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A Novel Energy threshold based Location Aided Routing in MANET

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Abstract— **In Mobile Ad hoc Network (MANET) all the nodes are mobile in nature having limited battery capacity that is called energy. Due to the dynamic behavior of network connection are not maintained for long time. All nodes in network are energy dependent and efficient energy utilization is one of the important issue in MANET. In this paper we proposed a new location based energy efficient scheme with AODV (LAR-EAODV) protocol. In this scheme energy dependent nodes are do routing with AODV protocol on the basis of location based protocol LAR (Location Aided Routing protocol). Nodes in network are not intimated about their energy status, for that energy threshold value of 10% are used to remove the suddenly link breakage. If the nodes in network are know about the energy status and also about the status of location of receiver that reduces the energy consumption. If the node ia apart of communication then in that case no link is break but if not then break. The main aim of proposed scheme is to enhance the energy utilization in network. In this paper we do the simulation in ns-2 simulator and maintain energy consumption table of nodes in previous scheme and proposed scheme and calculate the remaining energy of nodes till end of simulation, on that basis the energy utilization is increases in network and their performance is measure on the basis of performance parameter like Normal Routing Load, Packet Delivery Ratio etc.**

Keywords— MANET, LAR-EAODV ,LAR,NS-2,Energy Utilization,Threshold.

Introduction

A Mobile ad hoc network [MANET] is a decentralize network where mobile nodes are connected by wireless links without any pre-established infrastructure. A large degree of freedom and self organizing capability makes it completely different from other networks. It is one of the challenging and more innovative areas of wireless networking with many applications in different field. The applications are applicable in disaster management, rescue operations, vehicular network, agro sensing, pollution monitoring and many more. Ad hoc networking improves the efficiency of fixed and mobile internet access and enables totally new applications such as sensor and mesh networks. With its significant advantages over. the traditional wired network there also exist some challenges [1] like unpredictable mobility, restricted battery power, limited bandwidth, multi hop routing, dynamic topology, security etc. Among all these, efficient utilization of energy is one of the important concerns as nodes are battery operated. Energy efficiency continues to be a key performance metric as efficient utilization of energy increases the network longevity hence critical in enhancing the network capacity. So efforts are made to reduce the energy consumption in different ways. Recently it is reported in the literature that energy conservation can be done at all layer of the network protocol stack. Different study suggests different techniques to handle energy issue in different way. In this paper we propose ta novel techniques to reduced energy consumption and enhance energy utilization. Deployment of ad-hoc network leads to many challenges such as limited battery power or energy, limited bandwidth, multi hop routing, dynamic topology, security [2]. But, the major issue in MANET is energy consumption since nodes are usually mobile and battery-operated. Energy loss of a mobile node affects its functionality thus the overall network lifetime. To prolong life time of the network, ad-hoc routing protocol should consider energy consumption. Efficient minimum energy routing schemes can greatly reduce energy consumption and extends the lifetime of the networks.

The LAR [5] scheme determines a request zone. This request zone contains the source node *S* and the expected zone. The sides of the rectangle are parallel to the *x*-axis and the *y*-axis. For ex: the source node *S* depends on the expected zone to determine the four corners of the request zone. Node *S* includes their coordinates with the route request message transmitted when the route discovery is initiated. When a node receives a route request, it discards the request if the node is not within the request zone. For instance, if node *I* receives the route request from another node, node *I* forwards the request to its neighbors because it is located in the request zone. However, when node *J* receives the route request, node *J* discards the request, as node *J* is not within the request zone.

The (AODV) [13] Ad hoc on demand routing protocol is a On demand Reactive routing protocol. In this protocol if the sender S want to establish connection with destination D, it first generate a RREQ (Route Request) to the entire neighbor which are in radio range. The RREQ also contains the most recent sequence number for the destination valid destination route must have a sequence number at least as great as that contained in the RREQ. When a RREQ reaches a destination node, the destination route is made available by unicasting a RREP (Route Reply) back to the source route. A node generates a RREP if it is itself the destination it has an active route to the destination. Ex: an intermediate node may also respond with an RREP if it has a "fresh enough" route to the destination. As the RREP propagates back to the source node, intermediate nodes update their routing tables (in the direction of the destination node).RERR (Route Error) message is broadcast for broken links generated directly by a node or passed on when received from another node

The rest of this paper is organized as follows. Section 2 presents related work and problem statement are defined in section 3, the proposed scheme is developed in Section 4. Simulation

environment and experimental results are given in Section 5. Finally, Section 6 presents conclusion and future work.

Related Work

This paper proposes a new MANET routing algorithm [22] that includes quadrant based opportunistic routing, an intelligent energy matrix and energy status request messages with packet receipt acknowledgement notification. The proposed algorithm uses an intelligent energy matrix that creates a look up table including the key characteristics: reputation value, residual battery level and energy consumption. The proposed algorithm balances the traffic uniformly across four intermediate nodes in any desired quadrant. The simulation results presented in this paper demonstrate that due to the inclusion of the energy matrix and quadrant based routing, the number of broadcast messages decreases, reducing data flooding, providing improved channel efficiency and improves bandwidth utilization. Load balancing also increases the lifetime of intermediate nodes which provides improved route stability.

In this paper, we compare the performance of different protocols for ad hoc networks [23] Multipath routing based on fresnel zone routing (FZR), and Energy aware Node Disjoint Multipath Routing (ENDMR) protocol. Simulation results show that, with the proposed network coding in ad hoc network multipath routing protocol (NC-MR), packet delivery ratio, network lifetime and packet loss can be improved in most of cases. It is an available approach to multipath routing decision.

It constructs a shared bi-directional multicast tree [24] for its routing operations rather than a mesh, which helps in achieving more efficient multicast delivery. The algorithm uses the concept of small overlapped zones around each node for proactive topology maintenance within the zone. Protocol depends on the location information obtained using a distributed location service, which effectively reduces the overheads for route searching and shared multicast tree maintenance. In this paper a new technique of local connectivity management is being proposed that attempts to improve the performance and reliability. It employs a preventive route reconfiguration to avoid the latency in case of link breakages and to prevent the network from splitting.

Energy-efficient broadcast routing algorithms called Minimum Longest Edge (MLE) and Minimum Weight Incremental Arborescence (MWIA) are introduced in [6, 8]. MLE is able to achieve a longer network lifetime by reducing the maximum transmission power of nodes. With MLE, the likelihood that a node is overused is reduced significantly. This scheme was expanded by considering a scenario where we introduce edge weights on the basis of the remaining energy of the sending nodes and receiving nodes. MWIA was derived from this idea, which is the best possible solution for broadcast routing with the minimum largest edge-weight.

Cheng et al. proposed the Minimum Incremental Power (MIP) algorithm and it is known as the most energy-efficient heuristic in terms of the total energy consumption among all the topologies [7]. MIP is developed based on the Broadcast Incremental Power (BIP) algorithm. The MIP algorithm is used as a comparison for the solution to the Energy-balanced topology control problem, which instead of minimizing the total energy, minimizes the maximum energy consumption at each node.

Energy Efficient Location Aided Routing (EELAR) Protocol [5] was developed on the basis of the Location Aided Routing (LAR) [11]. EELAR makes significant reduction in the energy consumption of the mobile node batteries by limiting the area of discovering a new route to a smaller zone. Thus, control packet overhead is significantly reduced. In EELAR, a reference wireless base station is used and the network's circular area cantered at the base station is divided into six equal sub-areas. During route discovery, instead of flooding control packets to the whole network area, they are flooded to only the sub-area of the destination mobile node. The base station stores locations of the mobile nodes in a position table. Simulations results using NS-2 [12] showed that EELAR protocol makes an improvement in control packet overhead and delivery ratio compared to AODV [13], LAR [14], and DSR [15] protocols.

Li et al proposed the Online Max-Min (OMM) power-aware routing protocol [9] for wireless ad-hoc networks dispersed over large geographical areas to support applications where the message sequence is not known. This protocol optimizes the lifetime of the network as well as the lifetime of individual nodes by maximizing the minimal residual power, which helps to prevent the occurrence of overloaded nodes. In most applications that involve MANETs, power management is a real issue and can be done at two complementary levels (1) during communication and (2) during idle time. The OMM protocol maximizes the lifetime of the network without knowing the data generation rate in advance. The metrics developed showed that OMM had a good empirical competitive ratio to the optimal online algorithm [9] that knows the message sequence and the max-min achieves over 80% of the optimal node lifetime (where the sender knows all the messages ahead of time) for most instances and over 90% of the optimal node lifetime for many problem instances [6].

The Power-aware Localized Routing (PLR) protocol [16] is a localized, fully distributed energy-aware routing algorithm but it assumes that a source node has the location information of its neighbours and the destination. PLR is equivalent to knowing the link costs from the source node to its neighbours, all the way to the destination. Based on this information, the source cannot find the optimal path but selects the next hop through which the overall transmission power to the destination is minimized [6].

Power-aware routing (PAR) [17] maximizes the network lifetime and minimizes the power consumption by selecting less congested and more stable route, during the source to destination route establishment process, to transfer real-time and non real-time traffic, hence providing energy efficient routes. PAR focuses on 3 parameters: Accumulated energy of a path, Status of battery lifetime and Type of data to be transferred. At the time route selection, PAR focuses on its core metrics like traffic level on the path, battery status of the path, and type of request from user side. With these factors in consideration, PAR always selects less congested and more stable routes for data delivery and can provide different routes for different type of data transfer and ultimately increases the network lifetime. Simulation results shows that PAR outperforms similar protocols such as DSR and AODV, with respects to different energy-related performance metrics even in high mobility scenarios. Although, PAR can somewhat incur increased latency during data transfer, it discover routed that can last for a long time and encounter significant power saving.

Minimum Energy Routing (MER) can be described as the routing of a data-packet on a route that consumes the minimum amount of energy to get the packet to the destination which requires the knowledge of the cost of a link in terms of the energy expanded to successfully transfer and receive data packet over the link, the energy to discover routes and the energy lost to maintain routes [10]. MER incurs higher routing overhead, but lower total energy and can bring down the energy consumed of the simulated network within range of the theoretical minimum the case of static and low mobility networks. However as the mobility increases, the minimum energy routing protocol's performance degrades although it still yields impressive reductions in energy as compared performance of minimum hop routing protocol [18].

The Lifetime-aware tree routing algorithm [19] maximizes the ad hoc network lifetime by finding routes that minimize the variance of the remaining energies of the nodes in the network. LMT maximizes the lifetime of a source based tree, assuming that the energy required to transmit a packet is directly proportional to the forwarding distance. Hence, LMT is said to be biased towards the bottleneck node. Extensive simulation results were provided to evaluate the performance of LMT with respect to a number of different metrics (i.e., two definitions of the network lifetime, the root mean square value of remaining energy, the packet delivery ratio, and the energy consumption per transmitted packet) in comparison to a variety of existing routing algorithms and Least-cost Path Tree (LPT) [20]. These results clearly demonstrate the effectiveness of LMT over a wide range of simulated scenarios.

Local Energy-Aware Routing (LEAR) [21] simultaneously optimizes trade-off between balanced energy consumption and minimum routing delay and also avoids the blocking and route cache problems. LEAR accomplishes balanced energy consumption based only on local information, thus removes the blocking property. Based on the simplicity of LEAR, it can be easily be integrated into existing ad hoc routing algorithms without affecting other layers of communication protocols. Simulation results show that energy usage is better distributed with the LEAR algorithm as much as 35% better compared to the DSR algorithm. LEAR is the first protocol to explore balanced energy consumption in a pragmatic environment where routing algorithms, mobility and radio propagation models are all considered [6].

Problem Statement

Mobile ad-hoc network form infrastructure less topology because each node move's freely in any where any time that increase unreliability of the network so in our dissertation we "design energy aware base routing with location aided routing in MANET" and analyze the behaviour of network using various parameter like packet delivery ratio, routing load, energy analysis etc.

Proposed Work

In our proposal we design energy aware base routing with location aided routing in MANET scheme for that purpose we split our proposal in three module name as (1) energy module (2) routing module and (3) location aided module.

Energy Aware Routing Module:

The nodes in an ad hoc network are constrained by battery power for their operation. To route a packet from a source to a destination involves a sufficient number of intermediate nodes. Hence, battery power of a node is a precious resource that must be used efficiently in order to avoid early termination of a node or a network. Thus, energy utilization and management is an important issue in such networks. Efficient battery utilization, transmission power management and system power management are the major means of increasing the life of a node.

These management schemes deals in the management of energy resources. By controlling the early depletion of the battery, adjust the transmission power to decide the proper power level of a node and incorporate the low power strategies into the protocols used in various layers of protocol stack. There are so many issues and solutions which witnesses the need of energy management in ad hoc wireless networks.

A few reasons for efficient energy utilization in MANETs are Limited Energy of the nodes, Difficulties in Replacing the Batteries, Lack of Central Coordination, Constraints on the Battery Source, Selection of optimum Transmission Power, and Channel utilization. Finally at the network layer, issues which are open are as designing of an efficient routing algorithm that increases the network lifetime by selecting an optimal relay node. for that purpose we set each node initial energy as a random way and set threshold energy as 10 joule we also define discharge energy on the bases of transmission power, receiving power and idle power with respect to time and calculate existing path using AODV routing protocol.

AODV module:

In this module we will call distance bases routing technique by which we can find shortest path from source to destination. If shortest paths exist from source to destination, than only AODV base routing sends actual data packet through that shortest path routing, but our approach we use energy base routing so here sender sends routing packet for computation of route from source to destination and that time we also check of energy of intermediate node's if energy is greater than threshold energy so we insert in route else eliminated that path, if more than one route exist from source to destination for that case we find out shortest path and sends data from source to actual receiver that increases reliability of the network.

LAR Module:

In this module destination will run LAR routing protocol and will send location information to the sender node, after that location information base, route request packet will broadcast in only specific direction. This module will reduces the routing overhead of the mobile ad-hoc network. The whole procedure are given in proposed algorithm

```
//Create Routing module with energy level configure
Set NN = M;              //Number of mobile node
Set RP = AODV;           //Routing protocol
Set rng = 250 m;         //rng for radio range
Set eng = Random;        // initial energy (1 to 100)
Set Tx = 1.5 j;
 Set Rx = 1.0 j;
Set Sleep = 0.5 j;
Set Sensing = 0.3 j;
Set Ideal =0.1 j;
Set Sender = S;           // S ε M
Set receiver = R;         // R ε M
// Generate test Traffic
Compute route ();
RREQ_B (S, R, rng, eng)
{
// search route from source to destination
 if ((next_hop == true) && (rng ≤250) && (eng ≥ 10j))
 {
  next_hop -> Rx_RREQ;
  Call_energy();
  D_eng = eng--;//discharge energy
  rtable->insert(rtable->rt_nexthop);     // nexthop to RREQ source
  rtable1->insert(rtable1->rt_nexthop);//nexthop to RREQ destination
  if (destination == R)
  {
            If (more route live)
            {  Check eng of both routes;
               Call_energy();
               If (rt1_eng > rt2-eng)
               Accept RREQ_B;                    //from rt1
               D_eng = eng--;
            Send_ack through rtable1 to source node  }
```

```
        Else {   Accept RREQ_B;                    //from rt2
                  D_eng = eng--;
                 Send_ack through rtable2 to source node
               }
}
Else {destination not found ;}
}
 else
{
destination unreachable or energy value less than 10 Joule ;
}
// If connection Break after certain time

Receiver R uses LAR routing;
Receiver send expected location and speed information to sender;
If (node updates location)
 {
Use location info and sender send routing packet to expected zone;
If (dest == true)
            {
                        Data_packet_send (s_no, nexthop, type)
            }
 Else
     {
    Destination not found;
     }
}
```

Here we define proposed algorithm for energy as well as location base routing, here very first we create mobile node and then set sender and receiver node and all node set initial energy as a random after that, sender broadcast routing packet to find receiver, in route broadcasting time energy module base we find out intermediate node energy if energy value is greater than threshold value then we insert that node in route else eliminate that route path, after that we find out receiver node on the bases of threshold energy base routing and receivers sends acknowledgment packet to the actual sender, but after some time any node move and connection break down than receiver uses LAR (Location aided routing) and sends location information to sender node time to time, that message help full for finding receiver from minimum overhead bases because LAR uses direction base routing and increases the performance of the network. The main advantage of this scheme is if the node is reaches to threshold level and node is a part of communication then no connection will break or route will update it means the threshold value is only the intimation about the energy status. It will not break the route forcefully.

Simulation Environment and Results

Simulation will be done in Network Simulator- 2 (NS-2). The description about simulation environment is as follows:

Network simulator 2 (NS2) is the result of an on-going effort of research and development that is administrated by researchers at Berkeley [12]. It is a discrete event simulator targeted at networking research. It provides substantial support for simulation of different modules like energy, routing etc.The TCL (Tool Command Language) script is then used by ns during the simulations. The result of the simulations is an output trace file that can be used to do data processing (calculate delay, throughput etc) and to visualize the simulation with a program called Network Animator.

Simulation Parameter

We get Simulator Parameter like Number of nodes, Dimension, Routing protocol, traffic etc. According to below table 1 we simulate our network.

TABLE I. SIMULATION PARAMETERS

Number of nodes	50
Dimension of simulated area	800×600
Routing Protocol	AODV
Location based protocol	LAR
Simulation time (seconds)	100
Transport Layer	TCP ,UDP
Traffic type	CBR , FTP
Packet size (bytes)	1000 /sec.
Number of traffic connections	10
Maximum Speed (m/s)	Random
Transmit energy(j)	1.5
Receiving energy(j)	1.0
Idle energy (j)	0.1
Sense energy(j)	0.3
Sleep energy(j)	0.5

Performance Metrics

- **Packet Delivery Ratio:** The ratio between the number of packets originated by the application layer sources and the number of packets received by sink at the final destination.
- **Packet Dropped:** The routers might fail to deliver or drop some packets or data if they arrive when their buffer are already full.
- **Routing Load:** The total number of routing packets transmitted during the simulation.

Results:

1) Energy Saving Analysis LAR-EAODV with Threshold Approach

This graph represents the energy saving of each node in proposed scheme. Now in this graph we clearly visualized the saving energy of each node. In proposed scheme the nodes are doing routing on the basis of Location based energy threshold. The energy threshold has reduces the problem of immediately link brakeage by that most of the energy are wasted in retransmission. But here the nodes are doing routing on the basis of proposed scheme and saves lot of energy by that the network performances are definitely increases.

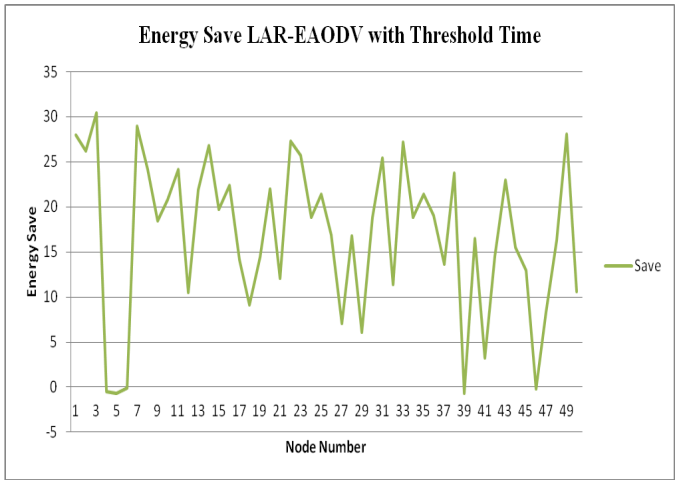

Figure 1

2) Energy Utilization in case of Previous EAODV and Proposed LAR-EAODV

Energy utilization has enhance the life of nodes because lot of energy are i.e. waste in retransmission and flooding but in proposed location based energy efficient threshold based routing the number of nodes are also aware about the destination estimation by that the sender is flooded the routing packets in that direction duration e to the presence of LAR protocol. The energy utilization are also enhance if the node will intimate in network about their low energy status. Now this graph represents the energy utilization in case of EAODV and LAR-EAODV. Here we simply visualized the effect of proposed scheme, about 20 % at an average energy is wasted in case of EAODV but it will be saved in proposed LAR-EAODV scheme.

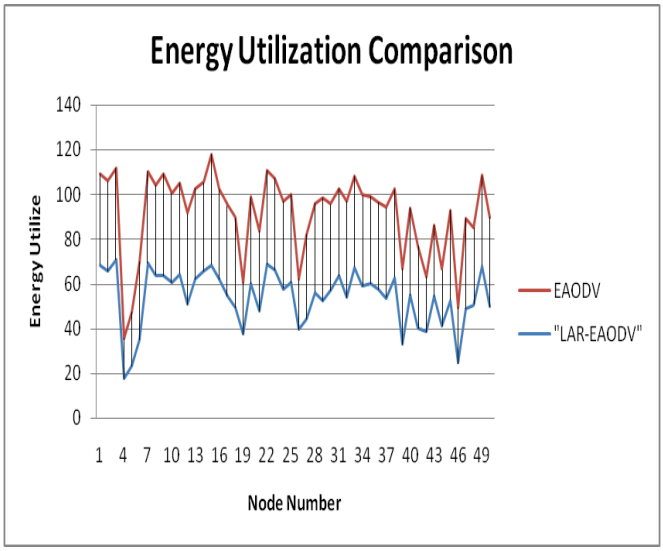

Figure 2

Routing load Analysis

Routing load analysis is one of the important performance parameter to analyse the network performance and lot of node energy is wasted for connection establishment because if the sender sends more routing packets in that case the more energy of node are wasted and the receiver is also busy to reply them, by that the data delivery are affected and energy consumption increases. Now in this graph the routing load in previous scheme are too much because in normal energy based routing each node has do the routing after connection establishment and this procedure call again and again because sender are no aware about the location of receiver. But in proposed scheme the sender are aware about the location of receiver by that the routing packets are only deliver at time of about 60 sec. after that no routing packets are deliver in network because every sender is know about the location of receiver. In previous scheme about 7500 routing packets are used for connection establishment in between sender and receiver but in proposed scheme only 3000 packets are used. It means that the about 4000 packets are unnecessary deliver in network for that consumes lot of energy that is completely wasted but in proposed scheme this energy is saved.

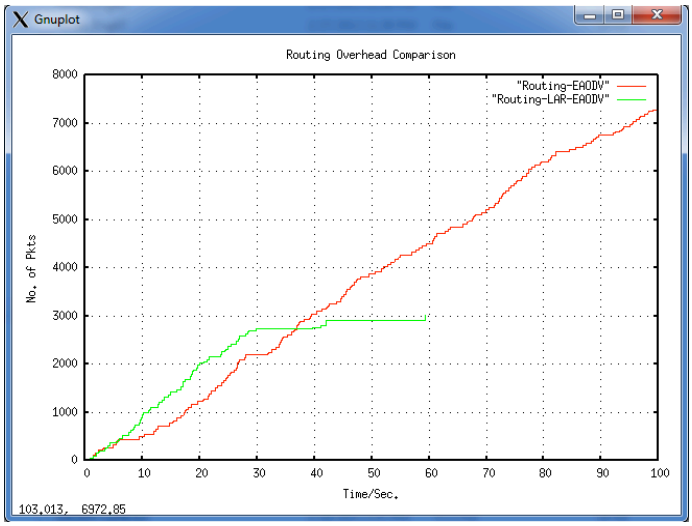

Figure 3

Packet Delivery Ratio Analysis

Packet delivery Ratio (PDF) is the percentages of data packets are successfully received in network. But this factor are completely depend on the number of packets are send and receive in network. If the less number of data packets are deliver and most of them are received it means the PDF are too good. In this graph the PDF of previous scheme are of about 92% but in case of proposed scheme the PDF is about 97% because of efficient utilization of node energy. In proposed scheme at the time of about 4 sec. the value of PDF are reaches to 100% after that at time 8 sec. the PDF of previous scheme are slightly more but at 10 sec. and after that the PDF are continuously increases.

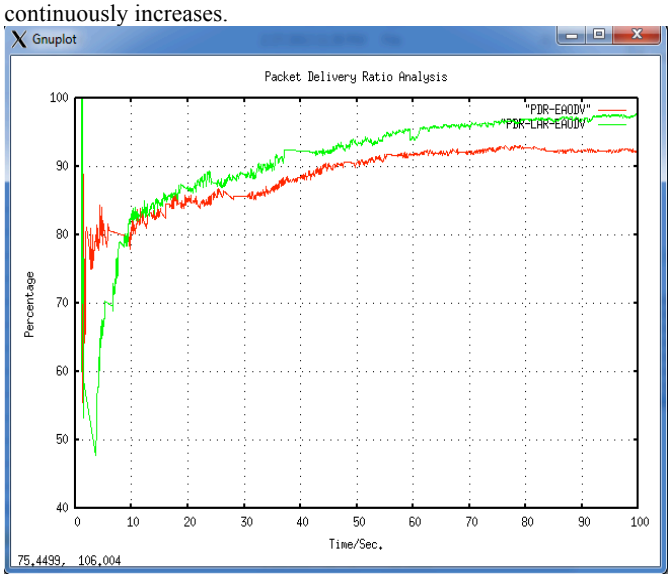

Figure 4

Conclusion and Future work

In this paper, we proposed an efficient routing scheme with location-aided routing (LAR) that improves the utilization o of node energy In this scheme, the nodes are communicate with each other up to energy threshold value. If any node has a part of communication then in that case it first completes communication with energy alert in between source to destination. The request packet is broadcasted in a request packets are delivered on the basis of location to determine the next broadcasting node. The neighbouring node with the shortest distance is chosen as the next broadcasting node. In this paper we compare the performance of Energy based AODV (EAODV) protocol and proposed (Location based energy based routing (LAR-EAODV) scheme. In our simulation experiments, we simulated the normal routing load, packet delivery ratio and most important energy utilization of nodes which take part in routing. Now results are clearly show that the performance and energy utilization are more improved then previous scheme by that the life of network are also increases.

Now in future we analyse the energy loss in case of attack and also try to analyse the energy consumption in WiMAX technology and compare their results with WiFi technology.

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