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Power Efficient Location Aware Routing Protocol to Improve Routing in MANET

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Abstract
The Mobile Adhoc network (MANET) uses the concept of dynamic topology in the wireless network. The major noteworthy issues in construction of MANET are the energy consumption by the nodes. According to the requirement of present situation a variety of energy efficient routing protocol has been suggested that helps in increasing the lifetime of the network. Emerging Trends in energy efficient routing protocols as the name suggest recognize that many approaches like clustered, genetic algorithm (GA) and so many has came in existence that helps in growing the network lifetime of energy efficient routing protocols. In this paper we proposed a novel Power Efficient Location Aware Routing (PELAR) protocol. In this protocol energy dependent nodes are growing the routing ability of AODV protocol on the source of LAR (Location Aided Routing) protocol. In network nodes are not aware about their energy status and also return flooding of routing packets is utilizes extra energy in network by that the bulk of the energy is exhausted in handshaking process. The main attempt of proposed PELAR protocol is to obtain improved the energy utilization in network. The performance of usual AODV, LAR and PELAR is show via simulation implemented on NS2 and observe that the proposed PELAR protocol decreases the energy utilization and improve the network lifetime that completely depend on the energy of mobile nodes.
Keywords: AODV, Energy Efficiency, LAR, MANET, Routing protocols

1. Introduction

Networks are typically divided into two main categories on the basis of connectivity, which are wired and wireless networks. In wireless network flexibility over ordinary wired networks provided. With the assistance of wireless networks, the clients could get information and obtain services even when they move from position to another position. The single hop and multi hop Mobile Adhoc Networks (MANET) are the two main categorizations of wireless networks. Base stations are utilized in single hop networks to achieve communication among all nodes. MANETs [1] are infrastructure less, self organizing networks of movable nodes without concern any centralized management like base stations etc. The communication among all nodes is achieved through other intermediate or forwarding nodes. So there is a requirement of a routing method between nodes. That's why the routing protocol has major part in MANET.

The MANET routing protocols are primarily categorized by their routing procedure and network organization. [2]. Flat routing, geographic position assisted routing and hierarchical routing are the main three categorization of routing protocols based on the network organization. Based on routing procedure, the routing protocols are assembled as Table driven and source initiated on demand driven [3]. Table driven protocols generally discover routes continuously and preserve it in routing table for all sources to destination pairs at the cost of high routing overhead. On demand protocols like AODV and DSR [4] acquire less routing overhead to discover route among a source to destination nodes only when it is required. As compare to table driven protocols, on demand protocols uses low bandwidth and power consumption.

AdHoc on Demand Distance Vector Routing (AODV) Protocol [4] discovers path among nodes at the time of communication only. It doesn't preserve topology information of all other nodes on network. In AODV, every time the node begins the route discovery for searching destination node using simple flooding for broadcasting the Route Request (RREQ) across the network. Power efficiency is a significant matter in MANETs where movable nodes rely on restricted power and computational resource; however are need to help in all sorts of fundamental network actions including routing forwarding of packets etc. So, to manage the network wide send of the RREQs, the source node utilizes the Expanding Ring Search (ERS) method [5], which allows a source node to broadcast the RREQ of increasingly larger regions of the network if a path to the destination node is not found. Sadly, some nodes in ERS method resend the RREQs unnecessarily. For enlarging the lifetime of the nodes in MANET, several power efficient protocols have been designed.

Rest of the paper is organized as follow: in section 2 AODV routing protocol is explained. In Third section location aware routing (LAR) protocol is described. Section 4 provides concepts of earlier approached used in this domain. In section 5 the problem statement is discussed. The section 6 explains the proposed PELAR algorithms. Section 7 gives the different element of simulation parameters and result analysis. Finally we conclude the paper in section eight.

2. Adhoc on demand Distance Vector (AODV) Protocol

Ad-hoc on demand Distance Vector (AODV) is a reactive protocol which creates routes when demanded by the source host and the routes are maintained and used when needed. Hello messages are used to detect and monitor links with neighbors. Each active node periodically broadcasts a Hello message that all its neighbors receive. In case a node fails to receive several Hello messages from a neighbor which are broadcasted, a link break is found [2]. AODV mainly has three distinct features firstly every request is assigned a sequence number so that the nodes do not repeat route requests that have already been passed on.

Secondly, time to live is present for every route request, which limits the number of times they can be retransmitted. Also, in a situation where a route request fails, we cannot assign another route request unless and until twice as much time has passed since the timeout of the previous request. AODV has a few advantages over other routing protocols like OLSR, which makes it one of the most preferred protocols. It doesn't require a central administrator to manage. The control traffic messages are reduced, but it is at the cost of increased latency in finding new routes. Minimal routing is practiced as the route information exists in the routing table, which shows the active routes in the network. It reacts quickly to topological changes and updates any host affected by the change in Router Error message (RRER).

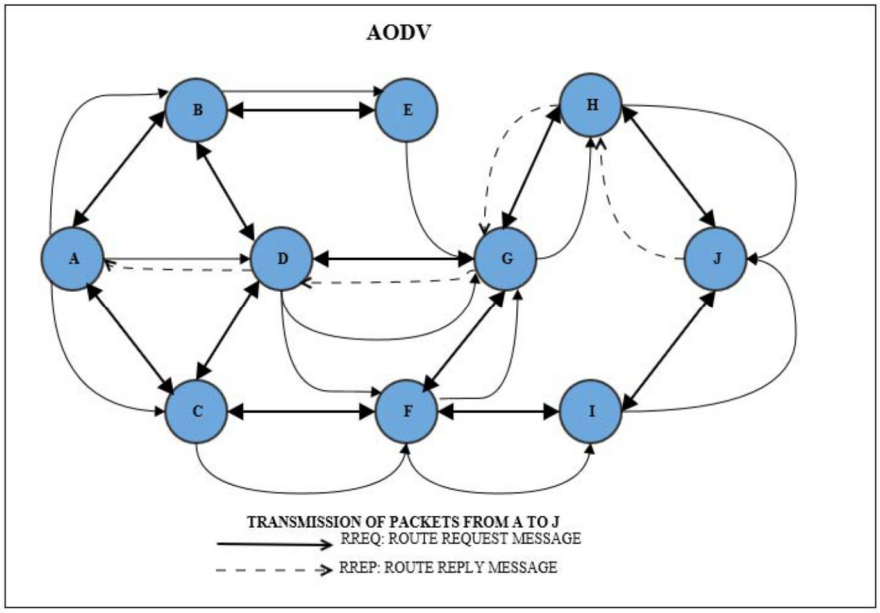

Figure 1: Transmission of data between source and destination as per AODV routing algorithm

In wireless routing protocol, sender node starts a route initiating procedure when route cracks. It might cause enormous control packets and amplify packet loss. This isn't a perfect technique in Wireless network where each nodes rather than sender and receiver in the route are stationary. One technique of overcoming this is by establishing the local route repair by receiver node. Authors of [17] propose an active path updating process "APULAR" for fast updating the broken route to recover from packet loss. Furthermore, to enhance throughput and to decrease the co-channel interference, authors utilize multiple interface with multi channels. They consider 4-hop as an interference range and will employ fixed channel assignment within the routers to decrease the inter flow interference. Their procedure is simulated on NS2 and evaluated with AODV and Infrastructure Wireless Mesh Routing Architecture (IWMRA).

3. Location Aided Routing (LAR) PROTOCOL

LAR [6] is an on-demand routing protocol whose operation is similar to DSR (Dynamic Source Routing) [7]. In contrast to DSR, LAR protocol uses geographical location information to limit the area for discovering a new route to a smaller "request zone". Instead of flooding the route requests into the entire network, only those nodes in the request zone will forward them. To determine the request zone, there are two schemes. In the first one, the source estimates a circular area (expected zone) in which the destination is expected to be found at the current time. The position and the size of the circle are calculated based on the location knowledge of the previous destination, the time instant associated with the previous location record and the average speed of the destination (see Fig.2). The request zone is the smallest rectangular region that includes the expected zone and the source. The coordinates of the four corners are included in the route request packet when initiating the route discovery process. RREQ broadcast is limited to this request zone. Thus, when the node in the request zone receives RREQ, it forwards the packet normally. However when a node which is not in the request zone receives an RREQ, it drops the packet. For example, in Fig 2, if node x receives the route request from another node, node x forwards the request to its

neighbors, because, determines that it is within the rectangular request zone. However, when node y receives the route request, it discards the request, as node - is not within the request zone.

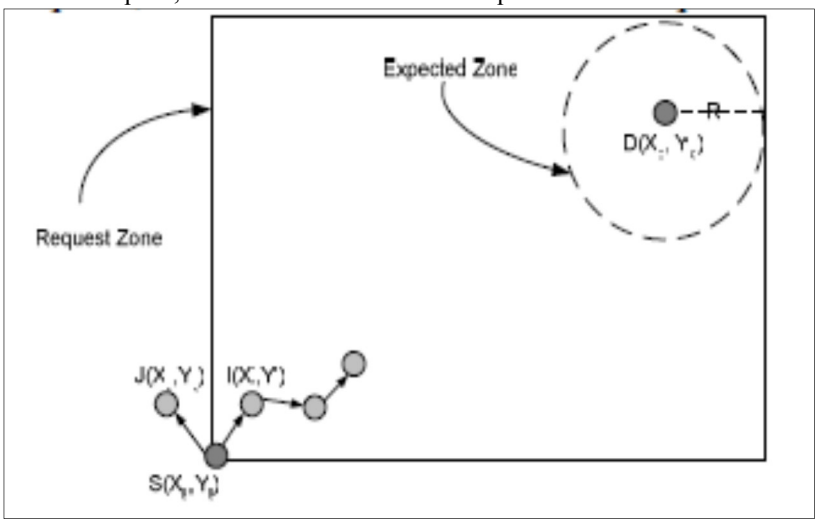

Fig.2: Standard LAR scheme

4. RELATED Work

Most of the work done by researchers in MANET based on battery life of the network, change in Topology, Mobility and Throughput. Different routing protocols came into existence whether they are Reactive protocols as well as Proactive protocols and Hybrid protocols. Different research work came out when implementing these protocols. In this paper work done by the researchers based on the battery life of the network is mentioned.

The author [8] discussed an Energy Aware Service And Route Discovery (EASARD) protocol which is better than ZRP and OLSR protocol due to its low energy consumption, high service availability and low overhead. The automatic localization problem in the network is solved by the Service discovery. Service is referred as entities which are available to the user in the form of networking nodes. A Service can be a scanner, printer. EASARD is an energy efficient service discovery protocol which provides drastic impact on network density and also in node mobility.

In paper [9] discussed an Energy entropy Multipath Routing optimized algorithm based on Genetic Algorithm (EMRGA). In EMRGA algorithm author calculate minimum node residual energy of each path. The path having maximum residual energy is selected first and so on in descending order. To evaluate the fitness of the path the average energy, minimum node remaining power, average network energy is combined. The EMRGA is better than AODV Multipath (AOMDV) in energy variance and also perform better in network lifetime. By applying Genetic Algorithm approach the entire system lifetime is improved.

The author [10] states that a Reactive Energy Saving Ad hoc Routing in short (ESAR) algorithm gives long life time network. In ESAR the packet is delivered through that selected path until the node reaches at the threshold value and at this time another alternate path is selected for packet deliver. ESAR increases the network lifetime by the applying the threshold concept in the entire available path. Every time a different path is calculated for packet delivered. ESAR performance is better than AODV and Energy Efficient Ad hoc on demand Routing protocol (EEAODR) because ESAR uses many alternate path while in AODV and EEAODV repeated use of same path reduces the network lifetime.

In paper [11] given an Efficient Power- Aware quality of service (QoS) Routing protocol (QEPAR) over DSR protocol with a QoS factor such as residual battery power and bandwidth. QEPAR gives better performance than DSR and DSDV in different parameter aspect such as minimum end to end delay, increase the network life time and minimize the energy consumption with good packet delivery ratio. QEPAR is combined solution of bandwidth (higher data rates) and energy consumption and also performs effectively in traffic loads. In QEPAR a weak node is replaced by an efficient node so that is reduces delay and search time.

In paper [12] states in the previous approach a Leader authoritative node is assigned to preserve data consistency .Every mobile node have a limited amount of battery so leader node may fail at any time. At this point of failure new leader is elected which maintain data availability and also data consistency and by doing this scenario large amount of overhead takes place for that large amount of energy is consumed .New approach defined by author takes palace to overcome the energy consumption by reducing overhead on the nodes. In this approach when the leader power reaches a minimum threshold value or before a leader node fails early precaution takes place by replacing leader with a healthy leader. Benefits of applying this approach to Reduce energy consumption and also low overhead.

In Paper [13] given a Loose-virtual clustering Routing protocol for Power Heterogeneous named as (LRPH). LRPH protocol uses the clustered approach to make use of battery power more efficient and also improve the performance. The Loose Virtual Clustering (LVC) algorithm detects unidirectional link and eliminate them to improve the performance. LPRH protocol is more efficiently work than Multiclass (MC) which is a position aided routing protocol for power heterogeneous and DSR. LPRH improves network stability, robustness and also connectivity.

In paper [14] states an energy efficient preemptive DRS (EE-PDSR) technique to improve the Energy efficient protocol. DSR doesn't maintain the alternate routes for communication hence this causes more overhead and also end to end delay. Preemptive DSR (PDSR) which is a multipath protocol is introduced for data packet transmission successfully but it doesn't reduce the power consumption on nodes then EEPDSR came in existence to overcome the energy efficient problem arises in PDSR and DSR protocol. EE-PDSR gives better packet delivery ratio and also end to end delay than PDSR and DSR.

The author [15] proposed a new efficient power aware routing protocol (EPAR) that increases the network lifetime of MANET. In contrast to other conventional power aware algorithms, EPAR not only search the capacity of residual battery power but also saves the energy used in forwarding data packets across over the specific link. EPAR uses a min-max formulation to select the path which has largest packet capacity. EPAR is a Reactive routing protocol. EPAR has a big improvement over an existing protocol that is DSR. In consideration of different parameter like throughput, packet delivery ratio and network life time EPAR is more reliable than other Reactive routing protocols as well as Proactive routing protocols.

The author [15] also states that protocols like AODV and DSR does not capable of maintaining route discovery and route maintenance under huge network load. Energy drainage problem arise in flooding of route request and route reply in AODV and DSR protocol. EPAR protocol best perform in comparison with AODV and DSR due to its min max formulation approach .EPAR selects the path which have maximum lifetime and also establish alternate path in case of exhaustion of node in the original path. In other words EPAR chooses the path based on its energy and lowest hop energy of each path is determined by calculating the battery power of each node.

In paper [16] proposed a clustered approach EPLAR (Efficient Power and Life Aware Routing) which is implemented to overcome the drawbacks of EPAR. The main drawback of EPAR is that it does not determine mobility because it does not support frequent movement of nodes and no alternate path is determined in case of nodes in the original path depleted. In EPLAR the network is splitted in too many clusters Each cluster consist of group of nodes having different lifetime and battery power of each node is calculated in the cluster hence lifetime of node is determined . EPLAR provide two advantages first it maintains link stability and other it provide security from black hole attack.

5. Problem Statement

Routing is one of the key issues in MANETs due to their highly dynamic and distributed nature. In particular, energy efficient routing may be the most important design criteria for MANETs since mobile nodes will be powered by batteries with limited capacity. Power failure of a mobile node not only affect the node itself but also its ability to forward packets on behalf of others and thus the overall network lifetime. For this reason, many research efforts have been devoted to developing energy aware routing protocols. Mobile nodes in MANETs are battery driven. Thus, they suffer from limited energy level problems. Also the nodes in the network are moving if a node moves out of the radio range of the other node, the link between them is broken. Thus, in such an environment there are two major reasons of a link breakage:

(1) Node dying of energy exhaustion
(2) Node moving out of the radio range of its neighbouring node

6. Proposed Method

To resolve the energy consumption issues of MANET discussed in problem statement we proposed a improved protocol for power and location aware routing protocol "Power Efficient Location Aware Routing (PELAR) protocol", in proposed method initially movable node is produced and then locate source and destination node and all nodes place preliminary energy as a random manner after that, source node send routing packet to search destination node, in route discovering time power module base we discover out middle node power, if power value is better than threshold value then we add that node in route else remove that node from route path, afterward we discover out destination node on the basis of threshold power based routing and receivers sends ACK packet to the source node, but after some time some nodes shift to another location and established connection will break down than recipient node utilizes PELAR and sends location information to source node time to time, this information is useful for discovery of destination node from least overhead basis just because PELAR utilizes direction base routing and amplifies the performance of the MANET. Our purpose is to obtain consistent path by which cost of energy can be decreased. At the end, trustworthiness and cost of energy of path should be wary in

path selection. The main point is that energy cost of a route is associated to its trustworthiness.

7. Simulation Environment and Results

The simulation study of proposed PELAR algorithm has been carried out on the NS2.31 [18] and offers a simulation study of MANET. The simulation study constraints are demonstrated in Table I. Simulation study model execute on random node moments for experiment, in this simulation node initiates at a random location, the timeout and pause, and then shifts to a different location at random preferring speed 35 m/s. 512 bytes of packet size and baud rate of 3 packets/sec.

Simulation Parameters

The following are the simulation parameters are preferred for simulating the PELAR protocol with existing AODV and LAR protocol.

TABLE I. Simulation Parameters

Examined Protocol	AODV
Number of nodes Used	20, 40, 60, 80, 100
Protocol of Location	LAR
Simulation area Dimension	800×600
Total time of Simulation	100 ms
Range of Node	250 m
Type of Traffic	CBR, 3pkts/s
Size of Packet	512 bytes
Traffic Connections	TCP/UDP
Maximum Speed (m/s)	35
Node movement	random

8. Performance Metrics:

In this simulation study some performance metrics is consider to evaluate the proposed PELAR algorithm with the existing AODV & LAR. The metrics is shown below:

- Packet Delivery Ratio (PDR): The ratio between the Numbers of packet transmits by source (sender) node to the Numbers of packet actually received by the target node.
- Normalized Routing Load (NRL): The Number of packets of routing sends for every single data packet sends by the source node to the destination node.
- Throughput: It is the calculation of Number of packets obtained by the network in a single unit of time.

The result on above mentioned performance metrics is presents below that express the results of proposed PELAR algorithm with AODV and LAR. The result of PELAR is much enhanced than AODV with LAR on same performance matrices.

9. Packet Delivery Ratio (PDR) Analysis

The proportion of data is effectively received in network is calculated through PDR graph in case of AODV, LAR and PELAR. The percentage performance of AODV protocol is less as contrast to other both protocols, which is near about to 89 % at the finish of simulation. The PDR performance of LAR and PELAR is approximately equal and offers the PDR performance near about to 97% at the finish of simulation.

In Figure 3 the PELAR protocol is improves the packet receiving percentage ratio and as well competent to preserved the strong connectivity among the links in dynamic network. The energy loss because of link breakage is about minor because the performance is equivalent to LAR. The table II illustrates the result of packet delivery ratio with respect to all three protocols at time 100 ms.

TABLE II. PDR Result

No. of Nodes	AODV	LAR	PELAR
20	93.92	96.05	93.22
40	94.85	97.14	96.95
60	95.54	94.3	96.79
80	93.55	93.69	95.51
100	91.84	91.32	94.06

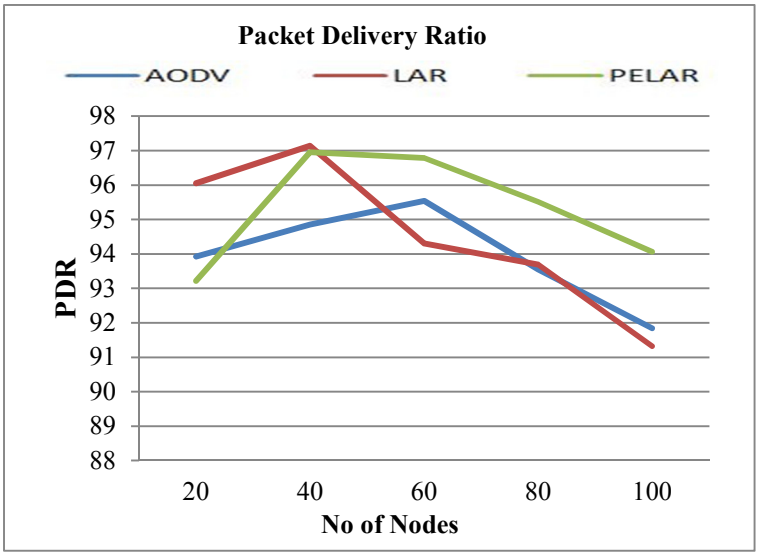

Figure 3: PDR with various nodes

10. Normalized Routing Load analysis

The number of routing packets is delivered in network for established connection among source and destination node. The normalized routing load is calculated through the number of routing packets and number of packets received at destination in predefined simulation time. The graph shows in figure 4 represents the performances of three protocols AODV, LAR and PELAR. The Location Aware Routing (LAR) protocol is helpful for preserving the location information of mobile nodes in dynamic environment. The LAR protocol is also get betters the routing system of AODV protocol by that the flooding of routing packets is reduced as compare to original AODV routing. Here in case of AODV about 3200 routing packets are received in network for connection establishment. In case LAR protocol about 2000 routing packets is received in network but in case of PELAR about only 1500 routing packets are received in network. It implies that in case of addition of energy factor to the LAR gives the improved performance in predefined simulation time and uses the energy for communication in network. Here the detail of normalized routing load has been presented. Table III shows the conclusions that while the network are huge the routing load will also raise.

TABLE III. NORMALIZED Routing Load Result

No. of Nodes	AODV	LAR	PELAR
20	235	202	1060
40	1754	1605	1476
60	2801	3855	2339
80	4519	4933	3195
100	5202	7165	7101

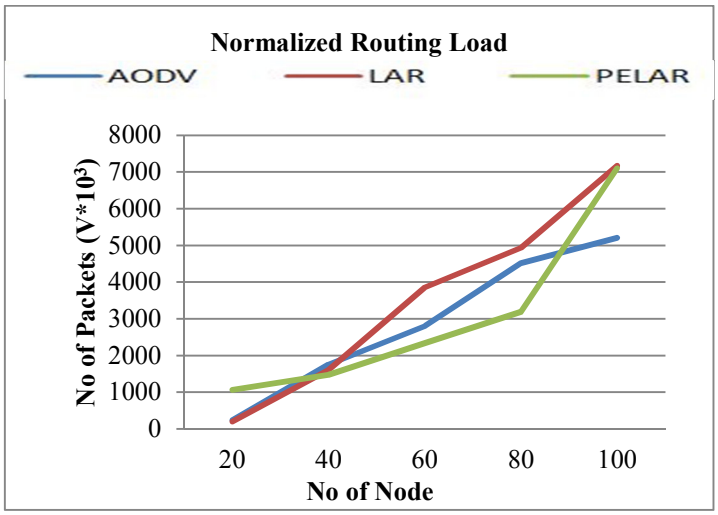

Figure 4: Normalized Routing Load with various nodes

11. Throughput Analysis

Throughput is one of the significant matrices to calculate the network performance per unit of time in network. In figure 5 the graph shows the performance of AODV, LAR and PELAR. The energy feature in initial two protocols are not built-in, means the network lifetime is not limited and as well not calculated the network life time of these two protocols. The energy factor in third protocol is included and it as well offers the equivalent throughput performance.

The throughput in case of proposed PELAR is somewhat down at the finish of simulation that signified the reduction of nodes energy and maintains the routing process up to finish of simulation. The throughput of all three protocols has evaluated here in which it seems to be that the PELAR gives the batter results with respect to LAR but here the AODV have the more efficient in throughput because the energy factor is not included in that.

TABLE IV. Throughput Result

No. of Nodes	AODV	LAR	PELAR
20	828	521.081	521.81
40	934	691.975	787.813
60	772.4	586.78	597.721
80	982.62	582.417	551.902
100	988.11	540.1	683.23

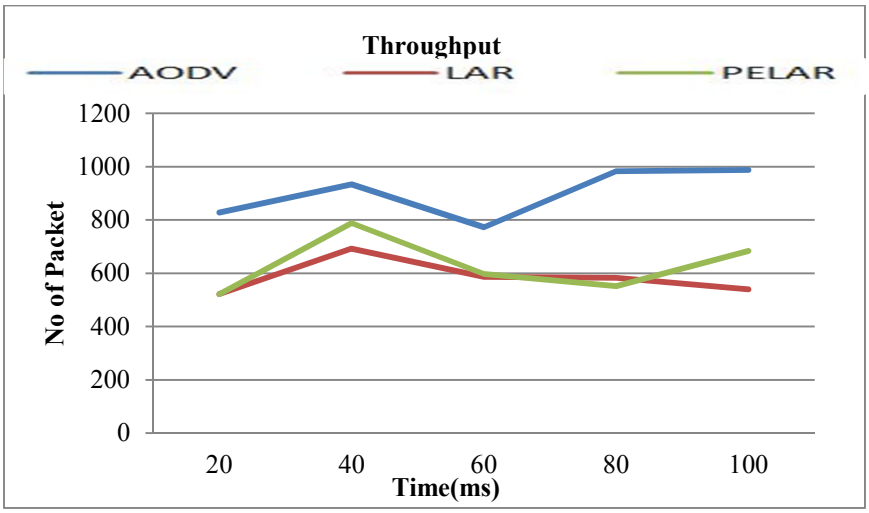

Figure 5: Throughput with various nodes

12. Conclusion

The number of nodes in MANET measured dependent on batteries for their power. So the most significant constraint for optimization is energy maintenance. It has been additional accomplished that because of the dynamically changing topology and infrastructure less, decentralized characteristics, position information and energy awareness is hard to accomplish in MANET. Therefore, position and energy awareness methods should be included characteristics for all sorts of applications based on Adhoc network. In this paper we proposed the PELAR protocol who accomplish the shortage of location unawareness by that the power or energy consumption of nodes are more uses in routing packets instead of retransmission of data because of link breakage. The proposed PELAR approach is decreases the flooding of routing packets and provides the better performance as compare to AODV and LAR protocol. The proposed PELAR protocol is improving the capability of AODV routing protocol and prolog the network lifetime. In future we would focus on LTE (Long Term Evolution) Technology and attempt will be made to suggest a solution for routing in AdHoc networks by tackling next core issues of safe and power or energy efficient routing.

References

[1] Agrawal, Dharma, and Qing-An Zeng. Introduction to wireless and mobile systems. Cengage Learning, 2015.
[2] Misra, Padmini. "Routing protocols for ad hoc mobile wireless networks."Courses Notes, available at http://www. cis. ohio-state. edu/~ jain/cis788-99/adhoc_routing/index. html (1999).
[3] Royer, Elizabeth M., and Chai-Keong Toh. "A review of current routing protocols for ad hoc mobile wireless networks." Personal Communications, IEEE 6, no. 2 (1999): 46-55.
[4] Perkins, Charles E. Ad hoc networking. Addison-Wesley Professional, 2008.
[5] Heo, Woonkang, and Minseok Oh. "Performance of expanding ring search scheme in aodv routing algorithm."

In Future Generation Communication and Networking, 2008. FGCN'08. Second International Conference on, vol. 2, pp. 128-132. IEEE, 2008.

[6] Ko, Young‐Bae, and Nitin H. Vaidya. "Location‐Aided Routing (LAR) in mobile ad hoc networks." Wireless Networks 6, no. 4 (2000): 307-321.

[7] Johnson, David B. "The dynamic source routing protocol for mobile ad hoc networks." draft-ietf-manet-dsr-09. txt (2003).

[8] Outay, Fatma, Véronique Vèque, and Ridha Bouallègue. "EASARD: towards an efficient energy-aware service and route discovery scheme in MANET." In Performance Computing and Communications Conference (IPCCC), 2010 IEEE 29th International, pp. 50-58. IEEE, 2010.

[9] Sun, Baolin, Chao Gui, and Pengyuan Liu. "Energy Entropy Multipath Routing optimization algorithm in MANET based on GA." In Bio-Inspired Computing: Theories and Applications (BIC-TA), 2010 IEEE Fifth International Conference on, pp. 943-947. IEEE, 2010.

[10] Mishra, Mahesh K., and Suchismita Chinara. "ESAR: An energy saving ad hoc routing algorithm for MANET." In Advanced Computing (ICoAC), 2012 Fourth International Conference on, pp. 1-5. IEEE, 2012.

[11] Varaprasad, Golla, H. N. Suresh, and G. Devaraju. "Implementing a power aware QoS constraints routing protocol in MANETs." In Computing, Communications and Networking Technologies (ICCCNT), 2013 Fourth International Conference on, pp. 1-7. IEEE, 2013.

[12] Mostafa, Atahar, and Ahmed E. Youssef. "A leader replacement protocol based on early discovery of battery power failure in MANETs." In IT convergence and security (ICITCS), 2013 International Conference on, pp. 1-4. IEEE, 2013.

[13] Zhao, Peng, Xinyu Yang, Wei Yu, and Xinwen Fu. "A Loose-Virtual-Clustering-Based Routing for Power Heterogeneous MANETs." Vehicular Technology, IEEE Transactions on 62, no. 5 (2013): 2290-2302.

[14] Ramesh, Vyshnavi, K. Sangeetha Supriya, and P. Subbaiah. "Design of novel energy conservative preemptive dynamic source routing for MANET." In Computing, Communication and Networking Technologies (ICCCNT), 2014 International Conference on, pp. 1-7. IEEE, 2014.

[15] Suresh, Hosahalli Narayanagowda, Golla Varaprasad, and Guruswamy Jayanthi. "Designing Energy Routing Protocol with Power Consumption Optimization in MANET." Emerging Topics in Computing, IEEE Transactions on 2, no. 2 (2014): 192-197.

[16] Anuja.M, Jayashree. S, Gobinath.S, Mrs R.M.Bhavadharini,“Maximizing the Network Lifetime of MANET Using Efficient Power and Life Aware Routing Protocol,” International Journal of Advanced Research in Computer Engineering & Technology (IJARCET) Volume 3, Issue 3, March 2014, ISSN: 2278-1323, pp 1028-1031.

[17] Agrawal, Chetan, Ajit Kumar Shrivastava, and Manish Manoria. "Active Path Updation for Layered Routing (APULAR) in Wireless Mesh Networks."Computer Engineering and Intelligent Systems 3, no. 9 (2012): 13.

[18] “Introduction of network simulator 2” accessed from http://www.isi.edu/nsnam/ns/index.html, accessed on 10/12/2015.