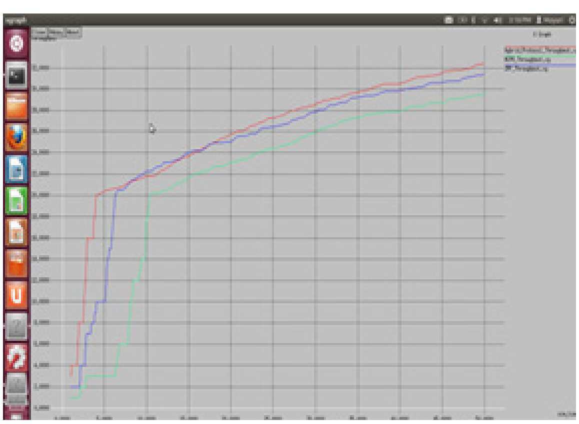


Fig9. Shows Throughput for NCPR, ZRP and Hybrid combination of NCPR with ZRP

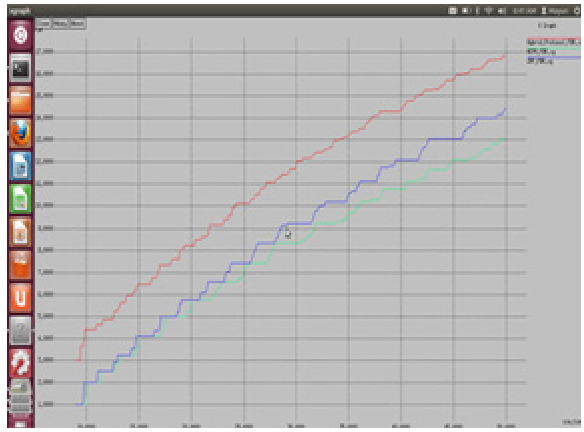


Fig10. Shows Packet Delivery ratio for NCPR, ZRP and Hybrid combination of NCPR with ZRP

Fig 9 shows the comparative graph for throughput. Throughput is defined as the amount of packet (bytes) transmitted during one second. In Hybrid Protocol, throughput is increased by 7.2% when compared to NCPR. In ZRP, throughput is increased by 2.85% when compared to NCPR.

Fig 10 shows the comparative graph for packet delivery ratio. PDR is the ratio of number of packets which are successfully received at the destination to the number of packets generated by the source. In Hybrid Protocol PDR is improved by 5.18% when compared to NCPR. In ZRP, PDR is improved by about 1.9% when compared to NCPR.

TABLE – 1
COMPARISON OF PROTOCOLS

Parameters	Routing Protocols	
	ZRP	Hybrid Combination of NCPR and ZRP
Packet Delivery Ratio	Increased by 1.9 % when compared to NCPR	Increased by 5.18 when compared to NCPR
Routing Overhead	Decreased by 6.84% when compared to NCPR	Decreased by 15% whe compared to NCPR
End-to-End delay	Decreased by 2.1% when compared to NCPR	Decreased by 5.94 when compared to NCPR
Throughput	Improved by 2.85% when compared to NCPR	Improved by 7.2% whe compared to NCPR

Table 1 shows the comparative analysis of NCPR ZRP and their hybrid combination. It is very clear from the table that performance of hybrid combination is much better than that of NCPR as well as than ZRP.

CONCLUSION

Broadcasting is the very important issue in MANET which needs to be focused. In this paper we proposed a Hybrid combination of both probabilistic Rebroadcast protocol and Zonal Routing Protocol for reducing routing overhead and latency in MANET. Probabilistic Rebroadcast Protocol is based on Neighbor coverage knowledge which includes additionally coverage ratio and connectivity factor. As NCPR and ZRP are clubbed together, which is combination of Reactive and Proactive routing protocol the latency time is reduced. This paper also discusses the recent routing protocols in MANET based on neighbor knowledge method. Simulation results show that proposed system significantly reduces overhead as well as the latency time.

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