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Novel Approach to Zone routing Protocol

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Abstract—Zone Routing Protocol is a type of hybrid routing protocol. In real life scenario various links in MANET are not relaible due to interference signals from various neighboring network, ambient noise and jamming signal from various malicious nodes. These types of links are not accounted for in ZRP which results in lower throughput, higher delay from end to end . Furthermore zone radius is fixed in ZRP resulting in frequent zone switching for highly mobile nodes thereby increasing the control and maintenance overhead .Further more in ZRP border casting is used which does not guarantees shortest routing path and as consequence.In this paper proposed approach is on enhancement of ZRP to resolve mainly two issues power management and bandwidth utilization.

Keywords – MANET, ZRP, IARP, IERP, BRP, MZRP, M2ZRP, RWP, SNR, GPS, Group Mobility, Proactive Routing, Reactive Routing, Hybrid Routing, Throughput, Jitter, End-to-End Delay.

I. INTRODUCTION

A mobile ad hoc network (MANET) is comprised of mobile hosts that can communicate with each other using wireless links. A route between two hosts may consist of hops through one or more nodes in the MANET [1]. A routing algorithm for an Ad hoc network should not only have the general characteristics of any routing protocol but also consider the specific characteristics of a mobile environment, particularly-bandwidth, energy limitations and mobility. Routing algorithms and protocols must save both bandwidth and energy capabilities and must take into account the low capacity and limited processing power of wireless devices.

Protocols are classified as: proactive such as OSLR, reactive such as AODV and hybrid such as ZRP. ZRP is the most simple self-organizing and self-configuring protocol without a heavy load in the network.

- In proactive or table driven routing protocol, every node maintains a routing table containing information of the network topology. The routing table contents changes with time due to the topology
- change as a result mobilition of nodes. The table size is
- large as it contains information of all the nodes in the network.
- Reactive/on demand routing protocol dynamically initiates the route discovery process when needed. It is a lazy approach and its main aim is to reduce the size and maintenance overhead of the routing table.
- ZRP, TORA combine the salient features of both proactive and reactive approach to exploit the advantages of both.

II. RELATED WORK

In recent past, a lot of attention has been shown by the research community to various issues related to ad hoc networks . Many protocols have been proposed for routing in such an environment .These protocols can broadly be classified into two types: *proactive* and *reactive* routing protocols .Proactive or *table-driven* protocols try to maintain routes to all the nodes in the network at all times by broadcasting routing updates in the network .Examples are DSDV, TBRPF, OLSR, WRP,STAR, and FSR. *demand* protocols attempt to find a route to the destination, only when the source has a packet to send to the destination. Examples are DSRAODV, and TORA. Proactive protocols maintain the routing information of one node to the other using routing tables. Whenever there is a need for the route to the destination, it is readily available incurring minimum delay. But, at the same time ,they may lead to a lot of wastage of the network resources if a majority of these available routes are never used. Reactive protocols are usually associated with less control traffic in a dynamic network; nodes have to wait until replies to the route queries are received. Also reactive protocols resort to frequent flooding of the network, which may cause network congestion. In between the above two extremes. The Zone Routing Protocol (ZRP) is a hybrid proactive / reactive protocol. It is a routing framework composed of the proactive Intra zone Routing Protocol (IARP), reactive Inter zone Routing Protocol (IERP) and the Border cast Resolution Protocol (BRP). ZRP is proved to work well compared to either table-driven protocols or on-demand protocols.

Zone Routing Protocol is a type of hybrid routing protocol in MANET. In real life scenario various links in the MANET are unreliable due to interference of signals from neighboring network from malicious nodes. These types of links are not accounted for in ZRP. Furthermore in ZRP border casting is used which does not guarantees shortest routing path and as consequence MZRP was developed which uses broadcasting and guarantees shortest path but with no path reliability and fixed zonal radius. We propose modified efficient version of the MZRP coined as M2ZRP which takes into account the link

SNR value as a measure of its reliability and security and also introduces the concept of variable zone radius. Qual Net network simulator is used for evaluation of performance of M2ZRP over ZRP and MZRP in two different network scenarios consisting of 50 and 80 mobile nodes respectively considering two different mobility models Point (RWP) and Group mobility model (GM). Results indicate a considerable improvement in throughput, end-to-end delay and jitter with enhanced reliability and security.

III. MANET

A Mobile Ad Hoc Network (MANET) consists of independent mobile nodes which communicate with each other over wireless radio links in an infrastructure less setup. The nodes generate their own data packets and forward others i.e. they act both as terminal and router. The routes between the nodes changes rapidly due to node mobility. So dynamic on demand routing protocols are needed in most of the application areas of MANET. They must be capable of handling unreliable links due to interference from nearby networks. The malicious nodes or selfish nodes selectively forwards its own traffic while dropping others and also advertises false routes through them. It is desirable for routing protocols to detect and avoid such nodes and further they should be scalable in order to adapt itself with the change in network size (i.e.number of nodes).

3.1. Routing Protocols in MANET.

They are divided into three broad classes namely proactive, reactive and hybrid (combination of proactive and reactive routing) . In proactive routing protocol every node maintains a routing table containing information of the network topology. The routing table contents changes with time due to the topology change as a result of node mobility. Siize of the routing table is large fall under this category. Reactive/on demand routing protocol dynamically initiates the route discovery process when needed. It is a lazy approach and its main aim is to reduce the size and maintenance overhead of the routing table. DSR, AODV and DYMO are typical examples of this category. Hybrid protocols like ZRP, TORA combine the salient features of both proactive and reactive approach to exploit the advantages of both.

3.2. Zone Routing Protocol (ZRP).

Zone Routing Protocol (ZRP) defines a network with a number of virtual, overlapping routing zones. For every node there exists a zone with radius k hops i.e. all the nodes within k hop distance from the particular node is an element of that node's routing zone. And other nodes within the zone are coined as interior nodes. ZRP basically combines the features pof two protocols proactive protocols and intrazone routing protocol used inside routing zones and a reactive routing protocol: Inter Zone Routing Protocol (IERP) used between routing zones. A route to a destination within a node's routing zone is directly established from the routing table of that node by IARP subcomponent of ZRP otherwise the node creates a border casting tree and sends a route request (RREQ) packet to its peripheral nodes containing its own address, destination address and a unique sequence number as a part of IERP subcomponent of ZRP. The value of this Seq_No is one more than the previous RREQ for the same source destination pair. Seq_No is used to ensure that the same RREQ(S, D) that was previously received at node I will be rejected if received again at node I. However new RREQ(S, D) will be received and processed at node I because the Seq_No is updated (i.e. incremented by 1). The peripheral nodes again first invoke IARP. If it fails i.e. the destination node is not a member of the routing zone of the peripheral node then the peripheral node initiates the IERP subcomponent of ZRP. The process continues until the destination is reached. The destination node sends a route reply (RREP) on the reverse path back to the source and the intermediate routers make the necessary changes in their routing table thereby establishing the path.

3.3. Modified Zone Routing Protocol (MZRP).

In Modified Zone Routing Protocol (MZRP) modified the IERP route discovery process of ZRP so that a node broadcasts the RREQ packets in its immediate neighborhood and the process continues until the RREQ reaches the destination node. Here the intermediate nodes like ZRP add its own address to the header field in RREQ before broadcasting to its neighborhood so that the RREQ's reaching the destination node have the entire path from the source to the destination stored in its header. When the destination receives the RREQ it sends a route reply packet (RREP) to the source node through the selected reverse path and thereby establishing the route from the source to the destination. The route found out in ZRP using BRP during the route discovery phase may not be the shortest. If the destination is unavailable within a nodal zone then peripheral nodes are searched for that zone and RREQ are multicast to them which takes a considerable amount of time. But MZRP always finds out the shortest route between two nodes belonging to different zones by broadcasting RREQ without searching for peripheral nodes. It contributes to reduction in searching time and control packet overhead leading to improvement in overall network throughput, end-to-end delay and jitter in comparison with ZRP.

IV. MOBILITY MODELS

Mobility model emulates the real life movement of mobile nodes with respect to their locality, velocity and direction of motion. It should accurately predict the actual node movement with minimum deviation. MANETs have various applications with each having its own node movement pattern requiring different mobility models to cater for them. When simulating a MANET protocol for a specific application, There are different kinds of mobility models defined in literature but in our work we confine ourselves to Random Way point Mobility (RWP) model and Group Mobility (GM) model.

4.1. Random Way Point Mobility Model.

Random Way Point (RWP) model is a commonly used synt.hetic model for node mobility in Ad Hoc networks. The characteristics of RWP are briefly summarized below:

I. Each node moves along a straight line in a zigzag fashion from one waypoint to the next.
II. The waypoints are uniformly distributed over the deployment area.
III. The node velocities are randomly selected from a given range.
IV. Optionally, the nodes may have so called "thinking times".

4.2. Group Mobility.

Group Mobility (GM) model divides the whole set of nodes into a number of subsets known as groups based on certain mathematical criteria.. Different groups move randomly as a unit independent of each other within the deployment area. Group movements are based upon the path traveled by a logical center for the group. It is used to calculate group motion. The motion of the group center completely. Individual mobile nodes randomly move about their own predefined reference points whose movements depend on the group movement.

V. NETWORK PARAMETERS

There are a number of metrics based on which performance of a routing protocol is evaluated. In our work we have used throughput, end-to-end delay, response time and jitter.

5.1. Throughput.

Throughput is defined as the average data transfer rate in Kbits/sec measured between a source and destination. It is important QoS in multimedia based applications, video streaming, teleconferencing and others. Throughput is adversely affected due to network congestion and signal interference from other nearby networks.

5.2. End-to-End Delay.

The end-to-end delay is the time taken by a packet to move from source to destination node and is calculated by the elapsed time when a packet is sent by the source node to the time when it is received at the destination node. This includes all possible delays like buffering, queuing and processing at intermediate routers. MAC layer delays are also included in the above. This metric is important in time critical and real life applications, where fast and timely delivery of messages is crucial.

5.3. Jitter.

Jitter is defined as the variation of a signal's instants from their ideal positions in time. For an example, say packets are transmitted to the receiver every 20 ms. Now if the 2nd packet is received 30 ms after the 1^{st} packet, then jitter is −10 ms. This is referred to as dispersion., jitter will be +10 ms. This technique is basically called clumping. In a communication system, the accumulation of jitter will eventually lead to data errors.

5.4. Response Time.

It is the time interval between the first packet sent from CBR client and received in CBR server. It is same as the end-toend delay except here we are concerned only with the first packet. delivery of the very first packet could be important. So we have to minimize response time in those cases.

VI. PROPOSED WORK

The proposed algorithm assumes that the network has already implemented any cast addressing and the Zone Routing Protocol (ZRP) uses any cast addressing . The zone radius,i.e. the Hop Count (HC) is assumed to be one for the network.

Algorithm for the proposed idea

1) The source S wishes tp send packet to destination D.
2) The destination node is a member of the any cast address. So, the packet can be sent to any of the member of the any cast group which is more nearer to the source S. belongs to the any cast address AA.
3) The source S checks its IARP packets which are sent periodically to all the nodes within its zone. If the routing information for any of the any cast address AA is found using IARP packets then the search is stopped and Step 7 and Step 8 is followed.
4) If the any cast address AA is not found within its zone, then IERP packets is border-cast to all the border nodes of S. If the routing information of the any cast address AA is found using IERP packets then the search is stopped and Step 7 and Step 8 is followed.
5) If the any cast address AA is also not found within the previously border-cast nodes, then IERP packets are again border-cast to all the border nodes of that previously border-cast nodes.
6) Step 5 is repeated until the any cast address AA is found.
7) If any cast address AA is found, then the IERP Route Reply packet is sent from the any cast address AA to the source.
B. Flowchart of the algorithm

Flowchart of the algorithm

START
Source S wishes to send data to destination node DN

DN=AA(Any cast Address)
routing information of IARP Packets is checked in search of DN
Is routing
information
found in IARP
packet for DN?
Send the ROUTE REPLY packet to S
DATA packets sent via the path
STOP
S border-casts IERP packet
Border-cast nodes checks
its own IARP packet
routing information for DN
Is another AA,
other than
DN found
nearer to S?
IERP border-casts from
nodes/subnodes/ subsubnodes
Y
N
Y
N

VII. PERFORMANCE EVALUATION

The proposed idea is simulated using MATLAB 2009b and a comparative study of the proposed idea of using anycast in Zone Routing Protocol (ZRP) is done with the hybrid protocol (Zone Routing Protocol (ZRP)). The proposed idea has lower control packet overhead, lower power loss, lower normalized routing load, and higher packet delivery ratio.

A. Simulation Parameters

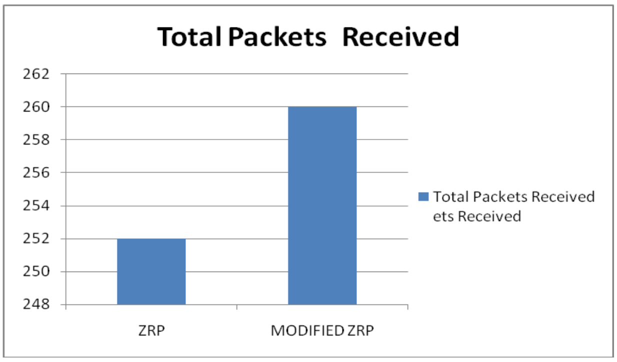
In this simulation we have the following parameters:

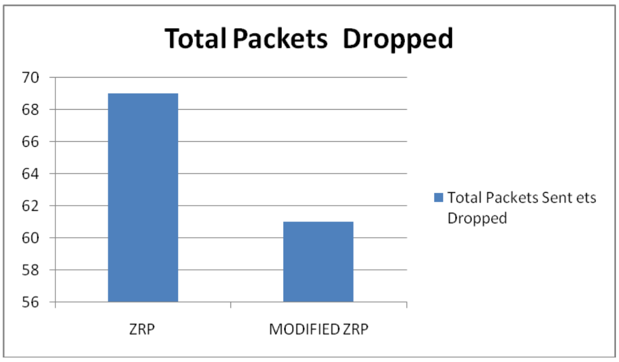
- Number of nodes- Ranges from 1000 to 4000.
- Type of topology- User-specific.
- Number of data packets- Ranges from 100 to 500.
- Zone radius (Hop Count) for ZRP- 1.
- Anycast addressing – Assumed to be already implemented in the network.

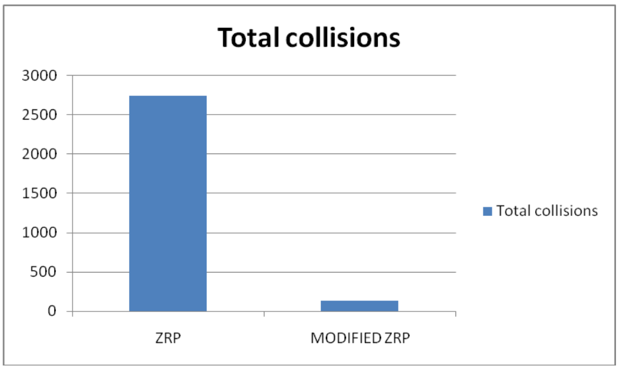
B. Simulation Results and Consideration

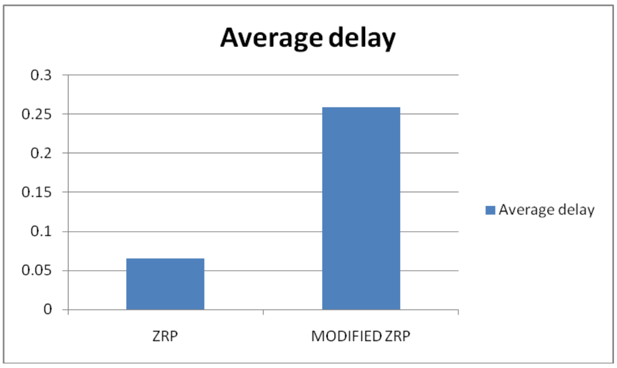
In Fig.8, we show the simulation results for the control packet for Zone Routing Protocol and Zone Routing Protocol using any cast. From this figure, we conclude that the control packet overhead for ZRP is more than the ZRP using any cast as the destination node is the member of the any cast group and hence, the search takes place for any of the any cast address member which is nearer to the source. we show the simulation results for the power loss against the number of message packets sent for ZRP and ZRP using any cast. From this figure, we conclude that the power loss for ZRP is more than the power loss for ZRP using any cast because in ZRP, the search is for an uni cast address which can be located far from the source, but in ZRP using any cast, the destination node is a member of any cast group. Hence, the most nearer any cast member can also be the destination. we show the simulation result of the comparison of packet delivery ratio against number of message packets sent, between ZRP and ZRP using any cast. Packet delivery ratio is the ratio between the received packets by the destination node (any cast address AA) and the sent packets by the source node. From we conclude that the packet delivery ratio for ZRP is lesser than ZRP using any cast because of the reason stated above. , we show the simulation result of the comparison of the normalized routing load against the number of message packets sent, between ZRP and ZRP using any cast. Normalized routing load is the ratio between the routing control packets and the received packets by the destination (any cast address). From this , we conclude that the normalized routing load for ZRP is higher than ZRP using any cast because of the reason stated above.

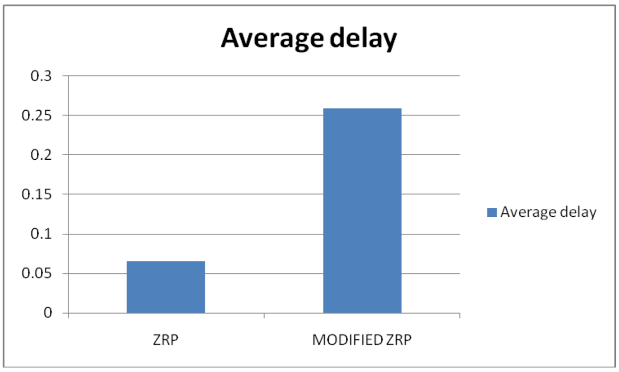
RADIUS=3	ZRP	MODIFIED ZRP
Total packets sent	321	321
Total packets received	252	260
Total Packets dropped	69	61
Total collisions	2746	132
Average delay	0.0658	0.2587


Total Packets Received
262
260
258
256
254
252
250
248
ZRP
MODIFIED ZRP
Total Packets Received ets Received


Total Packets Dropped
70
68
66
64
62
60
58
56
ZRP
MODIFIED ZRP
Total Packets Sent ets Dropped


Total collisions
3000
2500
2000
1500
1000
500
0
ZRP
MODIFIED ZRP
Total collisions


Average delay
0.3
0.25
0.2
0.15
0.1
0.05
0
ZRP
MODIFIED ZRP
Average delay


Average delay
0.3
0.25
0.2
0.15
0.1
0.05
0
ZRP
MODIFIED ZRP
Average delay

VIII. CONCLUSION

In this paper, attempt has been made to analyze existing Zone Routing Protocol. This paper proposed an improved Zone routing protocol l. The main concern of this research paper is to reduce the total collisions and average delay for sensor nodes in network and . We use NS2 for Simulation. Simulation result shows that collisions and average delay of nodes are better than that of existing protocol.

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