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EFFICIENT ROUTING ALGORITHM FOR WIRELESS SENSOR NETWORK TO REDUCE THE ENERGY CONSUMPTION

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Abstract: The energy consumption is one of the important constrain in wireless sensor networks. The nodes can be failed when the sensor nodes are deployed in unpredictable environmental conditions due to the battery loss, in that situation it is difficult to change the battery. So it will be wise to use an appropriate routing algorithm for searching the better available path that consumes lesser energy and minimize the delay. The Energy Efficient Genetic Algorithm Routing reduces the size of the forwarder list by considering only the nodes that are most nearer to the destination. In the next process the list is arranged occurred on their distance from the destination, the highest priority node will act as the next relay node and that selected relay node is nearer to destination. It also routes the acknowledgement using the Genetic Algorithm routing this is done to balance the energy spend by the nodes for transmission and reception. It provides better results than many existing Genetic Algorithm routing protocols in terms of end-to-end delay and network lifetime.

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1.INTRODUCTION

Wireless Sensor networks can make “anywhere at any time” getting connected into reality. For example Bluetooth is one of the wireless systems in wireless sensor networks. These networks can operate without having any fixed infrastructure. In mobile adhoc networks nodes are constrained by limited battery lifetime for their operation. In adhoc network one of the major constraint is energy efficiency.A sensor node could act as both data originator and data router.There are four main schemes in energy efficient routing protocols. They are Network Structure, Communication Model, Topology Based and Reliable Routing. In clustering technique data forwarding schemes are used to reduce and balance the energy consumption through data aggregation and periodical selection of different nodes in cluster head (CH).During network communication all the sensor nodes are minimize thepower consumption to achieve energy balance in cluster.Each cluster head gather the sensed information from its sensor nodes, that information can be transmitted to a Base Station. In the majority of routing algorithms, the periodical choice of the optimal path and the energy, whole problem together impact on the life time of WSNs.

2.RELATED WORKS

Protocol for Opportunistic Networks -The random nature of network topology is a major issue while expand new routing protocol for Opportunistic Networks (OppNets). In addition, other factors like intermittent connections, limited bandwidth etc. further restrict the execution of existing routing protocols. In this paper, a new context aware routing protocol called GAP is proposed. The proposed protocol efficiently merges the advantage of Genetic Algorithm and Probabilistic Routing to route the acknowledgement from the source to destination. The protocol applies the Genetic algorithm to predict the path a message would take if it is move to the next node. A Fitness function is defined to assess the efficiency of this predicted path. The acknowledgement is transferred to the nearest node only if the fitness value of the predicted path is higher than a threshold value, which is calculated by executing the concepts of probabilistic routing. Simulation results show that the GAP routing protocol outperforms Prophet, Spray and Wait and GAER protocol in terms of acknowledgement delivery ratio, overhead ratio and average latency.[1]

Scalability in LargescaleOpportunistic Routing - opportunistic routing using the broadcast nature of wireless networks, significantly gives the unicast through-put. Many variations of opportunistic routing designs have been proposed, although all of the present designs consistently rely onall of the topology statistics to construct forwarder lists andprocess data forwarding, which indeed restricts the application inlarge-scale wireless networks, where gathering global optimal in-formation is very costly. In this paper, they propose the localized opportunistic routing (LOR) protocol, which make use of the distributed minimum transmission selection (MTS-B) algorithm to partition the topology into small nested close-node-sets (CNSs) using local information. LOR can locally understand the optimal opportunistic routing for a large-scale wireless network with minimum control over-head cost. It does not use global topology information, LORhighlights an interesting tradeoff between the global optimality of the old forwarder lists and scalability inferred from the incurred overhead. Extensive simulation outcome show that LOR dramatically improves better performances over extremely opportunistic routing(ExOR) and MAC-independent opportunistic routing protocol(MORE), which are two popular designs from the literature, in terms of manage overhead, end-to-end delay, and throughputs. It also exhibits good performance in vehicular ad hoc networks[2].

Routing Optimization using Genetic Algorithm-An Ad-Hoc network is a group of wireless mobile nodes forming a provisional network without the aid of any established infrastructure or centralized administration. The topology of connectionsbetween nodes in ad hoc networks may be absolutelydynamic. Ad hoc networks need a highly adaptive routing scheme to deal with the frequent topology changes. In this paper we propose algorithm for better routing in clustering algorithm based on both cluster head gateway switching protocol (CGSR) and the mechanisms of a genetic algorithm (GA). We use GA's because GA mechanisms permit for self configuration systems and keep state information about the neighboring network superior than traditional MAANET routing mechanisms. GA mechanisms allow a node to alter routing information fast and efficient to modify an ever changing local topology, initiating fewer link breakages and increasing minimum MAC layer overhead. Also this proposed algorithm shows that GA s are able to find, if not the shortest path, at least a very good path between source and destination in ad-hoc network nodes[3].

Energy Efficient Wireless Sensor Network - The power consumption and energy efficiency of wireless sensor network are the significant problems in wireless sensor network. In this paper, the network topology optimization depends on complex network theory to solve the energy efficiency problem of WSN. The proposed energy efficient model of WSN according to the basic principle of tiny world from complex networks. Small world network has clustering features that are close to that of the rules of the network but also has similarity to arbitrary networks of small median path length. It can be used to optimize the energy efficiency of the entire network. Optimal number of multiple sink nodes of the WSN topology is proposed for optimizing energy efficiency. Then, the hierarchical clustering analysis is try to implement this clustering of the sensor nodes and pick up the sink nodes from the sensor nodes as the clustering head. Meanwhile, the modernize method is proposed to determine the sink node when the passing of certain sink node happened which can be starting point of the paralysis network. Simulation results prove the energy efficiency of the proposed model and validate the updating of the sink nodes to make sure the normal operation of the WSN[4].

Routing protocols in Wireless Sensor Networks-This paper presents a survey of routing techniques in Wireless Sensor Networks (WSNs). Compared with traditional wireless networks, WSNs are characterized with denser levels of node deployment, higher unreliability of sensor nodes and severe power computation and memory limitation. Various design problems such as energy efficiency, data delivery models, quality of service, overheads etc., for routing protocols in WSNs are highlighted. In this paper label most of the proposed routing methods as well as scheme designs, benefits and result analysis wherever possible. The routing protocols are classified into seven parts such as Data centric routing, Hierarchical routing, Location based routing, Negotiation based routing, Multipath based routing, Quality of Service (QoS) routing and Mobility based routing. This paper also compares the routing protocols against parameters such as power consumption, scalability, mobility, optimal routing and data aggregation. The paper concludes with possible open research issues in WSNs[5].

Enhancing Energy Efficiency of Wireless Sensor Network -Wireless Sensor Network (WSN) is known to be a highly resource restriction class of network where energy consumption is one of the major concerns. In this research, a cross layer design methodology take on to design an energy efficient routing protocol titled "Position Responsive Routing Protocol" (PRRP). PRRP is designed to minimum energy consumed in each node by reducing the amount of time in which a sensor node is in an separate listening state and reducing the particular communication distance over the network. The performance of the proposed PRRP was seriously evaluated in the context of network lifetime, throughput, and energy consumption of the network per separate basis and per data packet basis. This research results were analyzed and standard against the well-known LEACH and CELRP protocols. The results show a significant improvement in the WSN in terms of energy efficiency and the overall executionof WSN[6].

Minimize Energy Consumption Using Hierarchical protocol -Wireless Sensor Networks (WSNs) is a network which contains a group of autonomous nodes that are randomly distributed in a region of network area. The role of each node is the cyclic transmission of results to the sink. Enhancing the energy efficiency and improving the networking lifetime are the major challenges in this type of networks. To deal with this, the hierarchical protocols (Cluster based-approach, chain based-approach) have been introduced in order to minimize the network traffic toward the sink and extend the network lifetime. In this paper we will concentrate about LEACH protocol (Low Energy Adaptive Clustering Hierarchy Protocol) in order to provide a new method of selecting cluster head. This method is to focus energy consumption when the data is transmitted to the Base Station (BS). We estimate the performance of the LEACH protocol in advance method using simulation tool[7].

3.PROPOSED WORK

The proposed system EEGA protocol is similar to EEOR protocol but it makes itself efficient by reducing the size of the forwarder list by applying the condition that forwarder node is a one that is nearer to the destination. It also increases the reliability by using the acknowledgement packets and balances the energy for transmission and reception by routing the acknowledgement packets also Genetic Algorithm [8]. The major objective of EEGA protocol is, to reduce the size of the forwarder list and to use different paths for data and acknowledgement packets so as to balance the energy consumption. The working of EEGA protocol can be divided in to two steps, formation of routing table and updating the routing table whenever there is a change in thenetwork.Sending a packet from source to target in a network can be considered to include three parts,

(1) The source sending the packet to one neighbor node and that node is the target node;

(2) If the target is more than one hopaway from the source, then there is at least one node in the neighbor list to relay the packet to target;

(3) Agreement on choosing the actual relay node, among the neighbor of the transmitting node.

The time and effort incurred achieving the part1,isconstant. The same for part 2 depends on the distance between the source and the destination. It is very hard to find the cost on coming to an agreement as to choose the relaying node. It is assumed that the overall cost of communication is represented by the distance between the nodes to be communicated in thewireless sensor network. Thus, all nodes in a WSN basically function as mobile routers participating in some routing protocol required for deciding and maintaining the routes[9]. Since WSNs are infrastructure-less,self-organizing,rapidly deployable wireless networks, they are highly suitablefor applicationsinvolving special outdoor events, communications in regions with nowirelessinfrastructure, emergencies and natural disasters, and military operations. Routing is one of the key issues in WSNs due to their highly dynamic and distributed nature. In particular, energy efficient routing may be the most important design criteria for WSNs since mobilenodes will be powered by batteries with limited capacity.

Power failure of a mobile node notonly 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. Based on the aforementioned discussions, this paper surveys and classifies numerous energy efficient routing mechanisms proposed for WSNs. That can be broadly categorized based on when the energy optimization is performed[10]. A mobile node consumes its battery energy not only when it actively sends or receives packets but also when it stays idle listening to the wireless medium for any possible communication requests from other nodes.

Thus, energy efficient routing protocols minimize either the active communication energy required to transmit and receive data packets or the energy during inactive periods. For protocols that belong to the former category, the active communication energy can be reduced by adjusting each node’s radio power just enough to reach the receiving node but not more than that. This transmission power control approach can be extended to determine the optimal routing path that minimizes the total transmission energy required to deliver data packets to the destination[11].For protocols that belong to the latter category, each node can save the inactivity energy by witching its mode of operation into efficient-down mode or simply turns it off when there is 3 no data to transmit or receive. This leads to considerable energy savings, especially when the network environment ischaracterized with low duty cycle of ommunication activities. However,it requires well-designed routing protocol to guarantee data delivery even if most of the nodes sleep and do not forward packets for othernodes. Anotherimportantapproachto optimizing active communication energy is load distribution approach. While the primary focus of the above two approaches is to minimize energy consumption of individual nodes, the main goal of the load distribution method is to balance the energy usage among the nodes and to maximize the network lifetime by avoiding over-utilized nodes when selecting a routing path. While it is not clear that any particular algorithm or aclass of algorithms is the best for all scenarios,each protocol has definite dvantages/disadvantagesandiswell-suitedfor certain situations[12]. However, it is possible to combineandintegrate the existing solutions to offer a more energy efficient routingmechanism. Since energy efficiency is also a critical issue in other network layers, considerable efforts have been devoted to developing energy-aware MACand transport protocols. Each layer is supposed to operate inisolation in layered network architecture but, as some recent studies suggested, the cross-layer design is essential to maximize the energy performance.In fact, many routingprotocols introduced in this paper use the sameconcept, i.e. they exploit lowerlayer mechanisms such as transmission powercontrol and sleep mode operationin their routing layer algorithms.

The distance d between two nodes A(x1,y1) andB(x1,y2) is calculated bythe Euclidean distance equation,here the distancerefers to the geographicaldistance in meters. The Table 4.1 shows the network parameters or the algorithm

Table 4.1 Network Parameter Notations

Variabl	Description
N	Number of nodes in the
P	Number of packets transmitted between a pair of source and
(x, y)	x and y co-ordinates of a node
D	Distance between the nodes
T	Simulation time
EI	Initial energy of the node
Ec	Critical energy of the node
Er	Residual energy of the node

In the network considered, the source node formsthe set of neighboringnodes to forward the packet, when the destination is more than one hop away from the source. The set of neighbors is sortedaccording to its distance from thedestination, and normally the first of these nodes in the forwarder list relays thepacket towards the destination. The procedure continues till the destinationnode receives the packet.EEGA Algorithm finds the minimal path between the source and destination pairs specified in the network[13]. The fields used in the packet to be communicated are source, packet length, packet sequence number, x coordinate, y coordinate, z coordinate, distance, data.

sourc	Pack	Seq.n	X	Y	Z	Distan	Dat

Figure 4.1 Packet Structure Used in EEGA protocol

In the Figure 4.1 the first field source represents the node that originated the packet. Packet length represents the number of bytes contained in the packet. Packet sequence number is the index of the packet in the overall simulation of the network. x and y coordinates represents the position of the node, and z represents the speed of movement of a mobile node in number of steps per second[14]. As the nodes in our network are static, z coordinate is always 0. The distance field of the packet represents the geographical distance between the node and the source. The last field is the data to be communicated between the source and the destination nodes. The acknowledgment packet has the same fields, except the data field.

Packet with Message Digest hash generation:

In this algorithm, the first source device puts sensed data (SD) to packet P1. P1 has Source address (SA), BS address (BSA), Traversal path (TP), Current time (CT) and SD. Followed by, the Source device generates message digest hash (MD) for P1. Furthermore, it finds the shortest path (SP) to BS. (If the compromised device is available in WSN, it will deceive all sensor devices into believing that it is too close to the base station and all sensor devices)[15]. Then, the Source device transmits P1 to the base station through SP. After that, it puts MD to packet P2. P2 has SA, BSA, TP, CT and MD. Then it transmits P2 to Trusted Third Party (TTP) (Step 1-6).

Algorithm 1: GA based Neighbor-controlled Traffic-centric routing

Input : Source sensor device (S), All sensor devices (ASs), Base station (BS), Trusted Third Party (TTP), Time Threshold (TT)

Output: Sinkhole Devices (SHD)

Source sensor device side

1. S puts sensed data (SD) to packet P1
   (P1 has Source address (SA), BS address (BSA), Traversal path (TP), Current time (CT) and SD)
2. S generates message digest hash (MD) for P1
3. S finds the shortest path (SP) to BS

If the compromised device is available in WSN, it will deceive ASs into believing that it is too close to the BS and ASs)

4. S transmit P1 to BS through SP
5. S puts MD to packet P2 (P2 has SA, BSA, TP, CT and MD)
6. S transmit P2 to TTP

Base Station side

7.Create Traffic Record (TrRec), when TrRec is unavailable
8.Receive packet P1 via SP
9.Extract the following fields from P1(SA, BSA, TP, CT and SD)
10.Note packet received time (RT)
11.Delete the packets received at the very old time (before TT) from TrRec
12.Puts SA, BSA, TP, SD and RT to TrRec
TrRec = TrRec + (SA, BSA, TP, SD, RT)
13.AD[] = {}
14.For each packet P from TrRec
15.Extract TP from P
16.Extract all available devices id from TP
17.Put these all available devices id to AD
19.BS generates new message digest hash (NMD) for P
20.BS puts NMD to packet P3
21. P3 has SA, BSA, TP, CT and NMD)
22.BS Transmit P3 to TTP
End For
23.MFDs = Find most frequent device ids from AD
// Time-Varying Snapshot based suspicious devices
24.Trusted Third Party side
25.TTP received P2 from S
26.Extract the following fields from P2 (P2 has SA, BSA, TP, CT and MD)
27.TTP received P3 from BS

28.Extract the following fields from P3 (P3 has SA, BSA, TP, CT and NMD)
29.Res = "Safe"
30.If(MD != NMD)
{
Res = "Unsafe"
SuspiciousDevices = Remove SA and BSA from TP and extract remain device ids // Message Digest Hash-based Suspicious devices
}
but Res and SuspiciousDevices to RS and Inform to BS
Base Station side
31.Received RS from TTP
32.Extract the following fields from RS
(RS has Res and SuspiciousDevices)
SHD = {}
If(Res == "Unsafe")
{
SDs[] = Extract all available device ids from SuspiciousDevices
33.for each device D from SDs
{
if(MFDs.contains(D))
{
SHD = SHD + D // It concludes D is sinkhole device
}
}
}
34.BS isolate all detected sinkhole devices in SHD from WSN

Traffic Record Creation and Maintenance:

Next, The base station Create Traffic Record (TrRec), when TrRec isunavailable. Followed by, it Received packet P1 via SP. Then extract (SA, BSA, TP, CT and SD) from P1. Furthermore, base station note packet received time (RT). Then it deletes the packets received at the very old time (before TT) from TrRec. Followed by, it Puts SA, BSA, TP, SD and RT to TrRec.

WSN ROUTING PROTOCOLS

Routing protocols in mobile ad hoc networks can be classified as table-driven and on-demand. On-demand protocols include ad hoc on demand distance vector routing (AODV) and dynamic source routing (DSR).

A. DSR - This routing protocol uses packet forwarding via source routing and aggressively uses route cache to store full paths to the destination. Thus in DSR the sender knows the complete hop-by-hop route to the destination. DSR makes packet routing trivially loop-free. It also avoids the need for up-to date routinginformation at the intermediate nodes and also allows nodes to cache routes by overhearing data packets.The main advantage of DSR is that it does not make use of periodic routing advertisements, thus saving bandwidth and reducing power consumption. Also if a link to a route is broken, the source node can check in its cache for another valid route. These factors contribute to energy conservation and savings in DSR. Also the assumptions for the DSR protocol is that it operates in a network which has a relatively small diameter and the mobile nodes can enable promiscuous receive mode.

B.AODV - It shares DSR's on-demand characteristics and discovers routes as needed on demand basis via similar route discovery process. AODV uses traditional routing tables and maintains one entry per destination. Being a singlepath protocol, it has to invoke a new route discovery, whenever the path from source to destination fails. AODV uses destination sequence numbers to prevent routing loops and to determine freshness of routing information. AODV also uses a timer-based route expiry mechanism to promptly remove stale routes. If a low value is chosen for timeout, valid routes may needlessly be discarded. When the topology changes frequently, route discovery needs to be initiated often which can be inefficient as route discovery flooding is associated with overheads which can cause significant energy consumption. Also AODV is suitable when traffic diversity (number of active connections) increases, a condition with which DSR is not able to cope.

C. **Performance AnalysisMetrics-**The following metrics were used to evaluate the performance analysis of routing protocols under consideration. Data packet delivery ratio: The data packet delivery ratio is the ratio of the number of packets generated at the source to the number of packets received actually by the destination. This metric is used so that we can analyze that network capacity is not reduced by the use of energy extensions to MAC protocol. · Energy efficiency: is defined as total number of bits transmitted / total energy consumed, where the total bits transmitted is calculated using application layer data packets only and total energy consumption is the sum of each node's energy consumption during the simulation time. The unit of energy efficiency is bit/Joule and greater the number of bits per joule, the better the energy efficiency achieved. D. Random Waypoint Mobility Model.

The performance analysis of routing protocol for WSN includes its evaluation under realistic conditions and this includes movements of mobile users (i.e. mobility model). In our paper we consider the random waypoint mobility model. The random waypoint mobility model is considered as one of the most widely used. In order to facilitate communication within a WSN, an efficient routing protocol is required to discover routes between mobile nodes. Energy efficiency is one of the main problems in a WSN, especially in designing a routing protocol. In this paper, we surveyed and classified a number of energy aware routing schemes. In many cases, it is difficult to compare them directly since each method has a different goal with different assumptions and employs different means to achieve the goal. For example,when the transmission power is controllable, the optimal adjustment of the power level is essential not only for energy conservation but also for the interference control. When node density or traffic density is far from uniform, a load distribution approach must be employed to alleviate the energy imbalance problem. The effiecient-down mode approach is essentially independent of the other two approaches because it focuses on inactivity energy. Therefore, more research is needed to combine and integrate some of the protocols presented in this paper to keep WSNs functioning for a longer duration.

5.SIMULATION SETUP

The simulator used in the analyzing the wireless sensor network in this paper is NS2. This section provides simulation setup to demonstrate performance of Energy Efficient Genetic Algorithm Routing in the wireless sensor networks. 50 wireless sensor nodes are deployed randomly in a square area of 500m by 500 m, with uniform distribution. The packet generation rate is one packet per second.Packets of 1000 bytes each, are transferred between source and destination pairs for a simulation time of 150 seconds. The acknowledgment packet size is 40 bytes. All the sensor nodes in the network are deposited with an initial energy of 50 Joules. The energy spent by a sensor node in transmission of packet is maximum of 0.38 Joules, in receiving is 0.36 Joules. The node consumes a minimum energy of 0.003 Joules, when it is in idle state. The behavior of the network is observed for average End-to-End delay, maximum End-to-End delay and network lifetime. In these 50 nodes, 9 different source- destination pairs are randomly chosen for one-hop, two-hop, and more than two-hop communications.

6.PERFORMANCE EVALUATION

This section analyzes the performance of the wireless sensor network forEnergy Efficient Genetic Algorithm Routing for theparameters Maximum End-to-End delay, average End-to-End delay and networklifetime.The network scenario is defined as wireless sensor network with 50 nodes randomly deployed in the area of 500 m X 500 m. 250 m is the transmission range of each of the sensor nodes in the network.

Average End-to-End Delay

End-to-End Delay is defined as the time elapsed between the source node sending the packet and the destination node receiving the packet. The average of the End-to-End delay of all the packetstransmitted between each of the pairs of source-destinations gives the average End-to-End delay. It is observed that for one hop networks, Energy Efficient Genetic Algorithm Routing does not show any improvement, because the time for choosing the set of forwarder list is not needed. As the number of hops increases, the reduction in delay is more. For two-hop and three-hop communications the delay is reduced up to a maximum of

90 ms which is the same as 9% for 10-20 source-destination pair and 295 ms that is approximately equal to 30 %for 11-22 source destination pair, respectively.

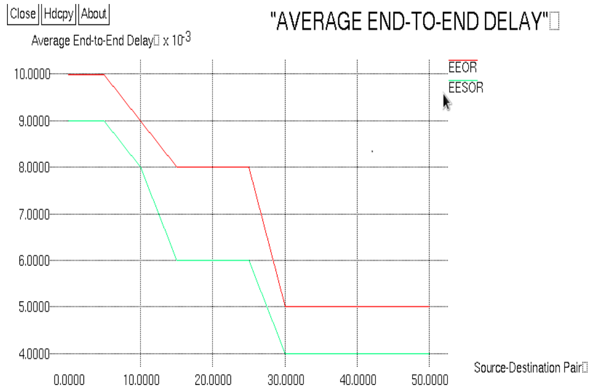

Figure 6.1 Average End to End Delay

Maximum End-to-End Delay

Figure 6.2 shows the plot of maximum of End-to-End delay values, for the same 9 pairs of nodes considered for analyzing average End-to-End delay. Once again, single hop communication takes same amount of time in Energy Efficient Genetic Algorithm Routing. Two-hop communication between the nodes 30 and 32 shows the maximum improvement of around 300 ms, or 3 % of total delay for each source destination pair. And more than two-hop communication yields a maximum reduction of delay by approximately 1000 ms, or 50 %, for the source destination pair 11-22. The reason for this reduction is decrease in the size of forwarder list in case of Energy Efficient Genetic Algorithm Routing, by considering only the neighbor nodes that are nearer to destination.

The small size of forwarder list reduces the time taken for prioritizing and sorting the nodes. The analysis of maximum End-to-End delay shows that, as the number of hops increases, the transmission delay increases. The End-to-End delay is lesser in Energy Efficient Genetic Algorithm Routing as compared to Energy Efficient Genetic Algorithm routing.

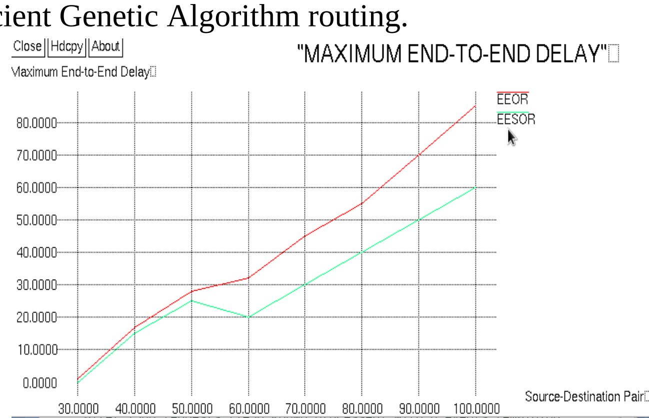

Figure 6.2 Maximum End-to-End Delay

Network Lifetime

The lifetime of a sensor node is considered as thetimefrom its deploymentto the time till which the node is having more than 10% of its initial energy. The node is said to be alive in this period. Beyond this period the node is said to bedead. Network Lifetime is the time between inceptions of the network to the time upto which 10% of the sensor nodes are alive. Figure 6.3 shows the network lifetime for both Energy Efficient Genetic Algorithm routing and Energy Efficient Genetic Algorithm Routing protocols plotted against different network sizes.Network size is considered as 25 nodes, 50 nodes, 75 nodes and 100 nodes for comparing the performance of Energy Efficient Genetic Algorithm routing and Energy Efficient Genetic Algorithm Routing.

The network performance is analyzed for the network sizes 25, 50, 75 and 100 nodes for network lifetime. The graph shows that the network lifetime increases for all the networks considered, irrespective of the network size.

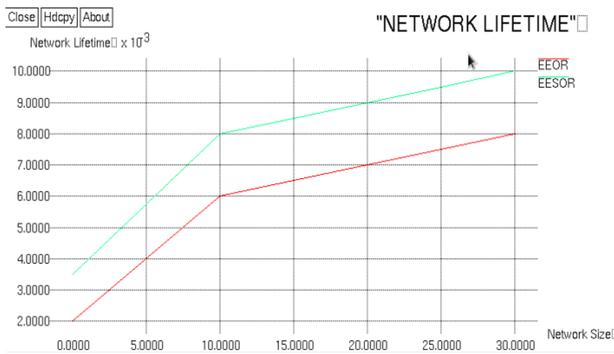

Figure 6.3 Network Lifetime

The proposed routing protocol EEGA shows significant improvement over the existing Genetic Algorithm routing protocols like EEOR, AsOR, MORE, EXOR in terms of end-to-end delay and network lifetime.

7.CONCLUSION AND FUTURE WORK

The presented EEGA algorithm is found to reduce the average end-to-end delay and maximum End-to-End delay lifetime since it includes only the nodes that are nearer to the destination into the forwarder list so the decision for selecting the next relay node can be done quickly.It also increases the network since the acknowledgement is also being routed Genetic Algorithm as well as the reliability of packet delivery increases.

The future enhancements that can be done to EEGA algorithm are:

(1) To add mobility to the nodes;

(2) To analyze the network for parameters like throughput and turnaround time;

(3) To add a Route Failure Notification Packet.

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