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OPTIMIZATION OF ENERGY EFFICIENT HETEROGENOUS RING CLUSTERING ROUTING IN WSN

Jyoti Sharma[1], Dr. Manish Bhardwaj[2], Anubha[3], Charu Awasthi[4]
[1,3]Department of Information Technology, KIET Group of Institutions, Delhi-NCR, Ghaziabad, India
[2*]Department of Computer Science and Information Technology, KIET Group of Institutions, Delhi-NCR, Ghaziabad, India
[4]Department of Information Technology, JSS Academy of Technical Education, Noida, India

Abstract: In WSN, industrial and Environmental monitoring is the main application and the most important challenge is to reduce the energy consumption as to extend the lifetime of network is very important. The intermediatory nodes acting as relay nodes keeps on working throughout the data transmission so energy of these nodes drains out rapidly which results in diminishing the life of the WSN. To overcome it, a protocol namely Energy Aware Revised Clustering Hierarchical Routing is proposed as an improvement over E2HRC. The five important processes are designed in this protocol namely random network formation, data Clustering (electing CHs), data collection, Re-clustering and node relocation (sink node). Analysis is done in both ways theoretically as well as simulatively and the result of simulation analysis shows that the energy aware revised clustering hierarchical routing protocol significantly lower downs the energy consumption and increase the network life time.
This work presents the energy aware revised clustering hierarchical routing protocol that reduces the energy consumption and increase the energy efficiency and compare the results of energy aware revised clustering hierarchical routing with E2HRC, RPL and LEACH.
Keywords: Heterogenous Routing, Cluster Head, LEACH, WSN, E2HRC.

I. INTRODUCTION

Existing System: A heterogeneous ring domain clustering mechanism with each ring having equal area is presented in this paper in order to resolve the energy balance issue in original IPv6 RPL. A new clustering mechanism and cluster head creation in dynamic rotation mechanism are also proposed. The announcement and acknowledgment message for clustering were implemented based on RFC and original

IPV6 RPL message structure. A new Clustering (E2HRC) routing protocol for wireless sensor networks was then proposed named Energy Efficient Heterogenous Ring Clustering Routing Protocol and its respective routing algorithms was designed. A deep analysis of Related messages was performed in detail. Experimental results proved that the E2HRC routing protocol balanced energy consumption more efficiently in comparison to the original IPV6 RPL. It decreased both node energy consumption and the number of control messages [1]. An Architecture of E2HRC is given in fig. 1.[1]

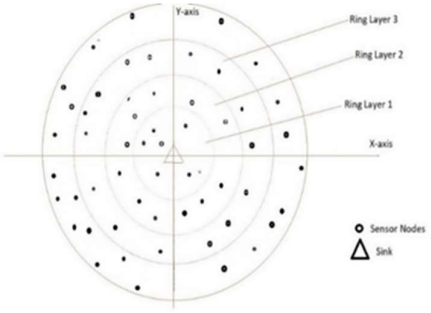

Fig. 1. Architecture of E2HRC

II. PROPOSED METHODOLOGY

This work proposed the energy aware revised clustering hierarchical routing protocol with node relocation method [2]. It has defined five processes for this protocol. First process is Clustering, second is to aggregate data, third is rotation of mobile node by swapping mechanism and relocation of sink node. In this system, the sensor taking various parameters are deployed in view as the Network scenario, Region partitioning, calculation of number of nodes, Coverage area and Probability of regions [3,4]. Clustering based routing always reduces the energy consumption and improves the access control mechanism of the network. So, a good mechanism for a clustering is required for designing an efficient routing protocol. Second the data aggregation process plays important role because it defines how the data is processed so a data collection algorithm is designed, which gives effective multi-hopping. After collecting data using this data aggregation method, an energy swapping algorithm is designed for rotation of mobile node [5,6]. By swapping the intermediate hop nodes, continuous energy consumption of nodes is significantly reduced during data transmission. Because it reduces the continuous working of some particular hop nodes[7]. It is done by identifying the nodes with maximum residual energy and then swapping them with low energy nodes. First theoretical analysis is done and then simulation is also done to show the results [8,9,10]. It clears that the energy aware revised clustering hierarchical routing protocol significantly reduces the energy consumption and so increases the life time of the wireless sensor network. NS2.3 is used as the implementation tool for this research work [11,12].

Many of the routing and data dissemination protocols proposed earlier follows homogeneous network architecture, in which all sensors are of peer level and have given the same data transmitting, sensing, storing and processing capabilities. Recently, there has been done a lot work in heterogeneous networks, particularly for deployments in real time. LEACH is considered as the basic protocol in the category of heterogenous clustering routing protocols and the basis of all the research work done in routing protocol in heterogenous architecture. LEACH is the first proposed protocol on the concept of CHs and it improved the network life time over other homogenous routing protocols [13]. Several modifications were done in heterogenous network like QoS based, IoT based, Entropy based modifications are few of them. All these enhancements improved Network life and proved to be best energy balancing approaches in WSN. Security is also considered as the major issue in WSN, so many algorithms are designed to ensure it in WSN [14]. In this research paper, a new routing protocol is proposed for WSN based on heterogeneous architecture. Energy aware revised clustering hierarchical

routing ensures heterogeneity by creating two types of nodes: normal and advanced on the basis of residual energy [15]. In energy aware revised clustering hierarchical routing, there is different mechanism of clustering for both the nodes. For normal nodes, CHs are elected on the basis of probability scheme using both the residual and average energy of the normal nodes [16]. Now only the normal nodes with high residual energy can become the cluster head in a round. In round robin manner, CHs are elected using this probability scheme. For Advanced nodes, a different probability scheme is adopted for CH election. These advanced nodes act as intermediate hops for normal CHs and send their sensed data to BS when they are not acting as CH [17]. Finally, some sensor nodes are put to sleep state during cluster formation to save network energy.

This proposed protocol has two level heterogenous network and is an improvement over SEP (Stable Election Protocol). The main goal of every routing protocol is mainly to efficiently balance the energy consumption and increase the network life. Deployment of Sensors is done randomly in a square region and the base station is situated in middle of that square region. The base station and sensors are static after deployment. Sensors are unaware of their location. Sensors keep on sensing the region continuously and sending data to the BS. It is not possible to change or charge the battery of the sensors as they are deployed densely in a harsh and dense environment [18]. In this sensing region, two types of sensor nodes are used in which some act as advanced and some as normal nodes depending upon the residual energy.

A. Energy Aware Revised Clustering Hierarchical Routing Architecture

Fig 2. Shows the architecture of proposed system. As It is known that there are 3 steps in any heterogenous and hierarchical system. First is Cluster formation in which CHs are chosen, they advertise themselves and creates cluster. Second is Data transfer phase in which data is transferred from sensors nodes to their corresponding CHs and CHs aggregate the data received to reduce the redundancy. Third is the final data transmission from CHs to BS. There are several problems with this architecture of traditional system few of them are imbalanced Cluster Size, once CH is depleted its data is lost completely. After this Several Protocols were designed to remove the drawbacks of traditional system, one of the recent improvements is E2HRC which also contains some drawbacks. Here, this work designed a new improved architecture to reduce the drawbacks in e2hrc and in traditional also which gives better performance than any traditional system and E2HRC. Steps of our proposed system are shown in fig.2.

Step 1: random deployment of nodes to form a dynamic network which has no fixed topology like E2HRC.

Step 2: Probability calculation for choosing CHs in which each nodes chooses some probability of being CH.

Step 3: Clustering of nodes depending on their chosen values.

Step 4: CHs creation of every Cluster depending upon the value of its chosen probability and residual energy.

Step 5: Data Aggregation in which CHs aggregates the data received from its corresponding Cluster members.

Step 6: discovery of neighbour CH in which each CH finds its neighbour CH as gateway through which it will send the data to BS [8].

Step 7: Mobile Node Rotation with Node relocation method in which all new iteration relay nodes are changed depending upon their residual energy to save the energy and new route is find out to BS.
Step 8: When new route is found, data from relay nodes lying on old route exchanges the data with the new ones.
Step 9: analysis the performance with the new route and new relay nodes.

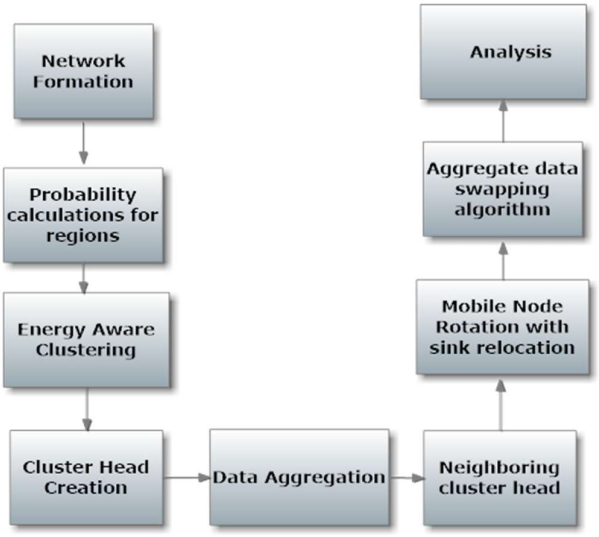

Fig. 2. Energy aware revised clustering hierarchical routing Architecture

B. Flow chart: Fig. 3 Shows the flow chart of proposed System. It is a sequence of how and when the steps given in section II are performed

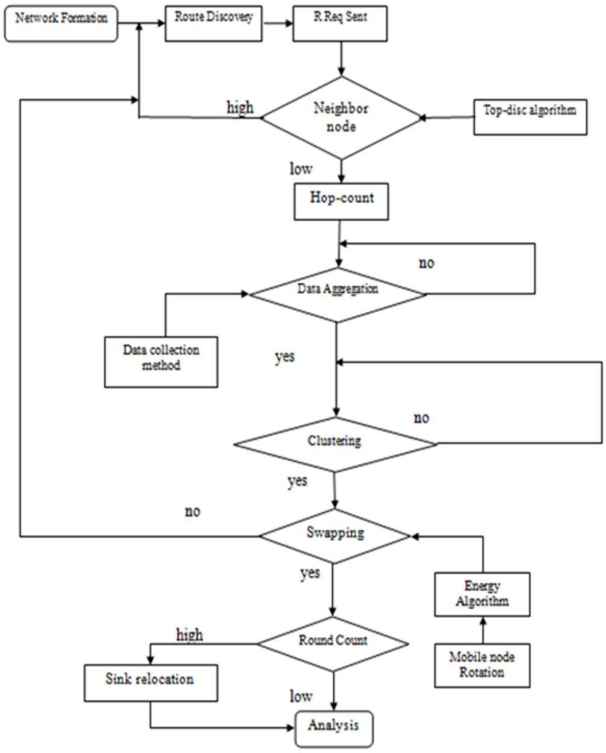

Fig. 3 Flow Chart of energy aware revised clustering hierarchical routing

III. METHODOLOGIES:

METHODOLOGY 1: DISTRIBUTED APPROACH

Introduction: Distributed approach for our proposed System is the approach in which every node is independent and individually runs the algorithm for clustering, there is no central control to choose CH and Clustering. So, node's energy consumption is comparatively large.
Algorithm: Algorithm and steps remains same as designed. The point here is that every node implements the algorithms independently. So, there are lots of control messages transferred.

METHODOLOGY 2: CENTRALIZED APPROACH

Introduction: Centralized Approach is the approach where there is central controlling entity. This Central entity is BS. BS has the responsibility for performing Clustering and CH election. So in this approach normal nodes has less functions to perform and less control packets are required. It is more energy efficient than distributed approach.
Algorithm: Algorithm and steps remains same as designed. The point here is that only BS implements the algorithm. So there are less control messages transferred.

IV. SIMULATION ANALYSIS

Simulation time vs throughput: Throughput is defined by the no. of successfully delivered packets per unit time. In our simulation, it is measured in kbps. The variation of throughput in different protocols is shown with respect to simulation time. Fig. 4 represents the performance of all five routing protocols: LEACH, RPL, E2HRC and energy aware revised clustering hierarchical routing on the basis of throughput and it is clearly seen that our proposed routing protocol i.e., energy aware revised clustering hierarchical routing out performs all the three protocols.

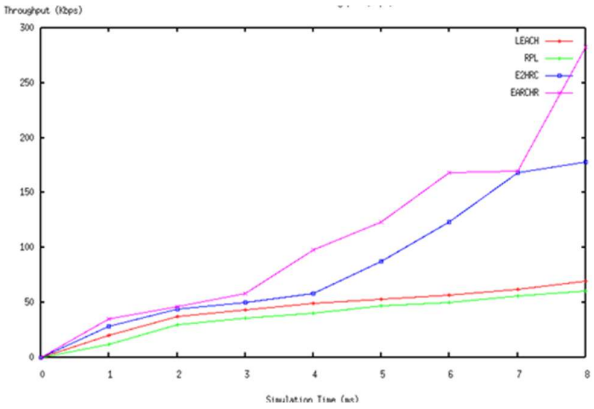

Fig. 4. Simulation time vs Throughput

Simulation time vs Overhead: Routing Overhead is the total no. of RREQ packets sent in the network throughout the simulation. Fig. 5 represents the routing overhead of all five routing protocols with respect to Simulation time and it is found that our proposed routing protocol energy aware revised clustering hierarchical routing gives the best performance that is the least routing packets overhead throughout the simulation.

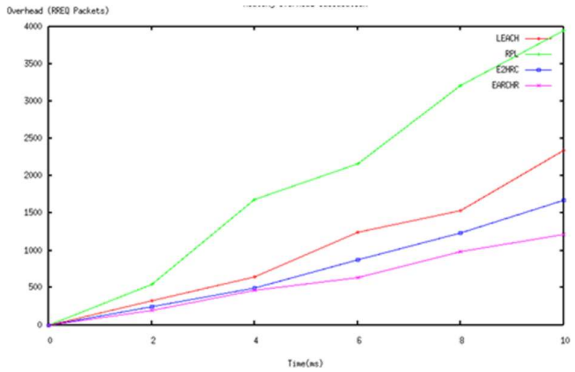

Fig. 5 Simulation time vs Overhead

Simulation time vs PDR: Packet Delivery Ratio (PDR) is the ratio of successfully delivered packets to the total no. of transmitted packets. Fig. 6 represents the packet delivery ratio of all Four routing protocols with respect to Simulation time and it is found that our proposed routing protocol gives the best performance that is the highest packet delivery ratio throughout the simulation.

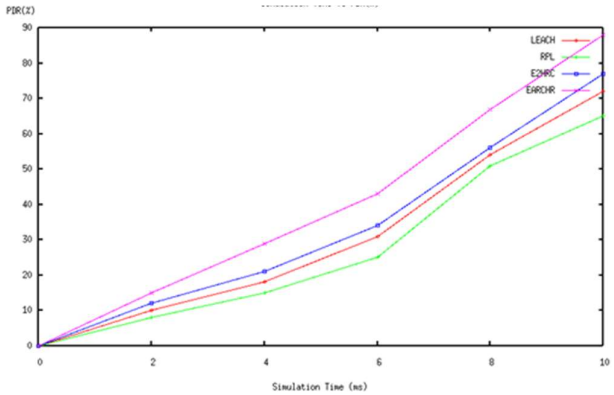

Fig. 6. Simulation time vs PDR

Packet size vs Loss: Loss is the no. of bytes of packet that are not successfully delivered when a packet is sent. Fig. 7 represents the performance of all the five routing protocols in the basis of no. of lost bytes with respect to total no. of sent packets. It is seen that energy aware revised clustering hierarchical routing has the least no. of lost bytes.

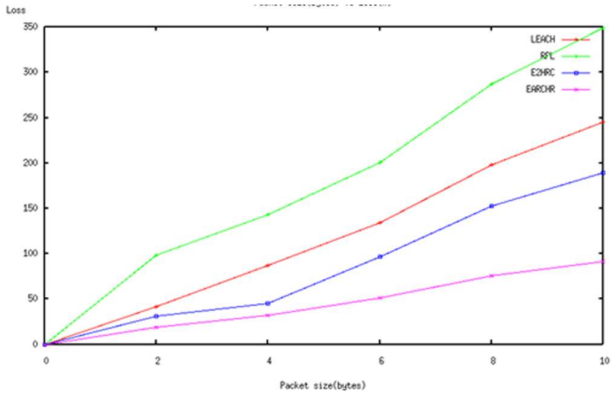

Fig. 7 Packet size vs loss

Simulation time vs E2E delay: End to End Delay (E2E delay) is the total time incurred in transmitting a packet from one end to other end. Fig. 8 shows the performance of different routing protocols in terms of E2E delay with respect to simulation time. It can be clearly seen that energy aware revised clustering hierarchical routing shows the least end to end delay and gives the best performance of all the routing protocols

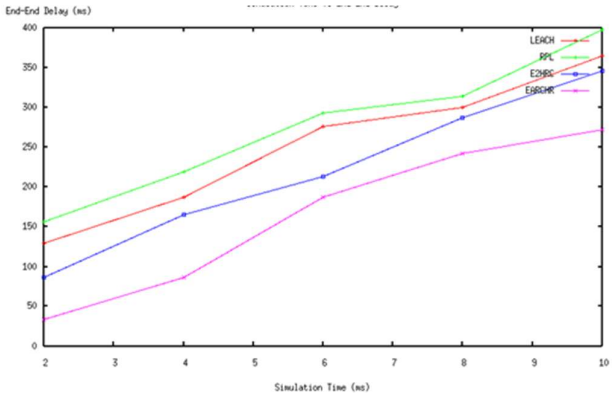

Fig. 8 Simulation time vs E2E Delay

Simulation time vs Energy Consumption: Energy Consumption is defined by the total energy consumed by all the nodes in the network. Fig. 9. Shows the plot between Energy Consumption and simulation time of all four routing protocols. In the wireless sensor network, Energy Consumption always increases with the time. According to Fig. 9, energy aware revised clustering hierarchical routing has the least energy consumption among all four routing protocols.

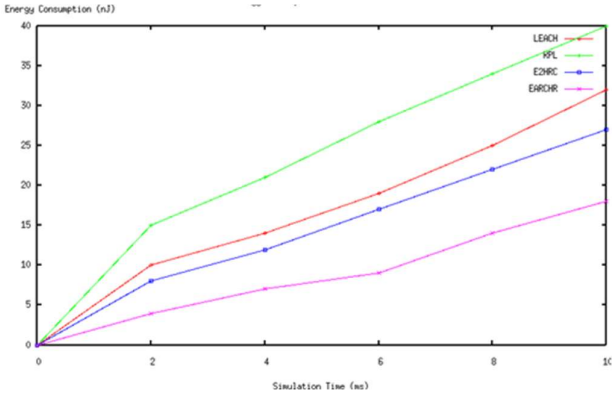

Fig. 9 Simulation time vs Energy Consumption

No. of Connections vs Average Delay: Average Delay is defined by the average of total delay incurred by all the nodes. Fig 10 shows the average delay with respect to simulation time. Energy aware revised clustering hierarchical routing shows less average delay than E2HRC routing protocols.

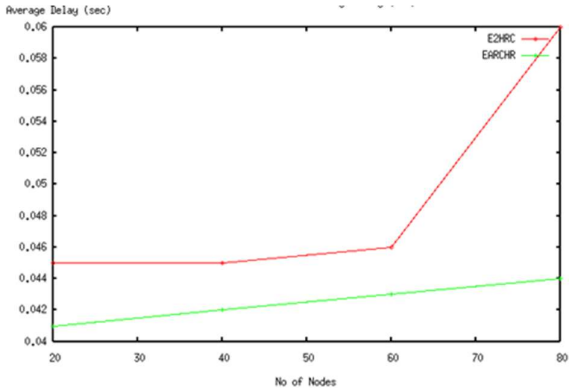

Fig. 10. No. of connections vs Average Delay

Pause time vs Remaining Energy: Total remaining Energy is the total energy left on all the nodes. Fig 11. Shows variation of total remaining energy with respect to simulation time. It can be seen that energy aware revised clustering hierarchical routing has the gives best result.

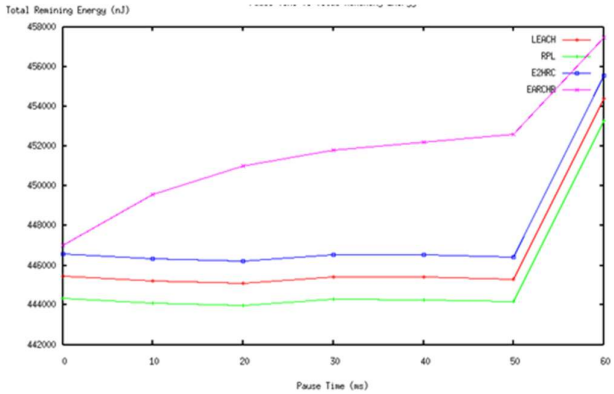

Fig. 11. Pause time vs remaining Energy

V. CONCLUSION

As sensor node has limited energy, using energy efficiently is considered as main challenge of WSN. A large range of routing protocols have been designed for WSN ensuring less energy consumption and network lifetime improvement. In this research work, a proposed improvement is given on E2HRC. In the WSN, while transmitting data, the energy level of the intermediate hop nodes which work as gateway to BS drain out rapidly due to the continuous multi hop mechanism. In this proposed energy aware revised clustering hierarchical routing protocol, the energy level reduction happened by the multi-hop method is lessen and the energy balance due to communication between clusters is also increased. Thus, it is proved that this protocol increases the energy efficiency and the network life time. In this thesis I discussed the design, analysis, and implementation of proposed System.

It uses a SWARM Optimization technique. I proposed an efficient solution to the proposed energy minimization framework by using the concept of re-clustering. It showed better performance than other heterogenous and hierarchical routing protocols like E2HRC, LEACH and RPL.

VI. FUTURE WORK

It can give better energy efficiency by making certain changes and parameters in aggregation methods. Also, the re- clustering criteria can be improved, which will give better packet delivery ratio and network life time. layering can be added to this to make it more scalable.

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