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An Energy Efficient Location based Multipath Routing for MANET

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Abstract – *Mobile ad hoc networks consist of wireless hosts that communicate with each other in the absence of a fixed infrastructure. Location of mobile nodes is plays a vital role in mobile adhoc networks, It provides useful routing information such as coverage, location service, target tracking and rescue. Due to mobility of mobile nodes, its leads path failure breaks. Hence the location information cannot be predicted. In this research work, we have developed an multipath energy optimized localization approach which attains to make a balance between network life time, location updated rate, energy and delay among the mobile nodes. My proposed work consists of three phases. In the first phase of the scheme is multipath routing prediction. In second phase, Cluster head is choosen based on mobile election phase. In third phase, optimized energy routing based on energy consumption model. By simulation results ELOER achieves high network lifetime, high location update rate, while attaining low end to end delay, less energy consumption than the existing schemes.*

Keywords –*Multipath routing and localization, Mobile chosen method, network lifetime, end to end delay, overhead, throughput and location update rate.*

I. INTRODUCTION

Ad hoc networks are self-organized and collaborative. Due to propagation path loss, the transmission radii are limited. Thus, routes between two hosts in a network may consist of hops through other hosts in the network. The task of finding and maintaining routes in the network is nontrivial since host mobility causes frequent unpredictable topological changes. Relative coordinates of neighboring nodes can be obtained by exchanging such information between neighbors. Alternatively, the location of nodes may be available directly by communicating with a satellite through GPS (Global Positioning System) if nodes are equipped with a small low-power GPS receiver. It is believed that the advantages of using location information outweigh the cost of additional hardware, if any. The distance information, for instance, allows nodes to adjust their transmission powers and reduce transmission power accordingly. This enables to use power cost as metric in the corresponding routing algorithms in order to minimize energy required per routing task and to maximize the number of routing tasks that a network can perform.

Localization is one of key supporting technologies to Wireless Mobile Networks it could provide accurate position information for kinds of expanding application. Due to the availability of such low energy cost mobile s, microprocessor, and radio frequency circuitry for information transmission, there is a wide and rapid diffusion of wireless mobile network. Wireless mobile networks that consist of thousands of low-cost mobile nodes have been used in many promising applications such as health surveillance, battle field surveillance, and environmental monitoring. Localization is one of the most important subjects because the location information is typically useful for coverage, deployment, routing, location service, target tracking, and rescue. Hence, location estimation is a significant technical challenge for the researchers.

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Need for Energy Optimized Location Aware Routing in MANET

Most proposed routing algorithms do not use the location of nodes, that is, their coordinates in two- or three-dimensional space, in routing decisions. The distance between neighboring nodes can be estimated on the basis of incoming signal strengths. Relative coordinates of neighboring nodes can be obtained by exchanging such information between neighbors. Alternatively, the location of nodes may be available directly by communicating with a satellite through GPS (Global Positioning System) if nodes are equipped with a small low-power GPS receiver. It is believed that the advantages of using location information outweigh the cost of additional hardware, if any. The distance information, for instance, allows nodes to adjust their transmission powers and reduce transmission power accordingly. This enables using power, cost, and power cost metrics and corresponding routing algorithms in order to minimize energy required per routing task and to maximize the number of routing tasks that a network can perform. Routing tables that are updated by mobile software agents modelled on ants are used. Ants collect and disseminate location information about nodes

II. Related Work

A. Mikki was introduced that an Energy Efficient Location Aided Routing (EELAR) Protocol [1] for MANETs which is based on the Location Aided Routing (LAR). It makes significant reduction in the energy consumption of the mobile nodes batteries by limiting the area of discovering a new route to a smaller zone. Thus, control packets overhead are significantly reduced. In EELAR a reference wireless base station is used and the network's circular area centered at the base station is divided into six equal sub-areas. At route discovery instead of flooding control packets to the whole network area, it was flooded to only the sub-area of the destination mobile node. The base station stores locations of the mobile nodes in a position table.

In this paper [2], DREAM protocol was introduced and some of location based protocols were analyzed. Distance Routing Effect Algorithm for Mobility (DREAM) is a location-based routing protocol work for Ad-hoc networks. Here in this comparison, distance and mobility plays an important role for ad hoc networks. DREAM protocols have some desirable properties of providing bandwidth and energy efficiency. With respect to existing protocols, DREAM achieves more bandwidth and energy which can be used for the transmission of data messages. The rate of control message generation is determined and optimized according to the mobility rate of each node individually. This protocol provide loop-free path, since each data message propagates away from its source in a specific direction. It is also adaptive to mobility, since the frequency with which the location information is disseminated depends on the mobility rate.

In this paper [3], it was proposed that novel routing protocol for MANET, the Energy- Aware Geographic Routing (EGR) protocol that combines greedy routing, energy awareness routing and constrained flooding. This protocol effectively prolongs the network lifetime as well as provides an acceptable delivery ratio and end-to-end delay.

Jiang et.al [4] proposed a novel localization approach where unknown nodes through their near anchor nodes to obtain their position. In order to reduce error during localization, a new means was used to approximate the distance between unknown nodes and anchor nodes when it is larger than node's communication radius.

In this paper [5], it was proposed a Location Based Opportunistic Routing Protocol (LOR) to addresses the problem of delivering data packets for highly dynamic mobile ad hoc networks in a reliable and timely manner. This protocol takes advantage of the stateless property of geographic routing and the broadcast nature of wireless medium. When a data packet is sent out, some of the neighbor nodes that have overheard the transmission will serve as forwarding candidates, and take turn to forward the packet if it is not relayed by the specific best forwarder within a certain period of time. By utilizing such in-the-air backup, communication is maintained without being interrupted. The additional latency incurred by local route recovery is greatly reduced and the duplicate relaying caused by packet reroute is also decreased

Oguejifor et.al [7] implemented a localization system that uses a RSSI trilateration approach in a wireless mobile network. The system position estimation accuracy was also evaluated. Finally it was concluded that for the proposed system to work there must be the availability of at least three anchor nodes within the network and whenever anchor nodes broadcast packets containing their locations and other sensed parameters, the blind node within the broadcast range can always estimate its distance to the anchor nodes, and if peradventure the blind nodes receive packets from at least three anchors, the blind node can localize its position.

Xiajoun Zhu et.al [8] examined two candidate solutions developed from existing ideas, with one assuming that nodes can hear from each other if and only if they are within transmission range, and the other assuming closer nodes observe larger RSSI. Both candidate solutions do not work well in practice. After changing ''closer'' to ''the closest'' and ''larger'' to ''the largest'' in the second approach, it was found that the new assumption is quite reliable in practice.

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Rama Prabha and Parvadha Devi [9] proposed a fuzzy logic based restriction system suitable for remote mobile hubs that are portable in uproarious, savage situations. The constituent frameworks used fuzzy multi lateration and a grid prediction to process the area of a hub as a zone. The signal strength is thrown into bins which encode the imprecision.

Laslo Gogolak et.al [10] presented WSN based fingerprinting localization method. The RSSI values of the communication links between the previously situated mobile s and the mobile mobile were recorded in an indoor environment through the experiment. Using the recorded RSSI values a feed-forward type of neural network was trained. The result of the training is a neural network capable of performing indoor localization. The accuracy of the localization between the real and the calculated values was measured with Euclidean distance and demonstrated with the cumulative distribution function.

Priti Narwal and Tyagi [11] proposed a technique called Multidimensional scaling which computes the position of nodes which are in the communication range of each other. This analysis technique find out the relative position of nodes with accuracy sufficient enough for most of the applications so as to solve the problem of recreation.

Martin Victor and Ramalakshmi [12] developed a localization system that carries high-location estimation accuracy at low cost. The system used spatiotemporal properties of well-controlled events in the network; light in this case, to obtain locations of mobile nodes. The system was to detect the multiple events in the network and to increase the area of the mobile field by increasing the number of nodes. By handling this kind of detection of multiple events in the network at once, mainly the time was saved.

Sachin Deshpande et.al [13] presented the location based associativity routing is proposed which makes use of physical location information of destination node to reduce the search space for route discovery only, and not for data delivery. It does not cover route maintenance in case of broken links. The Associativity-Based Routing Algorithm of selects the route, based on node's associativity states. Therein, the search space used to determine the route to the destination node is equal to the entire network space and due to broadcast, the amount of routing related traffic increases, thereby consuming large portion of bandwidth.

Varun mishra et.al [14] proposed multi-path routing scheme constructs multiple paths from each node to reduce the possibility of congestion. In this routing scheme, each data packet is delivered to the number of nodes or neighbor using one of the paths and established minimum more than two paths. The proposed energy based multipath path selection algorithm provides a MAX energy path that spending among nodes which therefore maximizes the network lifetime. The MAX energy spending will reduce the amount of energy consumption which is usually given to other nodes that follow the routing procedure to establish the route on the bais of MAX energy selection basis. The performance is enhanced in term of performance metrics that proves that the performances of proposed scheme are better than compared scheme.

In this paper [15], the multi-path routing scheme was proposed that can clearly be combined with a number of location update schemes in order to produce a full routing protocol. Previous work does not seem to be sufficient to design a routing algorithm satisfying listed desirable properties, and/or to find the best combination of basic routing scheme and location update scheme. It was assumed here that weaker basic routing component would contribute to weaker overall routing protocol that handles mobility, and therefore limited our scope by considering only simple location update schemes, or even static networks in initial experiments. That allowed us to concentrate on low communication overhead of the basic routing algorithm, measured by flooding rates, and scalability, and proposed multi-path algorithms that can be used as basis for a complete routing solution in mobile wireless networks.

Dan Pescaru and Daniel [16] proposed another anchor node localization technique that can be used when GPS devices cannot accomplish their mission or are considered to be too expensive. This novel technique was based on the fusion of video and compass data acquired by the anchor nodes and is especially suitable for video- or multimedia-based wireless mobile networks.

Divya Bharti et.al [17] proposed a mobility control scheme and we explored the impact of mobility over the performance of wireless mobile network. Two different protocols were used for the performance analysis of proposed mobility control scheme and the impact of this method over the selected protocols. It was analyzed the performance of the protocols on the basis of different parameters like Throughput, Packet Delivery Ratio, Routing Load and energy consumption.

Jang Ping Sheu et.al [18] proposed distributed localization scheme where each normal node gathers the necessary information via two-hop flooding and is thus scalable. Aside from this, each normal node uses a simplified approach and the proposed improved grid-scan algorithm to find the initial estimated locations of the normal node, thus reducing the computation cost. It also introduced a vector-based refinement scheme to correct the initial estimated location of the normal node, thus improving the accuracy of the estimated location.

In this paper [20], some interesting issues are addressed arising in such MANETs by designing an anonymous routing framework (ALARM). It uses node's current locations to construct a secure MANET map. Based on the current map, each node can decide which other nodes it wants to communicate with. ALARM takes advantage of some advanced cryptographic primitives to achieve node authentication, data integrity, anonymity and untraceability. It also offers resistance to certain insider attacks.

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The paper is organized as follows. The Section 1 describes introduction about WSNs, localization algorithms and design goals of WSNs. Section 2 deals with the previous work which is related to the localization algorithms. Section 3 is devoted for the implementation of proposed scheme. Section 4 describes the performance analysis and the last section concludes the work.

III. Implementation of Proposed Scheme

In the proposed scheme, multipath route is deployed to improve the load balancing and network lifetime. The mobile choosing approach is proposed to provide less performance loss and high energy saving against the more battery consumption. Localization scheme is proposed to locate target node and unknown mobile nodes.

A. Load balancing through Multipath

Due to the presence of path's poor quality, packets will be retransmitted or lost. It will cause more local energy consumption and serious congestion. Path quality decides the reliability of packets forwarding. The remaining energy of all mobile nodes determines the survival time of the network. Therefore, the way only using hops as a criterion to evaluate the quality of routing has failed to meet the requirements of the network service quality. By selecting the hops to the destination node, residual energy and transmission delay to comprehensively evaluate the nodes' quality, the preferred cluster heads are selected to establish the optimal transmission path. This has great significance to improve the transmission reliability. When packets are need to transmit, global optimal paths must be distributed and established from the source node to the destination node according to the cluster heads residual energy. It mainly includes the phases of topology establishment, nodes' residual energy calculation, multipath route discovery, routing maintenance, and so forth. Before transmission starts, the source node has data packets, it firstly reports to its cluster head. The cluster head chooses the mobile node with the minimum hop distance and the next hop within the transmission power coverage to discover the first optimal transmission path. Then the cluster head selects one node as the next hop which is with the minimum hop distance and within the transmission power coverage.

An exception arises when a message is created, where only one MAC needs to be checked by the immediate neighbour of the source node. It is obvious that two adjacent nodes can cooperatively compromise the communication path. It is able to manipulate and inject arbitrary messages that are routed through them. This seems to be only a slight improvement over simple hop-to-hop authentication at first. Instead of compromising one node, an attacker now has to gain control over two of them. And since they are co-located, an attack should be easy. Thus it seems nothing much is gained.

B. Mobile Election Phase

In this approach, the whole mobile field is divided into many smaller regions and a coarse target position is used to select regions in which mobile s need to report their decisions to the Cluster Head (CH). Therefore, this method can greatly save mobile energy. The energy a mobile uses can be divided into three main categories. The first category $E1$ is the energy a mobile uses to measure the signal from the target. The second category $E2$ is the energy a mobile uses to maintain essential functions, such as receiving information from the fusion center and keeping itself awake. The third category $E3$ is the energy a mobile uses to send the decisions to the Cluster Head.

A mobile election phase can reduce energy consumption by choosing mobile s containing more useful information and allowing those mobile s to send the decisions to the Cluster Head while mobile s containing less useful information are not allowed to send decisions to the cluster head., mobile s are selected based on target information from all mobile s. The computation cost of this selection method may be prohibitive if the total number of mobile s is large. The computation cost can also be alleviated based on mobile election phase.

The steps of proposed approach are as follows:

- Partition the whole mobile network into different regions. Place M0 number of anchor mobile nodes in grid points.
- Use anchor mobile nodes and the weighted average method to estimate a common target position.
- Use the coarse target position to choose all mobile s in the region where the estimated target is located.
- If the target falls into region $M1$, mobile s in the remaining neighboring region will be chosen.
- Selected mobile s will report decisions to the cluster head. Mobile s not in selected regions will not report decisions.

C. Optimized Energy Routing

The set of mobile nodes has been deployed to implement the localization of mobile nodes in wireless mobile network. In this network, anchor mobile nodes need to propagate the whole network for localizing the mobile nodes. Hence more number of anchor nodes is required for localization of mobile nodes. The relation can be determined by,

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$$a_k^2 = \frac{G_p P_l^{'}}{(d_k / d_l)^m} \quad (1)$$

$P_l^{'}$ is the power emitted by the target measured at a reference distance d_l, a_k is the signal amplitude from the target measured at the kth mobile, G_p is the gain of the pth mobile , which is determined by the mobile antenna, and m is the power decay exponent. The Euclidean distance between the target and the kth mobile is

$$d_k = \sqrt{(z_k - z_t)^2 + (y_k - y_t)^2} \quad (2)$$

Where (zk , yk) and (zt , yt) are the positions of mobile k and the target. Here, every mobile node has equal gain and $d_k = 1$

D. Proposed Packet Format

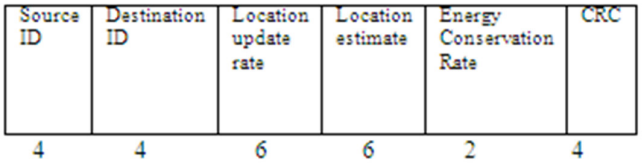

Figure 2.Proposed Packet format

In figure 2. The proposed packet format is shown. Here the source and destination node ID carries 2 bytes. Third one is authentication status of the node. The location update rate induces the whether the mobile nodes are located with anchor nodes. In fourth field, the location estimate is indicated to maintain memory requirement of unknown mobile nodes. n fifth, the energy conservation ratio is allotted to ensure minimum energy consumption. The last filed CRC i.e. Cyclic Redundancy Check which is for error correction and detection in packet while route maintenance process.

IV. Performance Analysis

We use Network Simulator (NS2.34) to simulate our proposed algorithm. Network Simulator-3 (NS2.34) is used in this work for simulation.NS2 is one of the best simulation tools available for Wireless mobile Networks. We can easily implement the designed protocols either by using the otcl coding or by writing the C++ Program. In either way, the tool helps to prove our theory analytically. In our simulation, 200 mobile nodes move in a 1200 meter x 1200 meter square region for 50 seconds simulation time. All nodes have the same transmission range of 250 meters. Our simulation settings and parameters are summarized in table 1.

No. of Nodes	200
Area Size	1200 X 1200
Mac	802.11
Radio Range	250m
Simulation Time	50 sec
Traffic Source	CBR
Packet Size	100 bytes
Mobility Model	Random Way Point
Transmitter Amplifier	150 pJ/bit/m^2
Package rate	5 pkt/s
Protocol	AODV

Table 1. Simulation Settings and parameters of ELOER

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A. Performance Metrics

We evaluate mainly the performance according to the following metrics.

End-to-end delay: The end-to-end-delay is averaged over all surviving data packets from the sources to the destinations.

Communication Overhead: It is defined as the total number of routing control packets normalized by the total number of received data packets.

Packet Delivery Ratio: The delivery rate is defined as the ratio of numbers of messages received by the destination and sent by senders.

Node degree: It is the important metric to evaluate the performance of topology control algorithms. If the node degree is higher, it indicates that higher collision will be. So value of node degree should be kept small.

Network connectivity ratio: It determines the nodes are connected in the intermediate region. It should be kept small while varying the average speed.

The simulation results are presented in the next part. We compare our proposed scheme ELOER with existing methods.

Figure 3 shows the results of connectivity ratio for varying the mobility from 5 to 25. From the results, we can see that ELOER scheme has slightly lower connectivity ratio than the existing method because of location update.

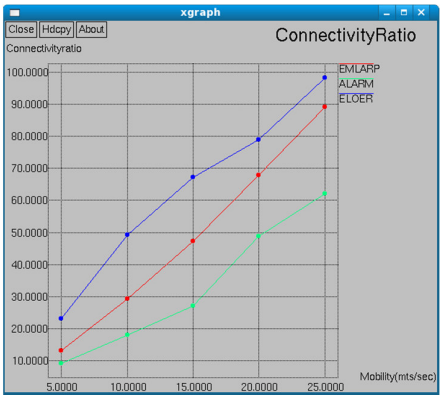

Fig.3. Mobility Vs Connectivity Ratio

Fig. 4, presents the comparison of node degree It is clearly shown that the node degree of ELOER has low overhead than Existing methods.

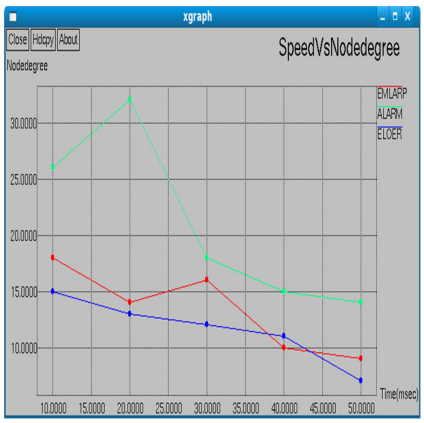

Fig. 4. Speed Vs Node degree

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Figure 5 shows the results of Time Vs End to end delay. From the results, we can see that ELOER has slightly lower delay than the Existing schemes because of stable routes.

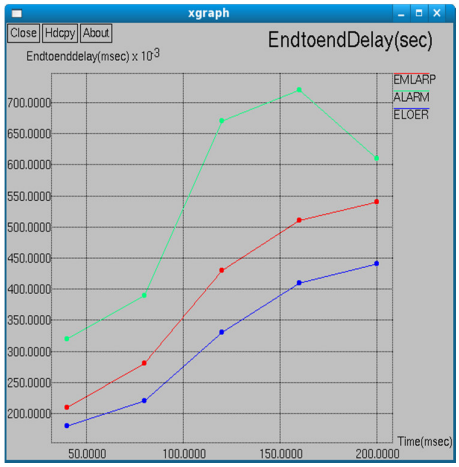

Fig. 5. Time Vs End to end delay

Fig. 6, presents the comparison of overhead while varying the nodes from 0 to 200. It is clearly shown that the of ELOER has low overhead than Existing methods

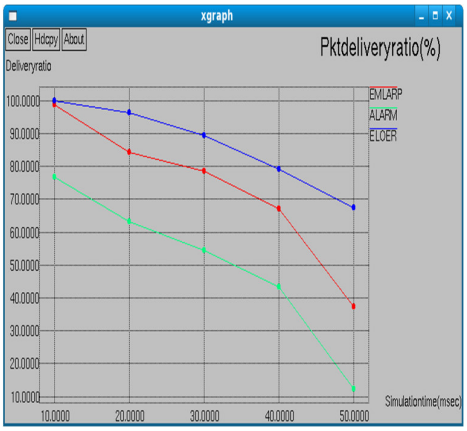

Fig.6.No. of Nodes Vs Overhead

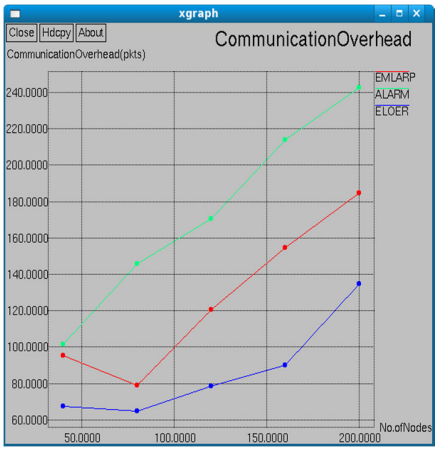

Fig.7. Throughput Vs Packet Delivery Ratio

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Figure 7 show the results of average packet delivery ratio for the simulation time 10, 20…50 secs for the 200 nodes scenario. Clearly our ELOER scheme achieves more delivery ratio than Existing schemes. Since it has both multipath routing and cluster enhancement features.

Table 2 presents the performance comparison of proposed and existing schemes.

METRICS	ELOER	EMLARP	ALARM
Detection efficiency (%)	38-63	25-45	16-32
PDR (pkts)	16-49	15-33	5-27
Network L_time (Secs)	226-667	100-347	223-440
End to end delay (msec)	0.582-0.295	0.678-1.47	0.798-1.76
Overhead (pkts)	10-21	26-47	37-78
Packet Integrity Vs Speed	71-48	64-39	87-65

Table2. Analysis of Proposed Method and Existing Methods in terms of different parameters

V. Conclusion

In this research work, we have developed an Optimized Multipath Localization Approach which attains to make a balance between network life time, location updated rate and delay among the mobile nodes. In the first phase of the scheme, multipath routing is proposed. In second phase, mobile election scheme is deployed to save energy of mobile nodes. In third phase, localization algorithm is proposed based on energy model. It contains following factors location update rate, location estimated field to favour better route selection and reduce energy consumption of mobile nodes. By simulation results we have shown that the ELOER achieves high network lifetime, high location update rate, while attaining low end to end delay, low overhead than the existing scheme ELMARP and ALARM while varying the number of nodes, speed, mobility and pause time.

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