A SEMINAR REPORT ON
"Hybrid Routing Protocol in MANETs"

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GOVERNMENT COLLEGE OF ENGINEERING, AMRAVATI

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DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING

CERTIFICATE

This is to certify that the seminar report entitled **"Hybrid Routing Protocol in MANETs**", which is being submitted to **Department of Computer Science and Engineering of Government College of Engineering Amravati** (Shri. Sant Gadge Baba Amravati University, Amravati). This is the result of the seminar work and contribution by

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under my supervision and guidance in semester VII.

Date:

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Declaration

I hereby declare that the seminar entitled "**Hybrid Routing Protocol in MANETs**", completed and written by me under the guidance of **Prof. M. B. Waghmare**, ,Department of Computer Science and Engineering, Government College of Engineering, Amravati. This work has not been previously formed the basis for the award of any degree or diploma or certificate nor has been submitted elsewhere for the award of any degree or diploma.

Place: Amravati

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(B.Tech 4^{th} Year)

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Place: Amravati

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Abstract

This seminar report explores the Zone Routing Protocol (ZRP), a hybrid routing protocol designed to optimize the efficiency of routing in mobile ad hoc networks (MANETs). ZRP combines the strengths of proactive and reactive routing strategies to overcome the limitations of each. In this protocol, the network is divided into zones, with proactive routing employed within each zone for low-latency communication, while reactive routing is used between zones to reduce overhead. The seminar delves into the architecture of ZRP, discussing its key components: the IntrA-zone Routing Protocol (IARP) for intra-zone communication and the IntEr-zone Routing Protocol (IERP) for inter-zone routing. Furthermore, it addresses the protocol's adaptability to network changes, scalability, and the balance it achieves between control overhead and route discovery latency. The report also compares ZRP with other routing protocols and highlights its practical applications, challenges, and potential improvements in dynamic and large-scale MANET environments.This report putted forth this routing protocol whose name is ZRP routing protocol based on clustering, which is more steady and there is acting better routing protocol performance than proactive and reactive routing protocols.

Contents

1.INTRODUCTION

1.1 Overview:

A mobile ad hoc network (MANET) is comprised of mobile hosts that can communicate with each other using wireless links. In this environment a route between two hosts may consist of hops through one or more nodes in the MANET. An important problem in a mobile ad hoc network is finding and maintaining routes since host mobility can cause topology changes. Mobile ad hoc networks have been employed in scenarios where an infrastructure is unavailable, the cost to deploy a wired networking is not worth it, or there is no time to set up a fixed infrastructure. Some scenarios where an ad hoc network can be used are business associates sharing information during a meeting, emergency disaster relief personnel coordinating efforts after a natural disaster such as a hurricane, earthquake, or flooding, and military personnel relaying tactical and other types of information in a battlefield. Based on the routing information update mechanism, Ad hoc wireless network routing protocols are basically divided into pro-active routing and re-active protocols.

Figure 1:

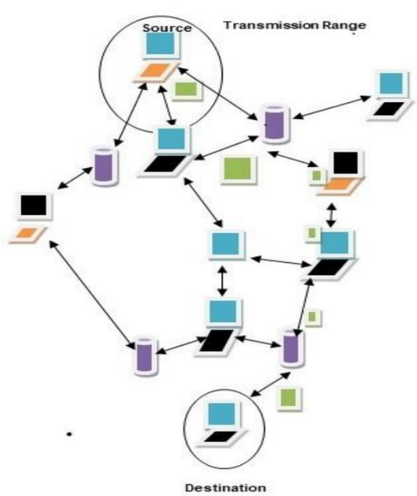

Figure 1: Mobile ad-hoc network

1.2 Problem Statement:

In mobile ad hoc networks (MANETs), ensuring efficient and scalable routing is a significant challenge due to the highly dynamic and decentralized nature of the network. Traditional routing protocols fall short in handling large-scale networks: proactive protocols suffer from excessive control overhead, while reactive protocols experience high route discovery latency. This leads to inefficient resource utilization, increased communication delays, and reduced network performance in dynamic environments where network topology changes frequently. The need for a routing protocol that balances control overhead and route discovery time while adapting to varying network conditions presents a critical challenge.

1.3 Objectives:

The objectives of addressing the problem statement outlined above could include:

- Enhance Routing Efficiency: To minimize routing delays and optimize route discovery by combining proactive and reactive routing techniques, ensuring timely data transmission in mobile ad hoc networks (MANETs).
- Reduce Control Overhead: To decrease the excessive control packet exchanges inherent in proactive protocols by restricting proactive routing to local zones, while using reactive routing for inter-zone communication.
- Improve Scalability: To support large-scale MANETs by dividing the network into manageable zones, making the protocol adaptable to network size and changes in topology without overwhelming the system with control messages.
- Adapt to Network Dynamics: To ensure the protocol remains responsive to frequent topology changes in MANETs, maintaining a balance between route discovery speed and network resource utilization.
- Balance Route Discovery and Maintenance: To efficiently manage the trade-off between the low-latency route discovery within zones and the reduced overhead in inter-zone communication, improving overall network performance.

- Optimize Resource Utilization: To minimize the use of network resources such as bandwidth and energy, which are crucial in resource-limited MANET environments, while ensuring reliable communication.

1.4 Outcome:

The use of the Zone Routing Protocol (ZRP) in mobile ad hoc networks (MANETs) results in enhanced network performance by effectively balancing proactive and reactive routing strategies. ZRP reduces control message overhead by restricting proactive routing to localized zones, while utilizing reactive routing for communication between zones, leading to lower route discovery latency and more efficient use of bandwidth and network resources. This hybrid approach ensures scalability, enabling ZRP to perform well in large and dynamic networks without overwhelming the system. Additionally, ZRP's adaptability allows it to respond quickly to frequent topology changes, maintaining reliable communication even in highly dynamic environments. Overall, ZRP achieves a balance between fast route establishment within zones and minimized overhead for inter-zone communication, optimizing both routing efficiency and resource utilization.

2.LITERATURE REVIEW

- "Advin Manhar1* and Dr. Deepak Dembla ." Without the need of a fixed foundation or base station, the Mobile Ad hoc Network creates its own wireless network. One of the most troublesome aspects of Mobile Ad hoc Network (MANET) is the occurrence of unexpected loss of network connectivity. As a result of this problem, packets continue to drop, and we must restore the connection by sending Route Request (RREQ) and Route Reply (RREP). As a result, network performance will suffer yet another setback. We used the scenario routing technique to combine the Dream Multipath Routing (DMR), Ad hoc on-demand multipath distance vector (AOMDV), Optimized link-state routing (OLSR), and Ad-hoc on Demand Vector (AODV) routing protocols to build the IHRP routing protocol in this work. According to previous studies, (AODV) is more suited when node motion is high. The purpose of DREAM Multipath Routing (DMR) is to maintain node mobility and location information coordinated. Route packet flooding is prevented by computing the expected chance of node relocation. The number of mobile nodes in the wireless network fluctuates, and the DMR operates on each one individually. In the network, each node maintains a list of nearby nodes and their current locations. Using the AOMDV routing protocol is effective for load balancing and preventing congestion on the network. OLSR is a good fit for networks that priorities link reliability above other considerations when routing traffic. When using the aforementioned (DMR, AODV, AOMDV, andOLSR) protocols to create the IHRP routing protocol, we are capable of better regulation of network behavior and perform.
- "Nicklas Beijar (2015)" - This paper presents the Zone Routing Protocol. First, wediscuss the problem of routing in ad-hoc networks andthe motivation of ZRP. We describe the architecture of ZRP, which consists of three sub-protocols. We describe the routing process and illustrate it with an example. Further, we describe the query control mechanisms, which are used to reduce the traffic amount in the route discovery procedure. ZRP does not define the actual implementation of the protocol

components. Therefore, we present the guidelines for implementation, and example implementations provided in the draft specifications. We discuss the problem of routing in networks with unidirectional links, and the proposal for a solution to it. The overhead of the routing protocol is important in the power and bandwidth limited ad-hoc networks. We discuss the factors influencing on the traffic amount based on measurements performed in a number of papers. We describe the significant issue of choosing an optimal zone radius, and two algorithms for automatic selection of the radius. Finally, we draw some conclusions about the performance of the protocol. The paper is based on literature research.

- "Dilli Ravilla1 V.Sumalatha (2011)." -An ad hoc wireless network has a dynamic nature that leads to constant changes in its network topology. As a consequence, the routing problem becomes more complex and challengeable, and it probably is the most addressed and studied problem in ad hoc networks. Based on the routing information update mechanism Ad hoc wireless networks routing protocols are classified into Proactive, Reactive and Hybrid Routing Protocols. Out of these, Hybrid Routing Protocol combines the best futures of the first two categories. The Zone Routing Protocol (ZRP) is one of the hybrid routing protocols in which every network node proactively maintaining routing information about its routing zone, while reactively acquiring routes to destinations beyond the routing zone. In this paper, we proposed the Independent Zone Routing Protocol (IZRP) an enhancement of the Zone Routing Protocol which allows adaptive and distributed configuration for the optimal size of each node's routing zone, on per-node basis. We demonstrate the performance of IZRP with various performance metrics. Furthermore, we compared the performance of IZRP and ZRP by considering performance metrics Packet Delivery Fraction, Normalized Routing Overhead and End-to-End Delay.
- "Xueqin Yang (2018)" VANET is the concrete the application of the wireless and mobile ad-hoc network in this automotive environment. Because ofthe frequent changes of the network topology, the fast mobile node, the heavy routing overhead and other reasons, it's veryuneasy to contrive a effective the

protocol of the routing layer for routing statistics among mobile vehicles. existing Routingprotocols which have existed about the VANET are little significant and little impact to simulate all kinds of traffic scenarios.Therefore, the design of the competent routing protocol has been more extraordinary meaning. This thesis putted forth thisrouting protocol whose name is improved ZRP routing protocol based on clustering, which is more steady and there is actingbetter routing protocol performance than traditional ZRP in MANET by using the concept of cluster in the hierarchical networkto replace the partition of traditional ZRP protocol. The new protocol which is depended on the algorithm of clustering setsdifferent freight (coach) as the cluster head, the ordinary vehicles to be the cluster members in two hops, in order to reduce thecalculated amount of clustering algorithm, the routing overhead, the ETE(end to end) delay and increase the delivering packetfraction. Result of the simulation illustrates that the improved protocol compared with the traditional ZRP routing protocol,mainly contains performance indexes the packet delivery ratio increased by 36%, routing overhead and end-to-end delay by 20% and 29% respectively.

3.IMPLEMENTATION

3.1.Working Details

3.1.1 Routing Protocols A number of routing protocols have been suggested for ad-hoc networks . These protocols can be classified into two main categories: proactive (table-driven) and reactive (source-initiated or demand-driven).

1. **On-Demand Routing Protocol :** RREQ packets are sent by sender nodes to find receiver target nodes, and then the connection is made and the data transferred. Reactive routing systems like AODV (Ad-hoc On Demand Vector) and DSR (Dynamic Source Routing) are examples .

2. **Table driven Routing Protocol (TDRP) :** TDRP methods are sometimes known as table-driven protocols. Proactive routing methods save routing table information on each node. Table-driven routing protocols carry data packets based on a routing table path. Because the whole path must be calculated before forwarding data, table-driven routing methods have the highest minimum latency and routing overhead. A couple of examples include Wireless Routing Protocol and DSDV (Destination Sequenced Distance Vector) .

3. **Hybrid Routing Protocol (HRP) :** HRP uses the zone idea for routing, so the routes discovered its fast, and it is a hybrid routing protocol that combines reactive and proactive routing protocol characteristics. ZRP (Zone Routing Protocol) is one example of a hybrid routing protocol.

3.1.2. Hybrid Routing Protocols:

It basically combines the advantages of both, reactive and pro-active routing protocols. These protocols are adaptive in nature and adapts according to the zone and position of the source and destination mobile nodes. One of the most popular hybrid routing protocol is Zone Routing Protocol (ZRP).

The whole network is divided into different zones and then the position of source and destination mobile node is observed. If the source and destination mobile nodes are present in the same zone, then proactive routing is used for the transmission of the data packets between them. And if the source and destination mobile nodes are present in different zones, then reactive routing is used for the transmission of the data packets between them.

3.1.3. Zone Routing Protocol: As seen, proactive routing uses excess bandwidth to maintain routing information, while reactive routing involves long route request delays. Reactive routing also inefficiently floods the entire network for route determination. The Zone Routing Protocol (ZRP) aims to address the problems by combining the best properties of both approaches. ZRP can be classed as a hybrid reactive/proactive routing protocol.

. ZRP Architecture:

The Zone Routing Protocol, as its name implies, is based on the concept of zones. A routing zone is defined for each node separately, and the zones of neighboring nodes overlap. The routing zone has a radius expressed in hops. The zone thus includes the nodes, whose distance from the node in question is at most hops. An example routing zone is shown in Figure 1, where the routing zone of S includes the nodes A–I, but not K. In the illustrations, the radius is marked as a circle around the node in question. It should however be noted that the zone is defined in hops, not as a physical distance.

The nodes of a zone are divided into peripheral nodes and interior nodes. Peripheral nodes are nodes whose minimum distance to the central node is exactly equal to the zone radius . The nodes whose minimum distance is less than are interior nodes. In Figure 1, the

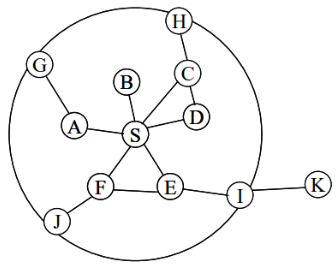

Figure 1: Example routing zone with ρ=2

nodes A–F are interior nodes, the nodes G–J are peripheral nodes and the node K is outside the routing zone. Note that node H can be reached by two paths, one with length 2 and one with length 3 hops. The node is however within the zone, since the shortest path is less than or equal to the zone radius.The number of nodes in the routing zone can be regulated by adjusting the transmission power of the nodes. Lowering the power reduces the number of nodes within direct reach and vice versa. The number of neighboring nodes should be sufficient to provide adequate reachability and redundancy. On the other hand, a too large coverage results in many zone members and the update traffic becomes excessive. Further, large transmission coverage adds to the probability of local contention.

There are three sub-protocols belong to the ZRP, including, IARP (Intra-zone Routing Protocol); BRP (Broadcast Resolution Protocol), IERP (Internal-zone Routing Protocol).

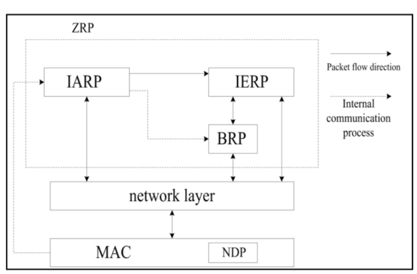

Fig. 1. ZRP components

ZRP Working : The information about neighbors is required to construct a routing zone of a given node. A neighbor is defined as a node with whom direct communication can be established. Neighbor discovery is accomplished by either the Intrazone Routing Protocol (IARP) or simple “Hello” packets.
IARP is proactive approach and always maintains up-to-date routing tables. Since the scope of IARP is restricted within a zone, it is also referred to as a “limited scope proactive routing protocol.” Route queries outside the zone are propagated by the route requests based on the perimeter of the zone (i.e., those with hop counts equal to), instead of flooding the network.
The Interzone Routing Protocol (IERP) uses a reactive approach for communicating with nodes in different zones.
Route queries are sent to peripheral nodes using the Bordercast Resolution Protocol (BRP). Since a node does not resend the query to the node in which it received the query originally, the control overhead is significantly reduced and redundant queries are also minimized.
ZRP provides a hybrid framework of protocols, which enables the use of any routing strategy according to various situations. It can be optimized to take full advantage of the strengths of any current protocols.
Neighbor discovery information is used as a basis for proactive monitoring of routing zones through the IntrAzone Routing Protocol (IARP) . Since ZRP assumes that local neighbor discovery is implemented on the link-layer and is provided by the Neighbor Discovery Protocol (NDP) , the first protocol to be part of ZRP is the IntrAzone Routing Protocol, or IARP . Hence the larger the routing zone, the higher the update control traffic. The paths to the nodes which are outside the routing zone can be achieved by IERP. If the destination belongs to its own zone, then it delivers the packet directly. Otherwise, source node bordercasts the Route Request to its peripheral nodes. If any peripheral node finds destination node within its routing zone, it sends a Route Reply back to source node indicating the path; otherwise, the node rebordercasts the Route Request packet to the peripheral nodes and this procedure continues until the destination is identified.

3.1.4. Improved Zone Routing Protocol Based on Clustering: The Basic Idea of novel ZRP based on clustering:
On the basis of the ZRP routing protocol, the network is divided into clusters. Each cluster creates a cluster head and divides into an area which is based on cluster head as the center and two hops for the radius. Table-driven routing strategy is used in the intra-zone and on-demand routing strategy is used in the inter-zone.
All nodes (except gateway node) belonging to a cluster need maintain this cluster routing table, which stores routing information of any node in the same cluster. It is necessary to notice that the gateway node, which belongs to the two clusters or more than two clusters, needs not maintain the routing information of the cluster members, only needs to maintain the routing information of the multiple cluster head nodes.
The network of the improved ZRP routing protocol based on clustering is divided into a number of relatively stable clusters by the dotted line. The node, that takes the cluster head node as the center and two hop as the radius, belong to the same cluster. As shown in Fig.2, node A, L, S, W is the cluster head , node G, H, I, M, Q as the gateway node and other nodes automatically become common nodes. The source node E sends data packetsto the destination node N. Firstly, node E needs to check whether the destination is within its zone or not. Since it is not found, a data request should be sent to the cluster head A. Cluster head A does not find the destination node E in its routing table. Consequently, it broadcasts a RREQ packet to its gateway nodes. The gateway node G, H, I continues to broadcast the request to its own cluster head. Finally, the route request is received by node L, which can find the destination in its routing zone, node L appends the path from itself to node N to the path in the route request. A route reply containing the reversed path , is generated and sent back to the source node.

. **Cluster Formation**

1. **Cluster Head Formation :** The car is not fit to be the cluster head because of the frequent changes of the network topology of highway environments and the fast car mobility. Compared with the car, freight (coach) is fit to be a cluster head which can maintain cluster information and perform message transmitting due to its slow driving speed and easy maintenance. This is

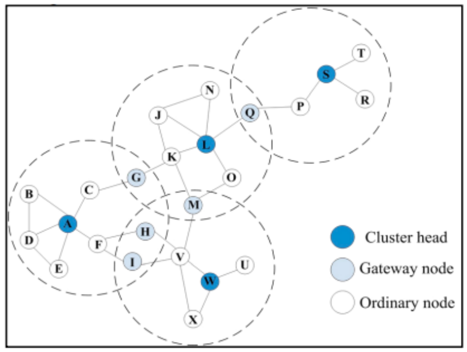

Fig. 2. Network structure of improved ZRP protocol

a kind of active clustering that cluster heads are generated by ours own, without algorithm of cluster generation. The main advantages of the method are simple structure, small calculation and stable topology. If there are many vehicles (or buses) within the close range, it selects the best storage node as the cluster head.

2. **Cluster Establishment :**Freight (coach) becomes the cluster head and other vehicles become isolated nodes. As depicted in Fig.3., node S becomes the cluster head and broadcasts the "hello" packet to the neighbor nodes in the two hop range. When the common node K receives the packet from cluster head S, it needs to determine whether the information of cluster head S in its own routing table or not. The node that has received the "hello" packet needs to send a "hello" response packet to the cluster head as a reply, which means that the node joins this cluster. Cluster members send data to each other to exchange routing information. The node would discard old routing table information and recreate a new routing table which contains only information of the cluster header if the node has received two or more than two packets different from cluster head, and then it becomes a gateway node.

Improved Intra and inter Cluster Routing Protocol
The intra cluster routing maintenance of routing protocol improved is similar to the traditional ZRP protocol. The member nodes which belong to the same cluster exchange and update information with other nodes by sending packets periodically. The gateway node

maintains a routing table which accesses to the other cluster heads by receiving information from multiple cluster heads. The source node needs to use a table-driven routing strategy when there is no valid routing to the destination. It sends a RREQ (request) packet which recorded the IP address of the source node and target node to the neighbor cluster head through the cluster head node and gateway node. Neighbor cluster head creates a RREP (response) packet to reply to the source node when it finds that the target node is a member of the cluster after receiving the RREQ packet, if not, it will continue to retransmit the RREQ packet for searching new path through the gateway node.

The **flow chart of improved ZRP routing algorithm based on clustering** is shown in Fig.4.:

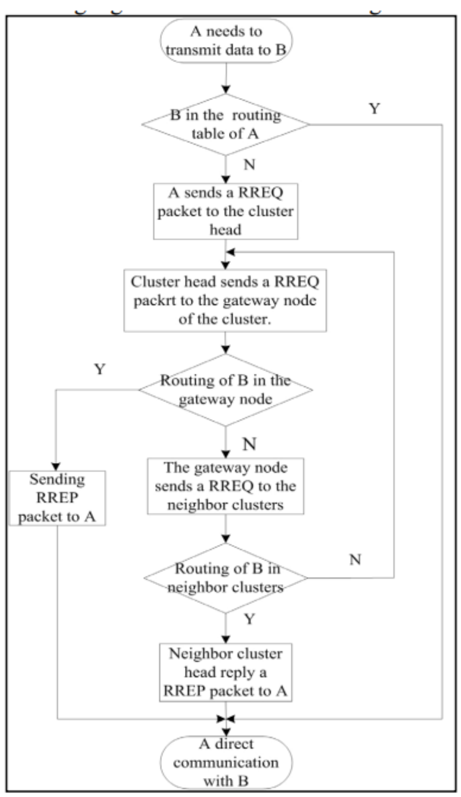

Fig. 4. Flow chart

4. APPLICATIONS

- **Military Communications:** MANET is Used in battlefield environments where communication infrastructure may be unavailable or unreliable. MANETs enable soldiers and vehicles to communicate securely and efficiently in dynamic conditions. ZRP Helps manage the high mobility and frequent topology changes of military networks, ensuring reliable and fast communication with reduced overhead.
- **Disaster Recovery and Emergency Services:** MANETis Essential during natural disasters (earthquakes, floods) where conventional infrastructure is destroyed. MANETs enable rapid deployment of communication networks for rescue and relief operations. ZRP Provides efficient routing with minimal delay and resource usage, allowing first responders to communicate seamlessly across dynamically changing zones.
- **Vehicular Ad Hoc Networks (VANETs):**MANET Supports vehicle-to-vehicle (V2V) and vehicle-to-infrastructure (V2I) communication for traffic management, collision avoidance, and smart transportation systems. ZRP Manages high-speed node mobility in VANETs by quickly adapting to frequent topology changes and ensuring efficient route discovery between vehicles.
- **Wireless Sensor Networks:** MANET: Enables communication between wireless sensors deployed in areas like environmental monitoring, industrial automation, and smart cities, where fixed infrastructure is impractical. ZRP Offers scalable routing with low energy consumption and control overhead, making it suitable for resource-constrained sensor networks.
- **Temporary Networks in Conferences or Events:**Facilitates temporary wireless networks at large events, conferences, or festivals, where infrastructure is not feasible. ZRP Manages the dynamic and dense environment efficiently, ensuring stable communication among attendees and devices with minimal setup time.
- **Rural and Remote Area Networking:** Provides internet

connectivity and communication services in rural or remote areas where infrastructure is lacking. ZRP Ensures efficient routing with low resource consumption, making it suitable for long-distance communication in such regions.

- **Mobile IoT (Internet of Things):** Provides connectivity between mobile IoT devices in applications like smart homes, healthcare, and wearable technology, where devices frequently move and communicate with each other. ZRP Enhances the performance of IoT networks by balancing localized and broader network communication, ensuring efficient data transmission in dynamic IoT ecosystems.

5. FUTURE SCOPE

The future scope of this seminar encompasses several potential avenues for growth and expansion:

- **Dynamic Zone Radius Adjustment:** Future development could explore more adaptive techniques for determining the optimal size of routing zones in real-time, based on node density, mobility patterns, and network load, further improving the efficiency of the protocol.
- **Improved Scalability for Heterogeneous Networks:** With the increasing diversity in network types (e.g., vehicular networks, drone networks, etc.), future versions of ZRP can be further optimized for heterogeneous networks, ensuring seamless routing in complex and mixed-protocol environments.
- **Performance in 3D and Aerial Networks:** As MANETs expand into three-dimensional space (e.g., in drone networks and unmanned aerial vehicles), ZRP's future adaptations could address the unique challenges of 3D mobility, such as varying altitudes and dynamic spatial changes, to optimize routing performance in aerial networks.
- **Quality of Service (QoS) Improvements:** Future research could focus on enhancing ZRP to provide better Quality of Service (QoS) for applications that require high reliability, low latency, or high bandwidth, making it more suitable for real-time applications like video streaming or telemedicine.
- **Artificial Intelligence (AI) and Machine Learning (ML) Integration:** Future improvements to ZRP could leverage AI and ML techniques to dynamically adjust routing parameters based on real-time network conditions, improving routing efficiency and performance in rapidly changing environments.
- **Adaptation for Large-Scale IoT Networks:** As the Internet of Things (IoT) continues to expand, future research could focus on modifying ZRP to better suit the specific needs of large-scale IoT networks, ensuring that it can handle high-density networks and diverse communication protocols.

6. CONCLUSION

ZRP combines two completely different routing methods into one protocol. Within the routing zone, the proactive component IARP maintains up-to-date routing tables. Routes outside the routing zone are discovered with the reactive component IERP using route requests and replies. By combining bordercasting, query detection and early termination, it is possible to reduce the amount of route query traffic. Since the actual implementation of IARP and IERP is not defined, the performance can be further improved by adapting other routing protocols as ZRP components. ZRP can be regarded as a routing framework rather than as an independent protocol . ZRP reduces the traffic amount compared to pure proactive or reactive routing. Routes to nodes within the zone are immediately available. ZRP is able to identify multiple routes to a destination, which provides increased reliability and performance. It ensures that the routes are free from loops. It is a flat protocol, which reduces congestion and overhead usually related to hierarchical protocols.

This report puts forth novel routing protocol about MANET which was called improved ZRP routing protocol based on clustering as sets the cluster head in advance to reduce the overhead of cluster head generation algorithms and divides the whole network into clusters to implement the discovery and maintenance of routing information. The improved ZRP will be straightforward prompt protocol in future. Certain and multitude simulations results evince that the put forth idea protocol has better delivery of packets from source to the destination and reduces routing overhead and end-to-end postpones on the network.

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