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# Energy Efficient Zone Based Location Aided Routing Protocol for MANET

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**Abstract—** ***A Mobile ad-hoc network consists of a set of mobile nodes which forms a temporary network without using any centralized point. In this paper we introduce an Energy Efficient Zone Based Location Aided Routing (EEZBLAR) Protocol for MANETs that is based on the Location Aided Routing (LAR). EEZBLAR makes reduction in the energy consumption of the mobile nodes batteries by limiting the route discovery process only to specified nodes. In EEZBLAR network is divided into zones and each zone is provided with a zone Leader which keep track of all the nodes in the zone in the form of a table. When route discovery process is initiated, instead of flooding RREQ packets to the whole network area, the RREQ packets are sent only to the zone leaders. The zone leaders maintain routing table which stores all the information about its zonal nodes. To show the reliability of the proposed protocol we present simulations using NS-2. Simulation results show that EEZBLAR protocol makes an improvement in throughput and packet delivery ratio compared to LAR, AODV, DSDV and DSR protocols.***

***Keywords— Location Aided Routing, MANET, Routing Protocols, Route discovery, NS2***

## I. INTRODUCTION

Communication has become very important for people to exchange information anytime and from anywhere. With the widespread rapid development of computers and the wireless communication, the mobile computing has already become the field of computer communications in high-profile link. An ad-hoc network is a collection of wireless mobile hosts forming a temporary network without the aid of any stand-alone infrastructure or centralized administration. MANET routing protocols can be classified into two classes: Table-driven (or Proactive) and On-demand (or Reactive/Source Initiated). Proactive also called table driven forwards the packet to already known route by continuously evaluating the routes within the network. Each node maintains the routing information and updates it consistently. A reactive protocol also known as on demand performs the routing process only when required. A route discovery has to be initiated by the node when no route is found. In This Paper we provide Reliability in location aided routing protocol by adding Table driven routing technique with GPS usability.

**Overview of Routing Protocols**

Routing is the process of establishing path and forwarding packets from source node to destination node. MANET routing protocols could be broadly classified into three major categories: proactive, reactive and hybrid as shown in Figure 1.

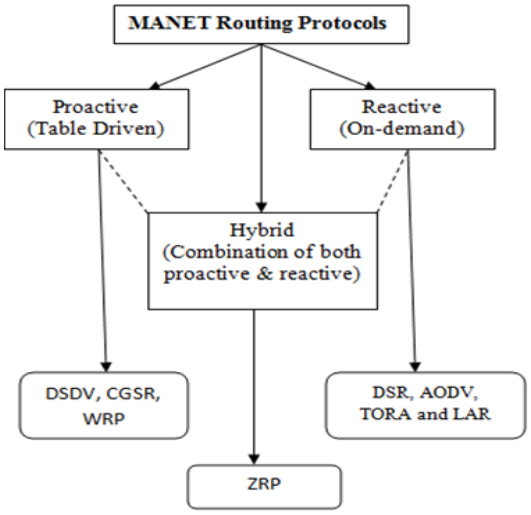


Fig 1. Classification of MANET routing protocol

Some MANET usage areas are Military scenarios, Sensor networks, Rescue operations, Students on campus, free internet connection sharing, and conferences. MANET uses multi-hop routing to provide network connectivity. The goal of routing protocols are- Find short routes, Decrease routing-related overhead and find – stable routes.

### *A. Proactive Routing Protocol*

In Proactive routing protocol, each mobile node maintains a routing table. Such routing information is available immediately, when a route to a destination is needed. Proactive protocols continuously maintains and updates the routing table within the network so that when it is required to forward, the packet route is already known and immediately ready for use. So there is not any time delay because there is no time spent in route discovery process. So a shortest path can be found without any time delay. However these protocols are not suitable for very dense ad-hoc networks because in that condition problem of high traffic may arise. The main disadvantages of such algorithms are high latency time in route finding and excessive flooding can lead to network clogging. Example: DSDV (Destination-Sequenced Distance-Vector), Wireless Routing Protocol (WRP), Hierarchical State Routing protocol, Optimized Link State Routing (OLSR) and Topology Dissemination based on Reverse-Path Forwarding routing protocol (TBRPF).

### *B. Reactive Routing Protocols*

Reactive Routing Protocols are also called on demand routing. It is more efficient than proactive routing. The main idea behind this type of routing is to find a route between a source and destination whenever that route is needed which helps to avoid routing overhead, whereas in proactive protocols we were maintaining all routes without knowing its state of use. So in reactive protocols it is not needed to maintain the routes which are not being used currently. This type of routing is on demand. On demand routing protocols avoids the cost of maintaining routes that are not being used. Example: Ad-hoc On Demand Distance Vector (AODV), and Dynamic Source Routing (DSR), Temporary Ordered Routing Algorithm (TORA) and Location Aided Routing (LAR).

### *C. Hybrid Routing Protocol*

Hybrid routing protocol is a combination of both proactive and reactive routing protocols. It uses a table driven approach within a given zone around the node, and a demand-driven approach is then applied outside of that zone. Example: Zone Routing Protocol (ZRP) and Temporary Ordered Routing Algorithm (TORA).

## II. LITERATURE SURVEY

Some of the most important routing protocols used in wireless mobile ad hoc networks.

### *A. Destination-Sequenced Distance-Vector Routing (DSDV)*

The Destination- Sequenced Distance-Vector Routing protocol (DSDV) [1], [22], [4] described is a table-driven algorithm based on the classical Bellman-Ford routing mechanism. The improvements made to the Bellman-Ford algorithm include freedom from loops in routing tables. Every mobile node in the network maintains a routing table which includes all of the possible destinations within the network and the number of hops to each destination. Sequence number is assigned to each entry by the destination node. Nodes are able to distinguish unused routes from new ones with the help of sequence number which avoids the formation of loops. Routing table updates are periodically transmitted throughout the network to maintain table consistency.

New route broadcasts contain the destination address, the number of hops to reach the destination, the sequence number of the information received regarding the destination, as well as a new sequence number unique to the broadcast. Route which has the latest sequence number is always used. If we have two updates with the same sequence number, the route with the smaller metric is used in order to shorten the path. Mobiles also keep track of the settling time of routes, or the weighted average time that routes to a destination will fluctuate before the route with the best metric is received [4]. By delaying the broadcast of a routing update by the length of the settling time, mobiles can reduce network traffic and optimize routes by eliminating those broadcasts that would occur if a better route was discovered in the very near future.

### *B. Ad Hoc On Demand Distance Vector (AODV)*

The Ad Hoc On-Demand Distance Vector routing protocol (AODV) [4], [13], [25] is an improvement of the Destination-Sequenced Distance Vector routing protocol (DSDV). DSDV has its efficiency in creating smaller ad-hoc networks. Since it requires periodic advertisement and global dissemination of connectivity information for correct operation, it leads to frequent system-wide broadcasts. Therefore the size of DSDV ad-hoc networks is strongly limited. When using DSDV, every mobile node also needs to maintain a complete list of routes for each destination within the mobile network.

AODV [4], [22] protocol is a distance vector routing protocol that operates on-demand. When a node wants to communicate with other node only then routes are set up. The nodes which lie on the path between the two end nodes only keep information about the route. When a source node wants to communicate with a destination node it initiates route discovery process. Route discovery works by flooding the network with route request (RREQ) packets. When a node receives the RREQ it checks its routing table to see if it is the destination or is it contains a fresh route to the destination. If it has the route to the destination, it sends a route reply (RREP) message back to the source, else it rebroadcasts the RREP. Each node keeps track of its neighbours. This is performed by regularly exchanging HELLO messages. If a route in the ad hoc network is broken then some node along this route will detect that the next hop router is unreachable. If this node has any active neighbours that depend on the broken link, it will propagate route error (RERR) messages to all of them. A node that receives a RERR will do the same check and if necessary propagate the RERR further in order to inform all nodes concerned. The advantage of AODV is that it tries to minimize the number of required broadcasts. It creates the routes on a on-demand basis, as opposed to maintain a complete list of routes for each destination.

### *C. Dynamic Source Routing (DSR)*

DSR is an on demand routing protocol [3], [4],[25]. In DSR the network is completely self-organizing and self-configuring, without the need for any existing network infrastructure. The protocol is composed of the two mechanisms: route discovery and route maintenance, which allows nodes to discover and maintain source routes to arbitrary destinations in the ad hoc network [3]. DSR maintains a route cache which keeps track of all the routes. When a node needs to send a packet to a destination it first checks its cache if it already knows a route to the destination. If the route to destination is not available in the route cache then route discovery mechanism is initiated. Route Discovery allows any host in the ad hoc network to dynamically discover a route to any other host in the ad hoc network [3]. A route reply is sent back either if the RREQ packet reaches the destination node itself, or if the RREQ reaches an intermediate node which has an active route to the destination in its route cache. The Route Maintenance procedure keeps check on the operation of the routes and informs the sender of any routing errors. Due to very high probability of routes being lost, Route maintenance is very

necessary for all routing protocols. The use of source routing allows packet routing to be trivially loop-free, avoids the need for up-to-date routing information in the intermediate nodes through which packets are forwarded, and allows nodes to cache the routing information in them for their own future use. [3]. This protocol operate entirely on-demand, allowing the routing packet overhead of DSR to scale automatically to only that needed to react to changes in the routes currently in use [25].

### *D. Location Aided Routing Protocol*

Location Aided Routing is an On-demand Routing Protocol. The goal of Location-Aided Routing is to reduce the routing overhead by the use of location information [2], [4], [8], [10], [11], [18], [20], [25]. Location information is used to restrict the flooding to a certain area. In Location Aided Routing protocol Global Positioning System (GPS) is used to achieve the physical location of node. With the help of location information the search space for a desired route is reduced which results in few route discovery messages [2], [11]. When a source node wants to send a packet to destination, source node contacts a location service to know the position of destination node. Because of which connection and tracking problems sometimes arises [15], [18].

Two algorithms are presented in [2] which include two schemes, LAR scheme 1 and LAR scheme 2. At the time of route discovery LAR scheme 1 uses expected location of the destination in order to determine the request zone. The smallest rectangle including current location of the source and the expected zone for the destination is considered as the request zone in LAR scheme 1. The sides of the rectangular request zone are parallel to the X and Y axes. When a source needs to initiate a route discovery process for a destination, it includes the four corners of the request zone with the route request message transmitted. The intermediate nodes which receive the route request packet then make a decision whether to forward it or not, by using this explicitly specified Request zone. Note that the request zone in the basic LAR scheme 1 is not modified by any intermediate nodes [22]. On the other hand, LAR scheme 2 uses distance from the previous location of the destination as a parameter for defining the request zone. Thus, any intermediate node J receiving the route request forwards it if J is closer to or not much farther from the destination's previous location than node I transmitting the request packet to J. Therefore, the implicit request zone of LAR scheme 2 becomes adapted as the route request packet is propagated to various nodes [22].

## III. ENERGY EFFICIENT ZONE BASED LOCATION AIDED ROUTING PROTOCOL

This section presents our proposed Energy Efficient Zone Based Location Aided Routing (EEZBLAR) protocol approach. The proposed protocol is a modification to the ad hoc routing protocol LAR [1], [19]. In EEZBLAR we are using table routing technique with GPS and making LAR more Reliable by combining these two techniques (table routing and GPS). EEZBLAR uses a approach in which a network is divided into zones and each zone is assigned with a Leader as shown in Fig 2 and Fig 3. The Leader is selected randomly and is given authority to keep track about the nodes of its zone in the form of Routing Table. Zone Leaders exchange their routing tables with each other so that they are also aware about the position of nodes of other zones. The Position of nodes is known with the help of GPS device, as each node in the network is equipped with GPS, with the help of which zone Leader and nodes are aware about each other's position. Now nodes do not need to regularly send HELLO messages to each other to tell their presence in the network which saves node's battery power. When a source node need to send a RREQ (Route Request) packet to Destination, it initiates a Route Discovery process, here the RREQ packet is not flooded to all neighbour nodes, the RREQ message is sent to the Zone Leader, which has routing table present with it. Zone Leader checks its routing table and Forward the RREQ message to another Leader which may have route to the destination in its Routing Table. The Zone Leader which has the address to the destination will send a RREP message to the Source. This technique results in a significant reduction in the number of routing messages and therefore the energy consumption of the mobile nodes batteries are decreased significantly.

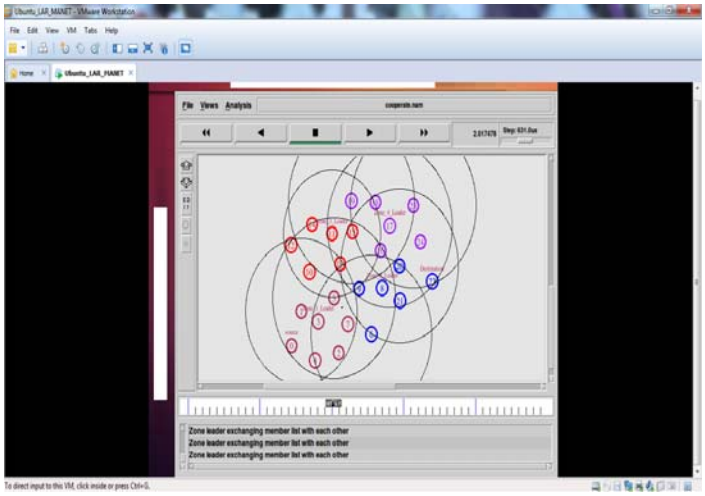

Fig 2. Simulation of EEZBLAR Protocol in NS2

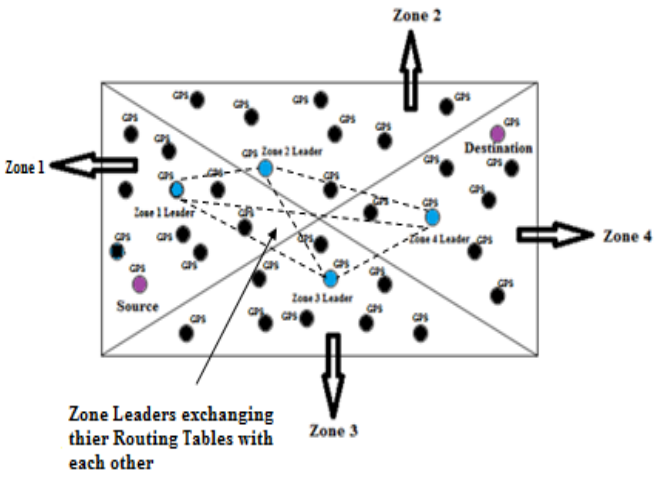


Fig 3. The defination of zones area in EEZBLAR

## IV. PERFORMANCE EVALUATION

In order to evaluate our schemes, we performed 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 [34]. Table 1 shows the simulation environment settings. The simulation network area is 1500 meter x 1500 meter that contains 25 number of mobile nodes and Simulation time is taken as 25 seconds. 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 1 NS2 simulation environment settings

| **Parameter** | **Setting Value** |
|---|---|
| Simulation Duration | 25 sec |
| Network Area | 1500*1500 m |
| No. of Mobile Nodes | 25 |
| Mobility Model | Random way point model |
| Pause time | 1sec |
| Transmission Range | 250 m |
| Packet Size | 512 bytes |

We compare performance of EEZBLAR with AODV, LAR, and DSR routing protocols. The measured performance metrics are the Data packets delivery ratio, Throughput and Energy.

### *1) Packet Delivery Ratio*

Packet delivery ratio can be calculated as number of packets received divided by the number of packets sent. . For better performance of a routing protocol, it should be better. The Packet Delivery Ratio is shown in Fig 4. The Simulation results show that EEZBLAR has the highest delivery ratio among the five compared protocols. LAR and DSDV have the second highest delivery ratio, AODV and DSR has the third highest delivery ratio. As an explanation to the good delivery ratio in EEZBLAR is that since control overhead is smaller, the battery life of mobile nodes is longer, and hence routes are maintained for longer time.

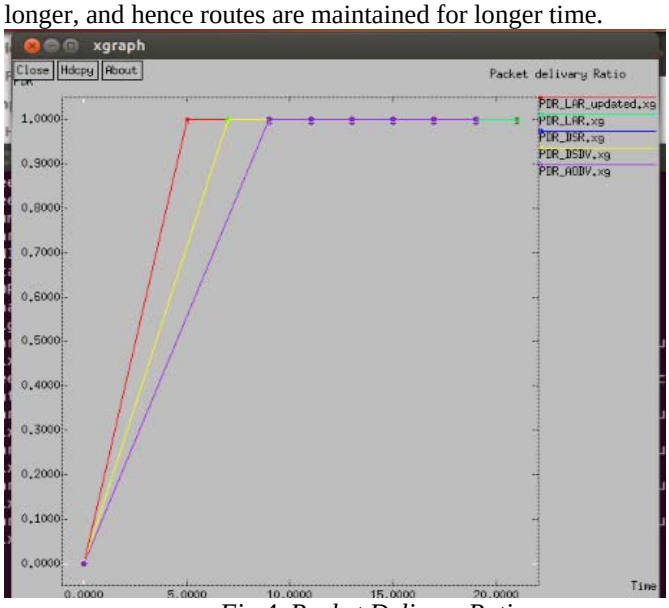


*Fig 4. Packet Delivery Ratio*

### *2) Throughput*

The throughput is defined as the total amount of data a receiver receives from the sender divided by the time it takes for the receiver to get the last packet. The throughput is measured in bits per second (bit/s or bps). The throughput is shown in Fig 5. Simulation Results Shows that EEZBLAR (LAR_updated) shows that EEZBLAR has the highest Throughput, DSDV has the second highest throughput, LAR has the fourth highest throughput, DSR has the fifth least throughput and AODV has the worst Throughput. As an explanation of good throughput in EEZBLAR is that since it uses limited bandwidth and limited energy.

### *3) Energy Efficiency*

Energy Efficiency is defined as using less energy to provide the same service. Energy Efficiency as shown in Fig 6. Simulation results show that EEZBLAR is most Energy efficient. Among five Routing protocol LAR is second energy efficient, AODV is third energy efficient, DSR is fourth energy efficient and DSDV is least energy efficient routing protocol.

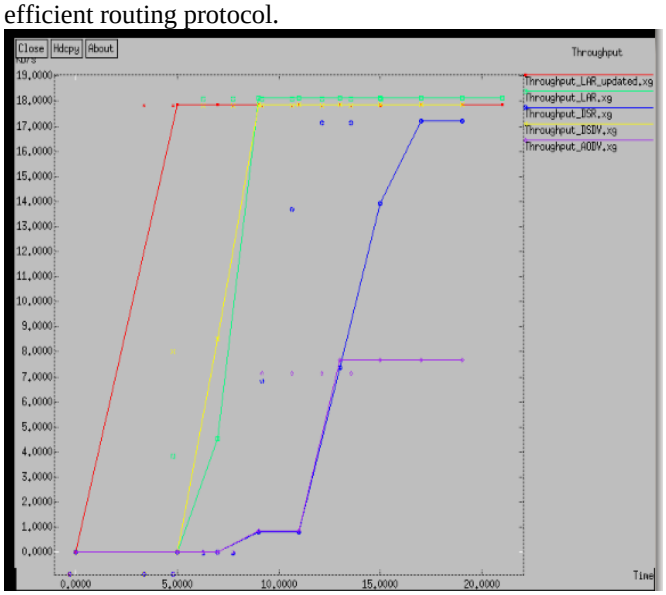


Fig 5. Throughput

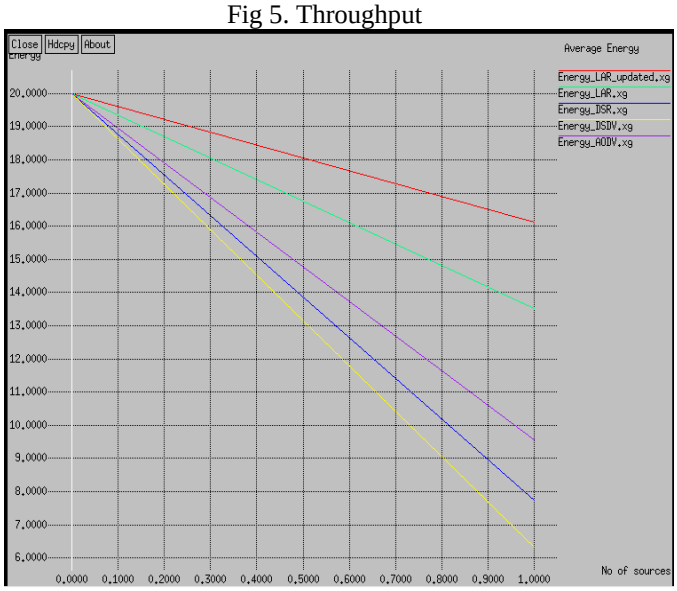


Fig 6. Energy Efficiency

## V. CONCLUSION

This paper proposed an Energy Efficient Zone Based Location Aided Routing Protocol (EEZBLAR) that is an optimization to the Location Aided Routing (LAR). EEZBLAR makes significant reduction in the energy consumption of the mobile nodes batteries by limiting the area of discovering a new route to a smaller number of nodes. To show the reliability of the proposed protocol we presented simulations using NS-2. Simulation results show that our proposed EEZBLAR protocol leads to an improvement in packet delivery ration and Throughput as compared to AODV, LAR, DSDV and DSR protocols.

## REFERENCES


[1] C. E. Perkins, and P. Bhagwat, "Highly dynamic Destination Sequenced Distance-Vector Routing (DSDV) for mobile computers," Comp. Commum. Rev., pp. 234-244, Oct. 1994.

[2] Y. B. Ko, and N. H. Vaidya, "Location-Aided Routing (LAR) in mobile ad hoc networks," in Proc. 4th annual ACM/IEEE international conference on Mobile computing and networking, 1998.

[3] J. Broch, D. B. Johnson, and D. A. Maltz, "The dynamic source routing protocol for mobile ad hoc networks," draft-IETF-manet-dsr-03.txt, Internet Draft, Oct. 1999.

[4] Elizabeth M. Royer, "A Review of Current Routing Protocols for Ad Hoc Wireless Networks," Personal Communications, IEEE, vol. 6, issue: 2 , pp. 46 – 55, 1999

[5] Guangyu Pei, Mario Gerla, Tsu-Wei Chen, "Fisheye State Routing: A Routing Scheme for Ad Hoc Wireless Networks" IEEE International Conference, IEEE, vol 1, pp 70-74,2000

[6] Daniel Camara, "A GPS/Ant – Like Routing Algorithm for Ad Hoc Networks" IEEE, vol 3, pp 1232 – 1236, sep 2000.

[7] Young-Bae Ko and Nitin H. Vadiya, "Location-Aided Routing in mobile ad hoc networks," Journal Wireless Networks, vol. 6, Issue 4, pp. 307-321, sept 2000.

[8] B. Karp, and H. T. Kung, "GPSR: Greedy perimeter stateless routing forwireless networks" in Proc. IEEE/ACM MOBICOM, Boston, MA. pp. 243–254, Aug.2000.

[9] Hannan XIAO, Winston K.G. SEAH, Anthony LO and Kee Chiang CHUA "A Flexible Quality Service Model for Ad-HOC Networks," IEEE, vol., pp. 445-449, May 2000

[10] J. Li, J. Jannotti, D. S. J. De Couto, D. R. Karger, and R. Morris, "A scalable location service for geographic ad hoc routing," in Proc. 6th Annual IEEE/ACM MOBICOM, Boston, MA, Aug. 2000, p. 120.

[11] Tracy Camp, Jeff Boleng, Brad Williams, Lucas Wilcox, William Navidi, "Performance Comparison of Two Location Based Routing Protocols for Ad Hoc Networks" IEEE, vol 3, pp 1678-1687, 2002

[12] Qi Xue , Aura Ganz. "Ad hoc QoS on-demand routing (AQOR) in mobile ad hoc networks", Journal of Parallel and Distributed Computing, vol. 63. Issue 2, pp. 154 – 165, 2003.

[13] C. Perkins, E. Belding-Royer, and S. Das, "Ad hoc On-demand Distance Vector (AODV) routing," University of Cincinnati, Internet draft, July 2003

[14] Carlos de Morais Cordeiro and Dharma P. Agrawal, "Mobile Ad hoc Networking," OBR Research Center for Distributed and Mobile Computing, ECECS, pp. 1-63, 2004.

[15] W. KieS, H. FuSler, and J. Widmer, "Hierarchical location service for mobile ad hoc networks" in Proc. ACM SIGMOBILE, vol. 8, no. 4, pp. 47-58, Oct.2004

[16] Harshavardhan Sabbineni, "Location-Aided Flooding: An Energy-Efficient Data Dissemination Protocol for Wireless Sensor Networks" IEEE TRANSACTIONS ON COMPUTERS, VOL. 54, NO. 1, JANUARY 2005

[17] Nen-Chung Wang , Si-Ming Wang, "An Efficient Location-Aided Routing Protocol for Mobile Ad Hoc Networks," 11th International Conference, vol. 1, pp. 335-341, 2005.

[18] K. Akkaya, and M. Younis. "A survey on routing protocols for wireless sensor networks. Ad Hoc Networks," 3(3), pp. 325–349, May 2005.

[19] Sidi-Mohammed Senouci and Tinku Mohamed Rasheed, "Modified Location-Aided Routing Protocols for Control Overhead Reduction in Mobile Ad Hoc Networks", FIP — The International Federation for Information Processing, Volume 229, pp 137-146, 2007.

[20] P.T.V.Bhuvaneswari and V.Vaidehi, "Location Aided Energy Efficient Routing Protocol in Wireless Sensor Network," IJSSST, Vol. 11, No. 4, pp. 41-50, 2008.

[21] Tzay-Farn Shih , Hsu-Chun Yen, "Location-aware routing protocol with dynamic adaptation of request zone for mobile ad hoc networks", Journal, vol. 14, Issue 3, pp. 321-333, June 2008.

[22] Mohammad A. Mikki, "Energy Efficient Location Aided Routing Protocol for Wireless MANETs," IJCSIS, vol. 4, No. 1 & 2, August 2009.

[23] Vasil Hnatyshin, Malik Ahmed, Remo Cocco, and Dan Urbano, "A Comparative Study of Location Aided Routing Protocols for MANET" IEEE,PP. 1-3, Oct 2011.

[24] Priyanka Goyal, Vinti Parmar, Rahul Rishi "MANET: Vulnerabilities, Challenges, Attacks, Application," IJCEM, International Journal of Computational Engineering & Management, vol. 11, pp. 32-37, January 2011.

[25] A.A.A. Radwan, T.M. Mahmoud, E.H.Houssein, "Evaluation comparison of some ad hoc networks routing protocols", Egyptian information Journal, vol. 12, Issue 2, July 2011, pp. 95–106, 2011.

[26] Basu Dev Shivahare, Charu Wahi, Shalini Shivhare, "Comparison Of Proactive And Reactive Routing Protocols In Mobile Adhoc Network Using Routing Protocol Property," IJETAE, Volume 2, Issue 3, pp. 356-359, March 2012.

[27] Rahul Desai, B P Patil, "A Survey of On Demand Routing Protocols for Mobile Ad Hoc Network," International Journal of Innovation, Management and Technology, IJIEASR, vol. 1, No. 2, pp 6-12, November 2012.

[28] Sumaiya Thaseen and K Santhi, "Performance Analysis of FSR, LAR and ZRP Routing Protocols in MANET," International Journal of Computer Applications, vol. 41, issue 4, pp. 20-24, 2012.

[29] Dr.S.S.Dhenakaran, A.Parvathavarthini, "An Overview of Routing Protocols in Mobile Ad-Hoc Network," IJARCSS, Volume 3, Issue 2, pp. 251-259, February 2013.

[30] Karim Habak, Mohammed Abdelatif, Hazem Hagrass and Karim Rizc, "A Location-Aided Routing Protocol for Cognitive Radio Networks" IEEE International Conference, pp.729-733, Jan 2013.

[31] Ruchi Gupta, Akhilesh A.Waoo, Sanjay Sharma and P. S Patheja, "A Research Paper on Comparison between Energy Efficient Routing Protocol with Energy and Location in MANET," IOSR-JCE, 8727, Volume 9, Issue 4 (Mar. - Apr. 2013), PP 70-75.

[32] Jia Meng, Hao Wu, Hengliang Tang and Xingyu Qian, "An Adaptive Strategy for Location-Aided Routing Protocol in Vehicular Ad Hoc Networks," 2013 IEEE, Seventh International Conference on Innovative Mobile and Internet Services in Ubiquitous Computing.

[33] D. Johnson, D. Maltz, and Y. Hu, "The dynamic source routingprotocol", IETF Internet draft, Jul. 2004

[34] "The Network Simulator ns-2," Information Sciences Institute, USA Viterbi School of Engineering, Sep. 2004, Available: http://www.isi.edu/nsnam/ns/