An Energy Efficient Routing Protocol for Heterogeneous Ring Clustering in WSN

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Abstract : A heterogeneous ring domain communication topology with equal area in each ring is presented in this study in an effort to solve the energy balance problem in original RPL (IPv6 Routing Protocol for Low Power and Lossy Networks). A new clustering algorithm and event-driven cluster head rotation mechanism are also proposed based on this topology. The clustering information announcement message and clustering acknowledgment message were designed according to RFC and original RPL message structure. An Energy-Efficient Heterogeneous Ring Clustering (E2HRC) routing protocol for wireless sensor network is then proposed an corresponding routing algorithms and maintenance methods are established. Related messages are analyzed in detail. Experimental results show that in comparison against the original RPL, the E2HRC routing protocol more effectively balances wireless sensor network energy consumption, thus decreasing both node energy consumption and the number of control messages.

***Keywords*— Wireless sensor network, clustering algorithm, routing algorithm, E2HRC, Low Power and Lossy Networks.**

I. INTRODUCTION

A wireless sensor network is composed of wireless sensor nodes and a sink node. Nodes are wirelessly interconnected to one another and to the sink. These networks are characterized as Low-power and Lossy Networks (LLNs), as individual nodes possess limited power and operate in harsh environments. If a node is not in direct communication range with the sink, the data it captures is reported in a multi-hop manner. In this way, nodes located closer to the sink end up relaying data for nodes that are farther away, thus creating hotspots near the sink. These hotspot nodes tend to deplete energy faster, thus reducing the wireless sensor networks lifetime. Wireless sensor network energy consumption is a popular research topic [1][2]. Considering of LLN characteristics and possible applications, the Internet Engineering Task Force (IETF) Routing Over Low-power and Lossy networks (ROLL) group has standardized a low-power and lossy network routing architecture called RPL [3][4]. This protocol is an open and accepted technical standard in regards to wireless sensor network IP-based development. The salient design feature of RPL is a routing framework that allows the use of different routing metrics and objective functions (OFs) to manage LLNs, including limitations and heterogeneous application requirements. RPL-based routing protocols have been proposed for different optimization objects. Packet forwarding and other factors to find that when nodes number is 150, the network is stable enough to satisfy practical application general requirements (based on the cortex M3-nodes for original RPL routing protocol in networks. An original RPL protocol implemented on operating systems to test real-world performance per factors including routing fairness and packet delivery rate; the results showed that the protocol merits further improvement in regards to network packet and routing control packet overhead.

II. LITERATURE SURVEY

Wireless sensor networks comprise an important research area and a near future for industry and communications. Wireless sensor networks contain resource-constrained sensor nodes that are powered by small batteries, limited process and memory and wireless communication. These features give sensors their versatility and drawbacks, such as their limited operating lifetimes. To feasibly deploy wireless sensor networks with isolated motes, several approaches and solutions have been developed; the most common, apart from using alternative power sources such as solar panels, are those that put sensors to sleep for time periods established by the application. In[5] J. C. Cuevas-Martinez, proposed a fuzzy rule-based system that estimates the next duty cycle, taking the magnitude being tested and battery charge as input.

In [6] M. Zhao, A three-layer framework is proposed for mobile data collection in wireless sensor networks, which includes the sensor layer, cluster head layer, and mobile collector (called SenCar) layer. The framework employs distributed load balanced clustering and dual data uploading, which is referred to as LBC-DDU. The objective is to achieve good scalability, long network lifetime and low data collection latency. At the sensor layer, a distributed load balanced clustering (LBC) algorithm is proposed for sensors to self-organize themselves into clusters. In contrast to existing clustering methods, our scheme generates multiple cluster heads in each cluster to balance the work load and facilitate dual data uploading. At the cluster head layer, the inter-cluster transmission range is carefully chosen to guarantee the connectivity among the clusters. Multiple cluster heads within a cluster cooperate with each other to perform energy-saving inter-cluster communications.

In [7] G.Han et al, A cross-layer optimized geographic node-disjoint multipath routing algorithm, that is, two-phase geographic greedy forwarding plus. To optimize the system as a whole, our algorithm is designed on the basis of multiple layers' interactions, taking into account the following. First is the physical layer, where sensor nodes are developed to scavenge the energy from environment, that is, node rechargeable operation (a kind of idle charging process to nodes). Each node can adjust its transmission power depending on its current energy level (the main object for nodes with energy harvesting is to avoid the routing hole when implementing the routing algorithm). Second is the sleep scheduling layer, where an energy-balanced sleep scheduling scheme, that is, duty cycle (a kind of node sleep schedule that aims at putting the idle listening nodes in the network into sleep state such that the nodes will be awake only when they are needed), and energy-consumption-based connected *k*-neighborhood is applied to allow sensor nodes to have enough time to recharge energy, which takes nodes' current energy level as the parameter to dynamically schedule nodes to be active or asleep. Third is the routing layer, in which a forwarding node chooses the next-hop node based on 2-hop neighbor information rather than 1-hop. Performance of two-phase geographic greedy forwarding plus algorithm is evaluated under three different forwarding policies, to meet different application requirements. Our extensive simulations show that by cross-layer optimization, more shorter paths are found, resulting in shorter average path length, yet without causing much energy consumption.

In [8] W. B. Heinemann, Networking together hundreds or thousands of cheap micro sensor nodes allows users to accurately monitor a remote environment by intelligently combining the data from the individual nodes. These networks require robust wireless communication protocols that are energy efficient and provide low latency. We develop and analyze low-energy adaptive clustering hierarchy (LEACH), a protocol architecture for micro sensor networks that combines the ideas of energy-efficient cluster-based routing and media access together with application-specific data aggregation to achieve good performance in terms of system lifetime, latency, and application-perceived quality. LEACH includes a new, distributed cluster formation technique that enables self-organization of large numbers of nodes, algorithms for adapting clusters and rotating cluster head positions to evenly distribute the energy load among all the nodes, and techniques to enable distributed signal processing to save communication resources. Our results show that LEACH can improve system lifetime by an order of magnitude compared with general-purpose multihop approaches.

In [9] A. W. Khan,"VGDRA, wireless sensor networks, exploiting the sink mobility has been considered as a good strategy to balance the nodes energy dissipation. Despite its numerous advantages, the data dissemination to the mobile sink is a challenging task for the resource constrained sensor nodes due to the dynamic network topology caused by the sink mobility. For efficient data delivery, nodes need to reconstruct their routes toward the latest location of the mobile sink, which undermines the energy conservation goal. In this paper, we present a virtual grid-based dynamic routes adjustment (VGDRA) scheme that aims to minimize the routes reconstruction cost of the sensor nodes while maintaining nearly optimal routes to the latest location of the mobile sink. We propose a set of communication rules that governs the routes reconstruction process thereby requiring only a limited number of nodes to readjust their data delivery routes toward the mobile sink. Simulation results demonstrate reduced routes reconstruction cost and improved network lifetime of the VGDRA scheme when compared with existing work.

In [10] E. Kadioglu-Urtis, Maximization of network lifetime through the efficient utilization of energy is one of the main objectives in wireless sensor network (WSN) design. Although energy balancing throughout the network for relaying the data traffic generated by sensor nodes toward a static base station prolongs network lifetime, some of the nodes are required to dissipate their energies sub optimally, i.e., farther nodes transmit some of their data to extended distances so that nodes closer to the base station are not overburdened. Base station mobility is proposed as a remedy for countering the suboptimal energy dissipation trends in WSNs. As the base station relocates, the burden of relaying the data coming from all nodes can be shared by a larger set of nodes, and hence, suboptimal energy dissipation can be mitigated. In order to take advantage of base station mobility for prolonging WSN lifetime, determining the optimal mobility patterns is of utmost importance. In this paper, we built a mixed integer programming framework to characterize the impact of various mobility patterns on WSN lifetime. Our results reveal that optimal Gaussian and spiral mobility patterns give the highest network lifetime values throughout the parameter space we explored.

III. EXISTING AND PROPOSED SYSTEM

Existing System

In the existing system, it was proposed a multiple hop clustering routing algorithm (RBMC) based on ring structure in which the communication area is divided into uniformly spaced concentric circles, thus realizing multiple hop communication between clusters supposing there is equal energy consumption in each ring. The number of cluster head nodes in each ring can then be calculated successfully. This algorithm can balance energy consumption in the wireless sensor network, while uniformly spaced concentric circles create an inner ring coverage area that is smaller than the outer ring thus preventing an energy hole in the inner nodes; the packet loss rate increases greatly due to signal interference from crowded nodes in inner clusters, however.

Proposed System

A heterogeneous ring domain communication topology with equal area in each ring is presented in this study in an effort to solve the energy balance problem in original RPL (IPv6 Routing Protocol for Low Power and Lossy Networks). A new clustering algorithm and event-driven cluster head rotation mechanism are also proposed based on this topology. The clustering information announcement message and clustering acknowledgment message were designed according to RFC and original RPL message structure. An Energy-Efficient Heterogeneous Ring Clustering (E2HRC) routing protocol for wireless sensor networks is then proposed and corresponding routing algorithms and maintenance methods are established. Related messages are analyzed in detail. Experimental results show that in comparison against the original RPL, the E2HRC routing protocol more effectively balances wireless sensor network energy consumption, thus decreasing both node energy consumption and the number of control messages.

E2HRC ROUTING ALGORITHM: We established backbone network type routing mechanism based on optimal direction angle (DA), node residual energy (EN), and hop difference (HC). When selecting relay nodes, the nodes in the backbone network consider the optimal direction angle, the residual energy, and the minimum number of hops to reduce network energy consumption and balance network energy.

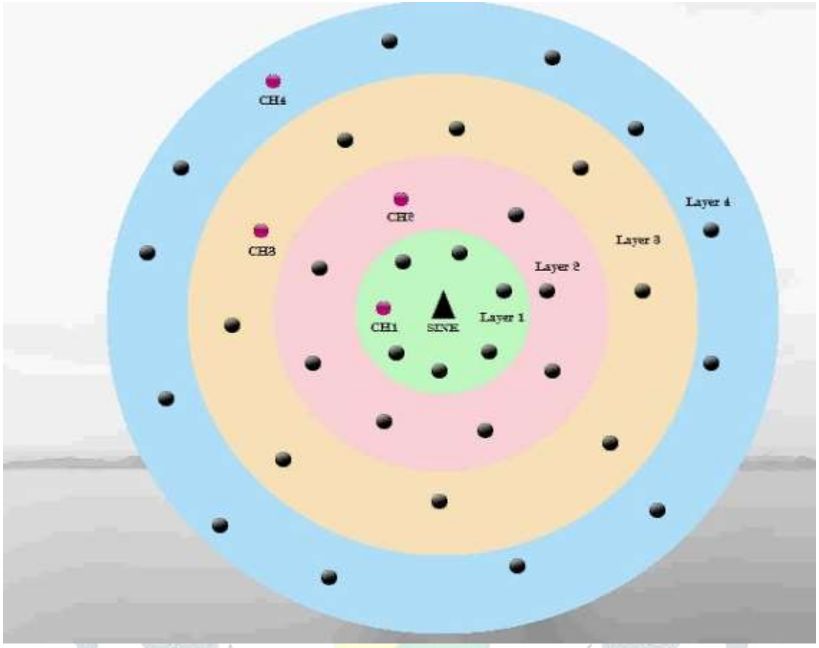

Figure1: Architecture of Topology of ring communication

IV. SIMULATION AND RESULTS

We set region size to 500m_500m with 120 nodes (one sink node and 119 route notes) randomly distributed throughout. The network topology was formed based on the most common sink topology (radial distribution around the network).

TABLE I
SIMULATION PARAMETERS

Attribute Parameter	Value
Number of the Nodes	120
Simulation time(s)	200
Simulation area	500*500m2
Simulator	NS
Mote Type	Sky mote
Operating System	Contiki 2.7
Radio medium	Omini Antenna Routing Protocol AODV
Mote startup delay (ms)	1000
Transmission range (m)	50

Figure 2: Data Transmission

In the fig 2 the wireless sensor network setup has been done. The data transmission start from base station to cluster head and routing starts from clusterhead1 to all sink node3.

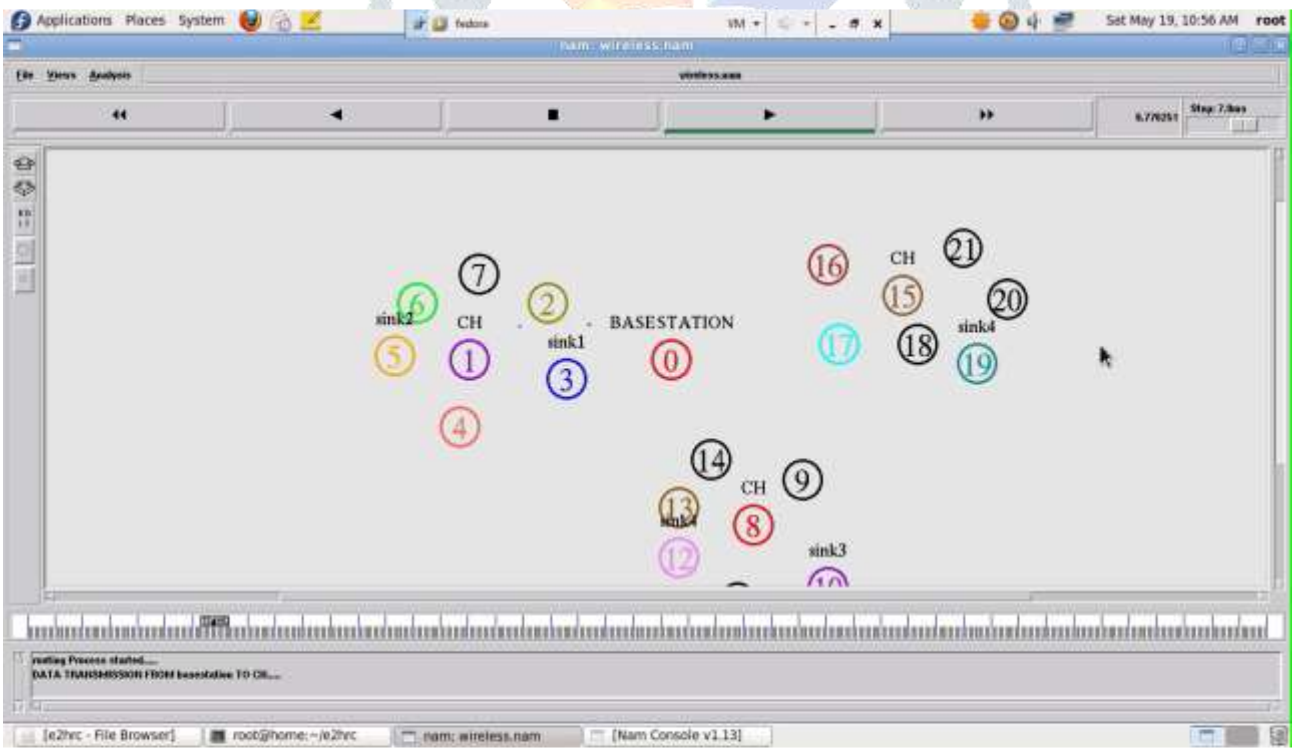

Figure 3: Energy Passing

In the above fig 3 the wireless sensor network setup has been done. The data transmissions start from base station to cluster cluster head and routing starts from cluster head. Energy is passing to the data transmission from base station to cluster head.

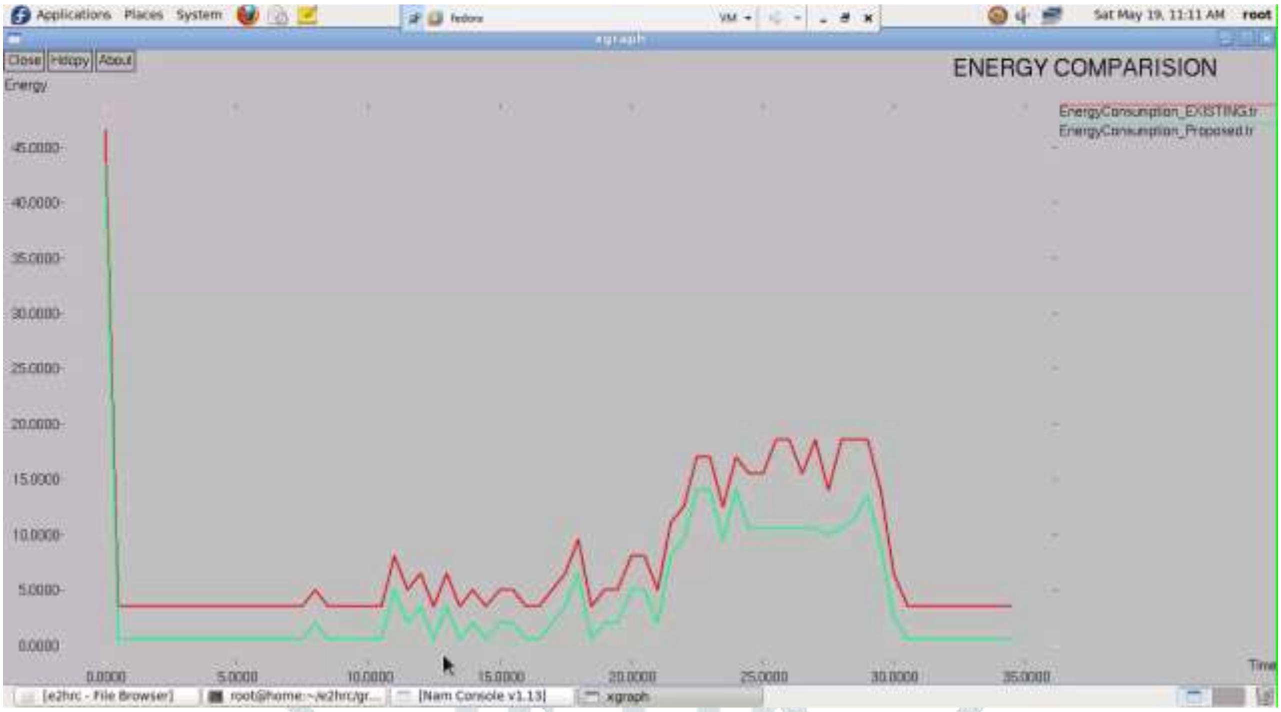

Figure 4: Energy Comparison

In the above graph the wireless sensor network setup has been done. The energy comparison between RBMC and RPL the how much energy is consumption of nodes. In this graph Energy efficient is higher than that the RPL.

Figure 5: Transmission of Data

In the above graph the wireless sensor network setup has been done. The original RPL transmissions of data will higher than the energy efficient protocol. Wireless nodes positions will be changed continuously because of they are in dynamic nature.

V. CONCLUSION

The proposed method yields better average energy consumption and overall performance than RPL while balancing the energy consumption of the whole wireless sensor network. We also designed a messaging structure for clustering and routing and verified that both protocols are efficient and effective. In future enhancement the control packet monitoring data numbers in the wireless sensor network Compared to the original RPL, the E2HRC routing protocol effectively decreased the number of control packets as time progressed. The proposed clustering algorithm and cluster rotation mechanism also achieved distributed cluster rotation to prevent an energy hole, and effectively decreased the number of control packets during cluster rotation, thus balancing the network load and improving network performance.

REFERENCES

[1] Guangjie Han, Jiawei Shen, Li Liu, Lei Shu. BRTCO: A Novel Border Line Recognition and tracking Algorithm for Continuous Objects in Wireless Sensor Networks, IEEE Systems Journal, 2016, DOI:10.1109/JSYST.2016.2593949.

[2] Li S, Zeng W, Zhou D, et al. Compact Conformal Map for Greedy Routing in Wireles Mobile Sensor Networks, IEEE INFOCOM, pp. 12,no. 11, 1632-1646, 2016.

[3] Guangjie Han, Yuhui Dong, Hui Guo, Lei Shu, Dapang Wu. Crosslayer Optimized Routing in Wireless Sensor Networks with Duty-cycle and Energy Harvesting, Wireless Communications and Mobile Computing,Vol.15, No.16, pp. 1957-1981, 2015.

[4] Ahvar E, Lee G M, Crespi N, et al. RER: a real time energy efficient routing protocol for query-based applications in wireless sensor networks,Telecommunication Systems, vol.61, no.1, pp. 1-15, 2016.

[5] Guangjie Han, Aihua Qian, et al. A Grid-Based Joint Routing and Charging Algorithm for Industrial Wireless Rechargeable Sensor Networks, Computer Networks, Vol.101, No.6, pp. 19-28, 2016.