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A New Energy Efficient Rbno Mechanism for on Demand Routing Protocol in Manet

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ABSTRACT

Ad hoc networks consist of wireless hosts that communicate with each other in the absence of a fixed infrastructure. They have potential applications in disaster relief, conference, and battlefield environments, and have received significant attention in recent years. Due to the highly dynamic nature, constantly changing topology and limited transmission range of the mobile nodes, routing in these networks is considered a critical research challenge. Mobile ad hoc network is a self-organizing and self-configuring network in which mobile host moved freely. In mobile ad hoc network location of mobile nodes are frequently changed in a particular region. Thus this work focuses about energy efficient region based node organization (RBNO) problem. This is an crucial issue in mobile ad hoc network due to dynamic topologies. In this paper, we proposed an improved energy efficient Region Based Node Organization (RBNO) location added routing for GPS enabled MANETs. It is also been evaluated for performance metrics such as end to end delay, control overhead, and packet delivery ratio. Use of this proposed RBNO based routing with exact location information of the nodes will reduces the control overhead resulting in higher packet delivery ratio.

Keywords: MANET, RBNO (Region Based Node Organization), AODV, LAR, PBR

I. INTRODUCTION

In an ad hoc network, a message sent by a node reaches all its neighbouring nodes that are located at distances up to the transmission radius. Because of the limited transmission radius, the routes between nodes are normally created through several hops in such multi-hop wireless networks. The use of the nodes' position for routing poses evident problems in terms of reliability. The accuracy of the destination's position is an important problem to consider. In some cases the destination is a fixed node (e.g., a monitoring centre known to all nodes, or the geographic area monitored), and some networks are static. The problem of designing location update schemes to provide accurate destination information and enable efficient routing in mobile ad hoc networks appears to be more difficult than routing itself.

We shall describe only the following simple strategy. If a message is reasonably "short," it can be broadcast (i.e., flooded) using an optimal broadcasting scheme.

If a message is relatively "long," destination search (or route discovery) can be initiated, which is a task of broadcasting a short search message. The destination then reports back to the source by routing a short message containing its position. The source is then able to route the full message toward the accurate position of the destination. In this article we consider the routing task, in which a message is to be sent from a source node to a destination node in a given wireless network. The task of finding and maintaining routes in sensor and ad hoc networks is nontrivial since host mobility and changes in node activity cause frequent unpredictable topological changes [1]. The destination node is known and addressed by means of its location. Routing is performed by a scheme based on this information, generally classified as a position-based scheme.

II. BACKGROUND

Each approach has its own advantages and disadvantages. Every node is aware of its own position and is notified of its neighbors' positions through small packets broadcasted by the neighbors to announce their position. Additionally, a node is able to determine the location of the destination through any location management scheme (VHR, GLS). This additional information allows improving routing significantly, especially for large-scale mobile ad-hoc networks, where the number of nodes can potentially reach several thousand or even millions such as considered in the terminodes project. In this way, the periodical advertisement of each node's position by sending small packets can be avoided [4].

A node does neither need to have knowledge of its neighbors' positions nor even of their existence. If a node wishes to send a packet, it just broadcasts it and every neighboring node receives it. The protocol takes care that just one of these nodes relays the packet any further. This is accomplished by introducing a small additional delay at each

node depending on its position relative to the last node and the destination. The node located at the most "optimal" position introduces the fewest delay and, thus transmits the packet at first. The other nodes detect this subsequent relaying and cancel their scheduled transmission. On one hand side, the overall delay is increased, but on the other hand side, the use of battery power can be reduced significantly at the same time as well [5].

III. RELATED STUDY

In [6] the multipoint relays (MPR) technique implement the flooding function in wireless networks. It is a technique to reduce the number of redundant re-transmission while diffusing a flooding packet throughout the entire network. Each node N in the network selects some neighbours as its Multipoint Relays (MPR). Only these neighbors will retransmit the flooding packets broadcasted by node N. These nodes called 2-hop neighbors whose distance to N is 2 hops. The MPR selection algorithm should guarantee that the flooding packets from N will be received by all its 2-hop neighbors after re-broadcast of N's MPRs.

Location-Aided Routing (LAR) protocol is an approach that decreases overhead of route discovery by utilizing location information of mobile hosts. Such location information may be obtained using the global positioning system (GPS) [7]. LAR uses two flooding regions, the forwarded region and the expected region. LAR protocol uses location information to reduce the search space for a desired route. Limiting the search space results in fewer route discovery messages. When a source node wants to send data packets to a destination, the source node first should get the position of the destination mobile node by contacting a location service which is responsible of mobile nodes positions. This causes a connection and tracking problems [9].

IV. PROPOSED DESIGN ARCHITECTURE RBNO

The location information was used in order to reduce flooding for finding a route to the destination. A lot of position-based routing algorithms even do not require the establishment of any route prior to data transmission [17]. In my proposed approach a packet can just be sent to any intermediate node into the direction of the destination, making almost stateless routing feasible. In this way, nodes neither have to keep track of installed routes nor to store routing tables.

(A) ENERGY EFFICIENT REGION BASED NODE ORGANISATION (EERBNO)

A further advantage of this proposed energy efficient RBNO is that position-based routing naturally supports geo-casting. In this there are small data packets which are broadcasted by the node to inform its neighbors about its position. Consequently, a node does normally not have any information about its neighbors. The algorithm takes care that an appropriate neighboring node is chosen to forward the packet. First, the source node determines the destination node's position prior to the transmission and stores these geographical coordinates in the header of the packet. From then on, basically every node, whether it is the source or any intermediate node, performs exactly the same algorithm to forward the packet.

The node stores its position in the packet header and just broadcasts the packet. Several neighbors around the transmitting node receive the packet. The only available

information a node has upon the reception of a packet is the position of the previous and the destination node from the packet header, and as well its own position through any location management service.

In this way, a node can easily determine if it is located within a 60° sector from the previous node's position towards the destination location with a radius that just equals the transmission range. The angle of 60° results from the precondition that each node within this sector should be able to detect the transmission of any other node within this sector for the algorithm to work properly, as described below. Only nodes within this sector are taking part in the elimination process to forward the packet (e.g. nodes A and B in Fig.). The other nodes just discard the packet (e.g. nodes C and E in Fig.).

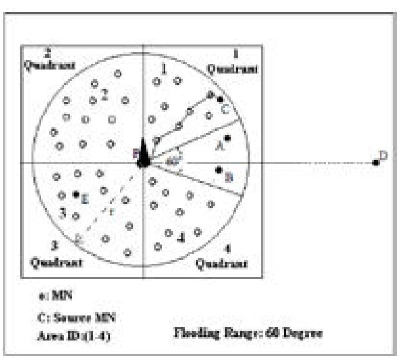


Figure 1. Proposed Energy Efficient Region Based 60° Node Organization Architecture Proposed algorithm uses a proxy node for location update and also determining some parameters related to node such as x-coordinate of node, y-coordinate of node, regions number, distance and angle of a node from proxy node. Proxy node is a node which is located at centre position of the whole network area. For Location management, network area is divided into four regions. Each region has mobile nodes, which is frequently moved from one place to another place. Here, proxy node which is act as a reference point. The proxy node is located at centre of the whole network area. These proxy nodes try to continue management of the node information & updated it in a log file.

Proposed protocol is also called as a Reactive Protocol and work as an on demand routing protocol. In Reactive protocols, nodes only discover routes to destinations on-demand. Reactive protocols often consume much less bandwidth than proactive protocols, but the delay in determining a route can be substantially large. Proactive protocol is suitable for small network not for larger network because protocol need to maintains node entries for each and every node in the routing table. Here, the algorithm uses AODV (Ad hoc on-demand distance vector) Protocol which is a reactive protocol.

Along with the above mentioned parameters of Node Regions based updating methods the algorithm can calculate unicast packets, aggregation of path, node density & aggregation with other protocol, packet forwarding, & duplicate packet identification.

(B) MATHEMATICAL ANALYSIS

(i) Average Residual Energy

Let Pij and Ep be the energy required to route data packet from node i to node j and the energy required to calculate position by the node respectively then the energy consumed by the node in the network Ec is

$$Ec = \sum_{i=1,j=2}^{n} Pij + Ep$$

Let Ee be the total initial energy of a node and Ec is the energy consumed by the node in the network. Therefore the average residual energy of each node Er may be calculated as Er = Ee – Ec. Total energy consumed by the node in the network is equal to the energy required to route packet from one node to another node plus the energy required to calculate the position of the node. The average residual energy level of nodes and hence of the network is given by equation .

$$Ea = \frac{(\sum_{r=1}^{n} Er)}{n}$$

Where n is the total number of nodes. The proposed protocol ensures less number of hop counts which in turn reduces Pij. This factor in turn increases the average residual energy level of each node and hence of the network. The lower computational complexity towards calculation of location information in making routing decision minimizes energy consumption per routing tasks.

(ii) Control Overhead Estimation for RBNO

With HELLO Packets, the number of control packets generated between all the nodes (N) in an ILCRP in simulation time (Tsim) is N. The HELLO packets generated between all the cluster heads(C) in Tsim is

$$C.\left(\frac{Tsim}{Tref}\right).\sum_{i=1}^{C}\sum_{j=1}^{C} \text{Hij}$$

Where Tref is the refresh period between each HELLO message. After Cluster formation, the number of control packets generated between all the nodes (n) in a cluster is n.(Tsim/Tref). Therefore for C clusters, control packets

$$n.C.\left(\frac{Tsim}{Tref}\right)$$

generated will be Hence the total number of control packets generated in EERBNO in Time Tsim is

$$N + C.\left(\frac{Tsim}{Tref}\right).\sum_{i=1}^{C}{}_{j=1}^{C} Hij + n.C.\left(\frac{Tsim}{Tref}\right)$$

Where
N – Total number of Nodes in the network C – Number of clusters in the network Tsim – Simulation Time

Tref – Refresh Period Hij– no of Hop counts
n – Number of nodes in a cluster
(iii) Packet Delivery Ratio for RBNO

$$\mu\sqrt{N}$$

The maximum packet delivered per node is

$$\mu$$

where the channel capacity is and N is the number of nodes.

(C) ENERGY EFFICIENCY IN ABOVE ARCHITECTURE

VI. EXPERIMENTAL RESULT
In order to validate the proposed protocol and show its efficiency in future we present simulations using network simulator version 2 (NS-2). NS-2 is a very popular network simulation tool. It uses C language for protocol definition and TCL scripting for building the simulation scenarios [18]. The simulation environment settings used in the experiments are shown in Table II. The simulation duration is 500 seconds and the network area is 1500 meter x 1500 meter that includes variable number of mobile nodes ranging from 50 to 250. A Constant Bit Rate (CBR) is generated as a data traffic pattern at a rate of 2 packets per second, and 20% of the mobile nodes are selected randomly as CBR sources. The scenario of nodes mobility is generated randomly based on random way point

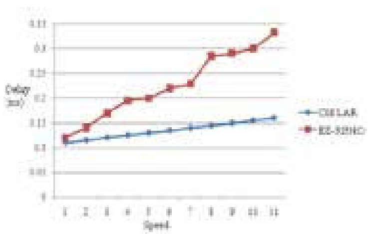
model where a mobile node moves to a new position and pauses there for time period between 0 to 3 seconds, then it move to another position.

TABLE I. NS2 simulation environment settings

Parameter	Setting Value
Simulation duration	500 sec
Network area	1500 m x 1500 m
Number of mobile nodes	50,100,150,200,250
Mobility model	Random way point model
Pause time	0 to 3 sec
Node transmission range	250 m
Data packet size	512 bytes
Number of CBR sources	20% of MNs
CBR rate	2 packets per second

Mobile node speed 5 to 30 m/s

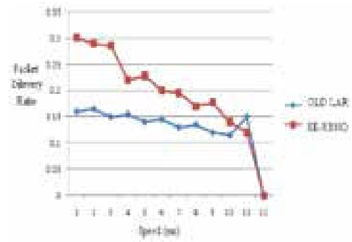
End to End Delay
End to End Delay indicates the time taken for a packet to be transmitted across a network from source to destination. It shows that the end to end delay reduces if the exact locations of all the nodes are obtained. On increasing the mobility of the nodes, the delay increases due to reconfiguration of the clusters. The end to end delay also increases due to increases in the number of nodes.



Graph 1: Comparison for Delay Vs Speed for RBNO & Existing LAR

Packet Delivery Ratio
It is defined as the ratio of total number of packets that have reached the destination node to the total number of packets originated at the source node. The location information of the nodes make the packets route loop free which results in high packet delivery ratio. Presence of CG-nodes and N-nodes lowers the delivery ratio in EERBNO protocol. On increasingthe mobility i.e., speed of the nodes, the delivery ratio decreases since most of the nodes move away from each other.

Packet delivery ratio between EERBNO and Old LAR.



Graph 2: Comparison for Packet Delivery Ratio Vs Speed

VII. CONCLUSION
The result graphs and above feature table of comparison shows the variance in residual energy with respect to the number of nodes and mobility (speed) of nodes. But with respect to residual energy, RBNO protocol scores higher compared to LAR protocol due to energy consumption by the GPS utility. Most of the LAR based protocols stress upon the fact that energy consumption is more when GPS enabled. Most of the protocols are for either GPS free or GPS scarce clusters. Though all the nodes are GPS enabled in the proposed protocol, the GPS utility is made to sleep when not in function as well as when there is no mobility for the node in order to reduce the power consumption. Only the cluster head's GPS function will be active during the functioning of the network

This review did not include discussion of relevant issues such as physical requirements, experimental design, location updates, congestion, scheduling node activity, topology construction, broadcasting, and network capacity. The successful design of localized single-path loop-free algorithms EERBNO with guaranteed delivery is an encouraging start for future research. The search for localized routing methods that have excellent delivery rates, short hop counts, small flooding ratios, and power efficiency is far from over. However, the research on position-based routing is scarce. Further research is needed to identify the best GPS- based routing protocols for various network contexts. Thesecontexts include nodes positioned in three-dimensional space and obstacles, nodes with unequal transmission powers, or networks with unidirectional links. Finally, the mobility- caused loop needs to be further investigated, and solutions found and incorporated in position-based routing schemes.

VIII. FUTURE WORK
Some problems and concepts that remains unaddressed and can be performed in future. Such as with the help of Distance and Angle of a node, we can identify the node which performs warm activity within the network. For this, we can place IDS (Intrusion Detection System) in central node position. We also embed source code of our proposed scheme in NS2. In our proposed scheme, I am simulating following network parameter: x-coordinate, y-coordinate, distance, angle. In future we can also simulate some other network parameters such as network diameter, radius etc.

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