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Reactive Routing Protocols Route Discovery Using CNRR Approach in Mobile Ad HOC Network

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Abstract
Information on the location of mobile nodes in Mobile Ad-hoc Networks (MANETs) has the potential to significantly improve network performance. The node location information to develop new techniques for route discovery in on-demand routing protocols such as the Ad-hoc On-Demand Distance Vector (AODV), thus making an important contribution to enhancing the experience of using mobile networks. A Candidate Neighbours to Rebroadcast the Route Request (CNRR) approach has been proposed to reduce the deleterious impact, known as the broadcast storm, of RREQ packets flooding in traditional on-demand routing protocols. The Link Stability and Energy Aware protocol (LSEA) has been developed to reduce the overhead while increasing network lifetimes. The LSEA helps to control the global dissemination of RREQs in the network by eliminating those nodes that have a residual energy level below a specific threshold value from participation in end-to-end routes.
Furthermore, merging the LSEA and CNRR concepts has the great advantage of reducing the dissemination of RREQs in the network without loss of reachability among the nodes.

Keywords
MANET, Route, Reactive, CNRR, LSEA, Broadcast.

I. Introduction
A Mobile Ad hoc Network (MANET) is an autonomous ad hoc network consisting of a collection of mobile nodes that utilize wireless transmission for communication and cooperation. MANETs are self-configured, self-organized and self-controlled, without reliance on any pre-existing infrastructure or centralized access points. Therefore, they can be deployed anytime and anywhere. The numerous applications of MANETs include search and rescue operations, academic and industrial applications, and Personal Area Networks (PANs). A node in a MANET is required to operate as a host as well as a router that can forward packets so that they can reach nodes that do not reside within the transmission range of the source node. The topology of MANETs is dynamic. Nodes are free to change their physical location by moving freely in all directions.
MANET is a special type of wireless network in which a collection of mobile network interfaces may form a temporary network without aid of any established infrastructure or centralized administration. Ad Hoc wireless network has applications in emergency search and- rescue operations, decision making in the battlefield, data acquisition operations in hostile terrain, etc. It is featured by dynamic topology (infrastructureless), multi-hop communication, limited resources (bandwidth, CPU, battery, etc.) and limited security. These characteristics put special challenges in routing protocol design. The one of the most important objectives of MANET routing protocol is to maximize energy efficiency, since nodes in MANET depend on limited energy resources.
The primary objectives of MANET routing protocols are to maximize network throughput, to maximize network lifetime, and to maximize delay. The network throughput is usually measured by packet delivery ratio while the most significant contribution to energy consumption is measured by routing overhead which is the number or size of routing control packets. A major challenge that a routing protocol designed for ad hoc wireless networks faces is resource constraints. Devices used in the ad hoc wireless networks in most cases require portability and hence they also have size and weight constraints along with the restrictions on the power source. Increasing the battery power may make the nodes bulky and less portable. The energy efficiency remains an important design consideration for these networks. Therefore ad hoc routing protocol must optimally balance these conflicting aspects.
Routing is mainly classified into static routing and dynamic routing. Static routing refers to the routing strategy being stated manually or statically, in the router. Static routing maintains a routing table usually written by a networks administrator. The routing table doesn't depend on the state of the network status, i.e., whether the destination is active or not. Dynamic routing refers to the routing strategy that is being learnt by an interior or exterior routing protocol. This routing mainly depends on the state of the network i.e., the routing table is affected by the activeness of the destination.
Classification of routing protocols in MANET's can be done in many ways, but most of these are done depending on routing strategy and network structure. According to the routing strategy the routing protocols can be categorized as Table-driven and source initiated, while depending on the network structure these are classified as flat routing, hierarchical routing and geographic position assisted routing. Both the Table-driven and source initiated protocols come under the Flat routing.

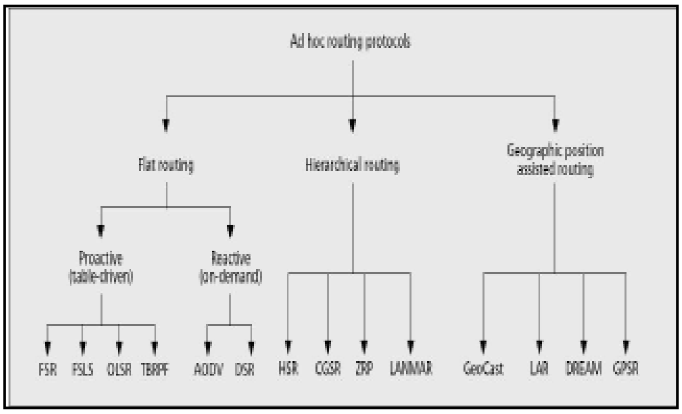

Fig. 1.1: Classification of Routing Protocols

II. Broadcast In Manets
There are two main characteristics of MANETs: they are wireless

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which means that broadcasting is inherent in their nature, and they are mobile which means that they are continuously moving and require frequent route updates. The following sections describe the above-mentioned properties.

A. Mobility – Induced error on Geography Routing in MANET

In Geographic routing, the packet forwarding technique was solely based on the location information of neighbors. Geographic routing in GPRS consists of two forwarding modes. i) Greedy packet forwarding, ii) Perimeter forwarding. Initially the packet was forwarded by greed forwarding in which all the nodes were identified the location based on the neighbor nodes. The packet forwarding mode has been changed in to perimeter forwarding mode when the node was found out the maximum location Final Stage.

B. Routing Protocols for MANET using Mobility Prediction

In the MANET the nodes can construct a path in the network using the routing capacity of the intermediate nodes. The communication was established in wireless multi-hop fashion. In other words the communication is established in a wireless multi-hop fashion. The node can also have other characteristics such as small size and battery powered, making the node not only mobile but also portable. As a result MANET can operate in places and situations where traditional networks cannot work properly, such us in disaster recovery areas, rural zones, and third world countries.

C. Energy Efficient Routing Protocols for MANET

Energy efficient Routing will be the most important Design in MANET. Since mobile nodes are powered by batteries with limited capacity. Power failures of a mobile node not only affect the node alone, it will affect the entire network life time. The routing protocols were proposed in MANETs are table-driven and on-demand driven routing. Routing in MANET includes new generation of on demand routing schemes (AODV, DSR, TORA, ABR etc). Proactive routing schemes (OSPF, RIP) compute global routes in the background. The Benefit of proactive routing includes low latency access, alternative paths for effective call acceptance control. These protocols concentrate on the energy properties scheme of applications.

D. Greedy Perimeter Stateless Routing for MANET

GPRS routing algorithm uses geography to achieve small per node routing state, small routing protocol message capacity, robust packet delivery etc. GPRS will use immediate neighbor information in forwarding decisions. Routing protocol will relay on end to end state delivery path between a forwarding router and packet’s destination.

E. Minimum Energy Mobile Wireless Networks

Position based algorithm is used to maintain the minimum energy between the user. Each user will be denoted by nodes over two dimensional planes. Each mobile node has a portable transmission set, reception, processing capabilities. This distributed protocol will find the minimum power topology in the Ad hoc networks

F. Stable Path Selection

Five Different Metrics have been proposed for stable path selection. The first technique is based on the local choice of the oldest link as the most stable link; the second class of metrics concerns the selection of the youngest links, because they are considered more resilient to breakage; the third criterion is based on the selection of the link with the highest average residual lifetime value; the fourth one makes selection of the link with the highest persistence probability; finally, the fifth metric focuses on the connection failure probability. The latter approach has been shown to be robust because it is based on the monitoring of the links lifetime of the mobile nodes in the wireless network, in the past and in the present, to predict its behavior, in the future without considering directly parameters depending by underlying mobility model such as node speed or direction. End-to-end delay of a source destination session is another considered performance metric, particularly for real-time applications.

III. Existing Methodology & Proposed Scheme

In existing methodology, a fully distributed cooperative scheme for NPV, which enables a source node, to discover and verify the position of its communication neighbors. For clarity, here we summarize the principles of route discovery and position verification process. A source node, S can initiate the protocol at any time instant, by triggering the 4-step message exchange process [POLL, REPLY, REVEAL and REPORT], after completing the message exchange process, source node S has derives distance range of neighbor nodes to discover the shortest path to reach destination, after route discovery S runs several position verification tests in order to classify each candidate neighbor as either VERIFIED, FAULTY, UNVERFIABLE. Clearly , the verification tests aim at avoiding false negatives(i.e..adversaries announcing fake positions that are deemed verified) and false positives (i.e., correct nodes whose positions are deemed faulty),as well as at minimizing the number of unverifiable nodes. We remark that our NPV scheme does not target the creation of a consistent “map” of neighborhood relations throughout an ephemeral network: rather, it allows the verifier to independently classify its neighbors.

A. Drawbacks of the Existing System

The network may contain few self nodes. These nodes will make of CPU power during the transmission from source node to Destination.

The self node may consume the energy. This is not suitable for energy optimization.

Every node will know about the neighborhood node only, Route looping can also occur while transmitting the longer packet. This is not suitable for energy optimization.

B. Proposed Scheme

Our proposed broadcast schemes use a novel neighborhood-based approach for dynamically selecting the group of nodes that forward the broadcast message. The source node selects a subset of its 1-hop neighbors for forwarding the broadcast packet, includes their addresses in the packet header, and broadcasts the packet. A node that receives a broadcast packet is a forwarding node if its address is included in the packet header. Otherwise, it drops the packet. Forwarding nodes repeat the same process carried by the source.

The two broadcast schemes we propose differ in the method used for selecting forwarding nodes. In the first method, a number of 1-hop neighbors that have the largest number of neighbors are selected as forwarding nodes. In the second method, a subset of 1-hop neighbors that can reach all 2-hop neighbors forms the forwarding group. The two schemes are respectively referred to as the Broadcast-based CNRR Scheme, and the Broadcast-based Covering Neighbors Scheme. Below, they are described within the context of on-demand route discovery. In this case, the packet being broadcast is the Route REQuest (RREQ) packet, and the goal is finding a path to a destination node.

When a RREQ packet reaches its destination node, the destination sends a reply to the source of the request, and it does not forward the packet. Information on neighbors that is used in the proposed schemes is obtained via HELLO messages that are exchanged periodically, as in LSEA & AODV.

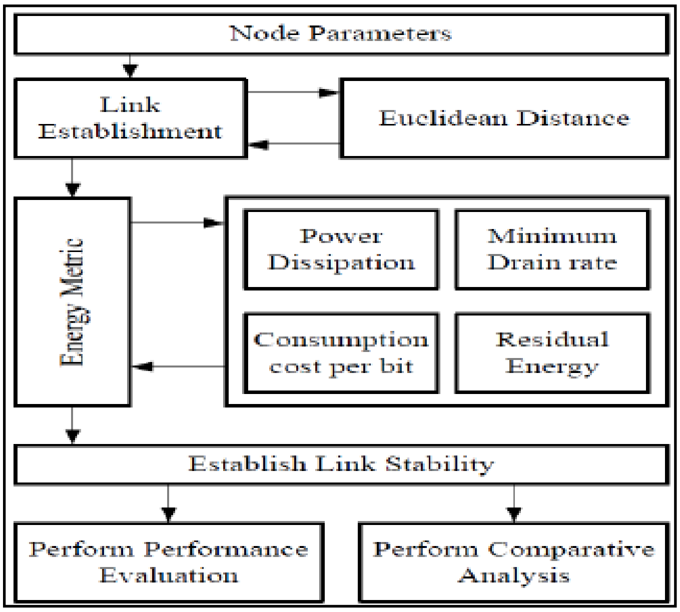

Fig. 3.1: Overall Scheme of the proposed system

The PROPOSED FRAMEWORK algorithm (See Figure 1) requires each node i to advertise its location (xi, yi, zi), rate of energy consumption (MDR), and link stability index for each link outgoing by node i. We will insert the information mentioned above in PROPOSED FRAMEWORK HELLO packet. Each node broadcasts HELLO packets to all its neighbors that are in its communication range; each node in PROPOSED FRAMEWORK maintains the table of its direct neighbors. When a node receives the HELLO packet, it updates the information of the neighbor, if neighbor ID is already present in table or adds neighbor information, if it is a new neighbor.

The data forwarding strategy of PROPOSED FRAMEWORK is based on a greedy technique such as GPSR. However, differently by GPSR, the next hop selection tries to minimize the joint energy stability metric. PROPOSED FRAMEWORK packet forwarding presents high scalability property because only the neighborhood and destination knowledge are necessary for the greedy technique. The flexibility of energy-stability-based greedy forwarding is offered through the capability to weight the stability and the energy consumption on the basis of the interest of the application layer. This means that if an application is more sensitive to the path stability and, consequently, the link stability, it is possible to give more importance to the si;j index.

Route Request

Protocol PathDiscovery()
{ while(1)
{ for each chosen neighbor
if destination is in the neighborhood(nbr) vector
{ unicast RREQ to the neighbor;
exit(); }
Choose a value in K such that (3≤ K ≤ 7)
if ((n/k) <= 1)
{ if (n/2 <= 1) {
Choose the only neighbor to rebroadcast ;
Unblock the neighbor if it was previously blocked by other node in the network }}
Choose n/K farthest neighbors from nbr vector;
Block the other neighbors from rebroadcasting;
PathDiscovery(); } }

Route Reply

If current node is the sender then
Create a chase packet
Broadcast the chase packet
Start transmitting the data
Else
Route the route reply message to the sender.
End if
1 if(node = = source)
then broadcast(RREQ) with routelist;
else if(received RREP)
then sort(routes);
using [link_Quality (strong),
Maximum(min_re_energy) and
minimum(delay)];
else rebroadcast(RREP);
endif //go to 2
2 if (node == intermediate node)
calculate remaining energy
calculate delay;
update in routelist;
broadcast(RREQ) with Route_list;
endif //go to 3
3 if (node == destination)
then stop broadcast(RREQ);
update as advertised_hop_count = 0;
Calculate overall delay, link quality;
Update route_list,
reply (RREP) with route_list;
endif

The number of rebroadcasts is determined by the reachability parameter K which ranges between 3 and 7. The number of route requests to be rebroadcasted by each node to determine an optimal path depends on the chosen reachability parameter and the local density of the network. Selecting half of the neighbors from the neighborhood vector in a dense network establishes a shortest path between the source and the destination nodes reducing the control overhead to half from the one that is actually required.

IV. Performance Evaluation Of Proposed Scheme

The proposed system is classified with energy metric evaluation and link stability metric which considers mainly the power dissipation factor that frequently alters with respect to the mobility of the nodes in the simulation area. The system mainly uses greedy approach where the data packets are forwarded based on the heuristic nature of the energy factors considers. The architecture is quite flexible for usage of minimum energy consumption even

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with highest mobility.

To compare the different routing protocols for MANETS there are a group of important parameters to take into account. These parameters are common in the quantitative analysis but it is necessary to know and to understand them to do a theoretical study. In the next points some of the most representatives are explained:

- **Throughput**

Packets delivered per second (TCP traffic only). Examining throughput, especially when it is considered relative to different network scenarios, helps to determine how well the routing protocols permit applications to optimize the use of the available bandwidth.

- **Packet Delivery Ratio**

Packets successfully delivered to destinations over total number of packets sent. Packet delivery ratio is calculated by dividing the number of packets received by the destination by the number of packets originated by the application layer of the source. It specifies the packet loss rate, which limits the maximum throughput of the network. The better the delivery ratio, the more complete and correct is the routing protocol.

- **Control Packet Overhead**

The routing overhead describes how many routing packets for route discovery and route maintenance need to be sent in order to propagate the data packets. It is an important measure for the scalability of a protocol. It, for instance determines if a protocol will function in congested or low-bandwidth situations, or how much node battery power it consumes. If a protocol requires sending many routing packets, it will most likely cause congestion, collision and data delay in larger networks.

- **Control Byte Overhead**

The total number of control bytes used in the control packets.

- **Delay**

It is End-to-end packet delay, from source to destination. The end-to-end delay measures the delay a packet suffers after leaving the sender and then arriving at the receiver application.

This includes delays due to route discovery, queuing at Internet protocol (IP) and medium access control (MAC) layers, and propagation in the channel.

- **Hop Count**

It represents the number of hops that a packet has taken before it has been correctly delivered.

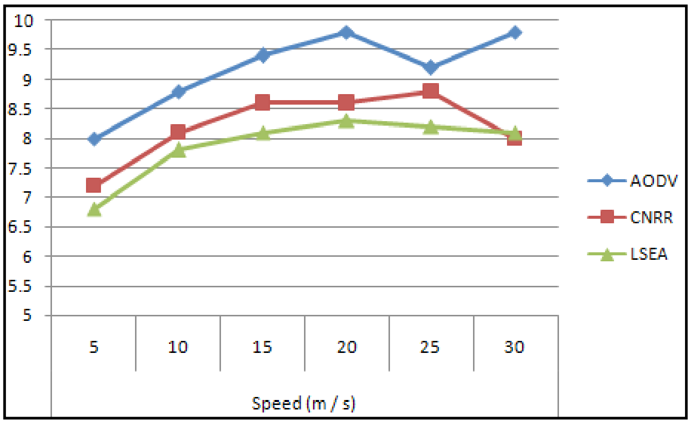
Table 4.1: - Simulation Environment

Map Size	350m * 350m
Channel Bandwidth	11Mbps
Channel Delay	10sec
Simulation Time	900s
Number of Hosts	100
Channel Gain	0
Mobility Model	Random Way Point
Message Packet Size	512bytes

Three performance metrics are of interest: (1) Route Request Success Rate, (2) Saved Rebroadcast, and (3) Route Request Delay. In each simulation, we compare the performance of our LSEA protocol with AODV protocol, which is well-known and commonly used ad hoc on demand routing protocol.

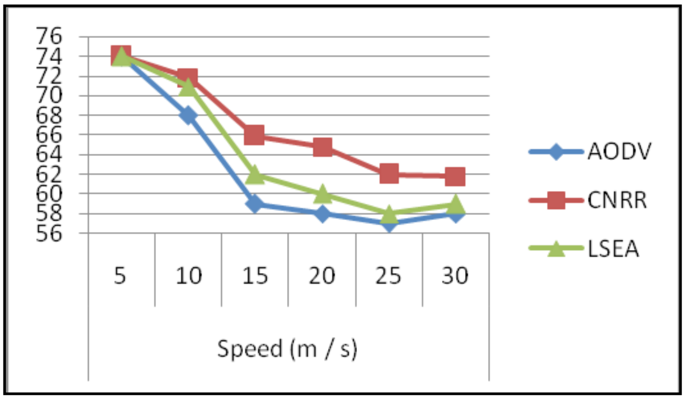
A. Total Overhead

The proposed mechanisms increase path stability because the returned path consists of those nodes with better link lifetimes and high residual energy levels.



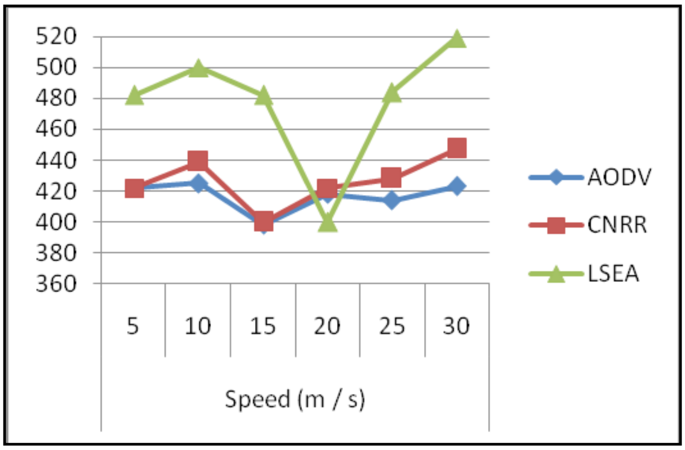
B. Delivery Ratio

The data delivery ratio of the proposed schemes was compared with that of the AODV protocol. The results show that the combined effects of residual energy and link lifetimes affect the delivery ratio. This figure shows that LSEA give a better average packet delivery ratio than the AODV protocol.



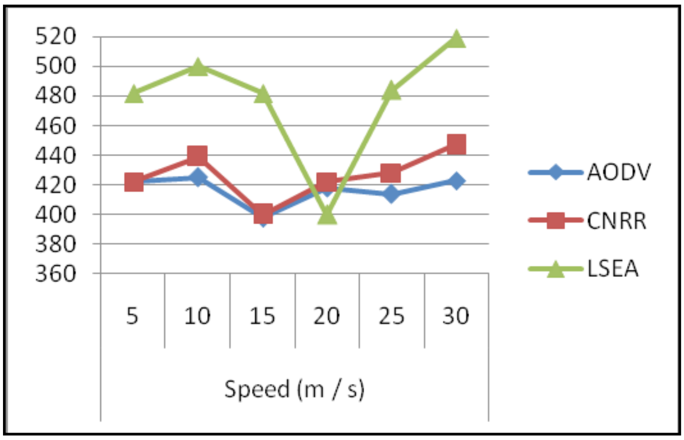
C. Network Lifetime

The network lifetime increases with increases in the energy threshold level in the case of the LSEA protocol. When the energy threshold is increased, any node can be prevented from forwarding the RREQ if its energy is below this level.



D. Average End-to-End Delay

The average end-to-end delay of the proposed schemes using two protocols LSEA & AODV. As can be seen from the figure, the average delay experienced by the packets is greater in the case of AODV than in the proposed schemes. However, in some cases the delay in the proposed schemes is greater.



V. Conclusions

The Candidate Neighbours to Rebroadcast the RREQ (CNRR) approach was proposed as a way to reduce the overhead in MANETs. The CNRR routing protocol utilizes the nodes' location information to select four neighbour nodes for rebroadcasting received RREQ messages when there is no information in the routing table for the intended destination in the RREQ packet. CNRR applies a source routing strategy in which the source node selects four neighbours based on their distances. This source strategy has rarely been used in geographical routing protocols to improve the route discovery phase.

In order to implement these two versions, we selected the AODV routing protocol for modification. The standard AODV 'hello' message was modified in both versions of the above-mentioned protocols to enable the (x, y) coordinates of each node to be carried/shared. Furthermore, the RREQ message was modified with the addition of a cnrr field to carry the four candidate nodes' addresses.

The proposed system discusses about a scalable routing protocol based on the joint metric of link stability and energy drain rate, has been proposed. It is based on the local topology knowledge and it makes use of a greedy technique based on a joint metric and a modified perimeter forwarding strategy for the recovery from local maximum.

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