STUDY ON PERFORMANCE EVALUATION OF ENERGY SAVING IN WIRELESS SENSOR NETWORKS

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Abstract: Today wireless sensor networks most important problem is energy control and design of an efficient energy strategy for prolonging the whole networks lifetime. In this paper first we present the literature study of efficient wireless sensor network .second we present the three LEACH, GAF and DEED energy efficient routing protocol and we have taken packet delivery fraction , end to end delay compare these schemes by using NS-2.34 simulator. Packet delivery fraction is the ratio of the data packets delivered to the destinations to those generated by the sources. End to end delay is the total latency experienced by a packet to traverse the network from the source to the destination.

Keywords: LEEH, DEED, GAF, WSSN,

I. INTRODUCTION

Today technological advances, the manufacturing of small and low cost sensors became technically and economically feasible. Wireless sensor network (WSN) is far and wide considered as one of the most important technologies for the twenty-first century [24]. Wireless technologies, in the simplest sense, allow one or more devices to communicate without physical connections–without requiring network cabling. Wireless communication technology is rising daily; with such growth more rapidly or later it would not be practical or simply physically possible to have a fixed architecture for this kind of network. With the development of computer networks extending restrictions and joining distant locations, wireless sensor networks (WSNs) materialize as the new boundary in rising opportunities to accumulate and development data from remote locations. Wireless sensor networks have several applications battlefield surveillance, habitat monitoring, healthcare, traffic control etc. Characteristics of WSNs are Ease of use, Communication failures, Ability to cope with node failures, Power consumption for nodes that use batteries or Energy harvesting, Ability to cooperate with harsh environmental conditions, Scalability to large scale deployment [25].

II. LITERATURE SURVEY

In data networks, the main function of network layer is routing. Routing is the process used to determine route for packet traveling from source to destination. Routing is performed by the routers, which updates the routing tables with minimizing cost functions like physical distance, link delay, etc. The metric for optimization can be distance, number of hops or estimated transit time. Protocols are used to implement handshaking activities such as error checking and receiver acknowledgements. Some of the algorithms used for routing in ad hoc networks are destination-sequenced distance vector routing, wireless routing protocol, ad hoc on-demand distance vector routing and dynamic source routing protocol [13, 14]. Amit Mangalekar et al. (2015) analyze and present the performance of AODV and DSR routing protocols for ad hoc networks using ns-2 simulations. DSR perform better under high mobility simulations than AODV. DSR protocol can support high mobility network and while data transmission minimum energy consumed. By using DSR protocol we minimize the required energy and studied the Packet delivery ratio, throughput and energy graphs at different units [18]. Pankaj Kumar et al. (2015) are numerous routing protocols have been proposed in this regard getting energy efficiency in heterogeneous situations. Efficiency of WSNs declines as changing the heterogeneous parameters of sensor nodes. In this paper, performance of various Distributed Energy-Efficient Clustering based protocols like DDEEC, EDEEC, TDEEC and TADEEC under various scenarios. Performance of these protocols is observed based on stability period, network life time and throughput [18]. Jyoti Kumari, Prachi (2015) propose an energy efficient routing algorithm for WBANs that will take into consideration two additional attributes (node criticality and communication count) along with the above stated attributes. These four parameters in the proposed algorithm will result in enhancement of working lifetime of the network via less energy consumption in comparison to existing routing protocols [20]. Nishita Payar, Prof. Chandresh R. Parekh (2014) examines the performance of the conventional LEACH protocol and gives an enhancement to it for energy efficiency. The proposed protocol considers many parameters like residual energy and distance from base station etc. for cluster head selection and energy efficient routing [19].

III. ENERGY CONSUMPTION IN WSSN

The energy consumption in wireless sensor networks occurs [10] in three domains: sensing, communication and data processing. When sensing message, the sensors consume the energy. How to save the energy is due to the mode of sensing messages, while the physical energy consumption is fixed. In certain conditions, we can save the energy up to the data's character. Communication is the major consumer of energy. The relation between energy consumption and communication range in wireless sensor networks is

$$E=Kd$$

Where E is the energy consumption.
d is the communication range, and $2<n<4$.
k is a constant.
From the formula, we can see that the longer the range is, the more the consumption is.

And the data processing also consume energy.
Energy waste in MAC layer has several major reasons:-

- The first reason is the idle listening, that is listening to an idle channel in order to receive possible data.
- When transmitting the packets can cause collision.
- The third energy waste occurs as a result of control packet overhead, so we should use a minimal number of control packets.
- The fourth reason is overhearing. It means that a node receives the packets that are destined to other nodes.
- At last, the nodes receive and process some unnecessary data, and it causes energy waste

The factors of energy consumption of routing layer are as below:- First is the transmission of control message. Most of the routing protocols for wireless sensor networks need to send hello packet and other control message, which consume much energy. Second is the complexity of the routing arithmetic. The more complex the routing arithmetic is the more energy is consumed.

IV. ENERGY EFFICIENT ROUTING PROTOCOL

A. LEACH (Low energy adaptive clustering hierachy)

Routing protocol in [10, 15] uses the idea of dynamic clustering to balance the energy consumption of the whole network. It is to make the nodes which hold more energy to be the clusters header, then to divide the nodes into several clusters, and to transmit the clustering information from the head node to the sink node. The optimized LEACH routing protocol can let the head nodes account for 5 per of all the nodes in the networks. So multiplex routing is only among the head nodes and it saves the energy of the whole networks. LEACH routing protocol prescribes the dynamic some nodes for long time to be the cluster header exhausting the energy consumption of the whole networks is balanced. The simulation shows that LEACH protocol helps to prolong the lifetime of the networks. But in the LEACH protocol, cluster header's periodical electing increases the energy consumption. And assuming that all the nodes can be communicated to sink nodes directly, it reduces the applications of LEACH protocol. The operations that are carried out in the LEACH protocol are divided into two stages, the setup phase and the steady-state phase[16].

Set-up Phase

In the set up phase, all the sensors within a network group themselves into some cluster regions by communicating with each other through short messages. At a point of time one sensor in the network acts as a cluster head and sends short messages within the network to all the other remaining sensors. The sensors choose to join those groups or regions that are formed by the cluster heads, depending upon the signal strength of the messages sent by the cluster heads. Sensors interested in joining a particular cluster head or region respond back to the cluster heads by sending a response signal indicating their acceptance to join. Thus the set-up phase completes[16].

Steady State Phase

As soon as a cluster head is selected for a region, all the cluster members of that region send the collected or sensed data in their allotted TDMA slots to the cluster head. The cluster head transmits this collected data in a compressed format to the base station which completes the second phase, called the Steady State Phase. Once the steady-state finishes the data transmission to the sink, the whole process comes to an end and a new search for the forming of cluster heads for a region and new cluster-member formation begins. In short, it can be said that a new set/up phase and steady state starts with the end of data transmission done to the sink. This alternative selection of cluster heads within the region, which is carried among the sensors in a self-organized way helps in reducing or lowering the energy that is utilized. There is a possibility that all the sensors might not be too close to the cluster head so the amount of energy that is utilized by the farther sensor is not equal to the amount of energy utilized by the nearest node. In order to minimize this, cluster heads formation or the role of Real Time Support and Energy Efficiency in WSN cluster head is performed by a rotation among all the nodes in the group. LEACH minimizes global energy usage by distributing the load of the network to all the nodes or cluster members at different intervals.

B. DEED (Distributed energy-efficient data communication protocol)

DEED is a completely distributed, high energy-efficient data communication protocol, and its feature is that the nodes are organized by clustering. The area covered by clustering is limited in a range, and the nodes make the decision independently to be the head or to be a member in a cluster. The cluster headers organized a routing tree according to the weight. In the tree, the root node collects other cluster headers' data and transmits to the sink node.In DEED protocol, the area covered by the cluster is limited with the radius r, that is to say the nodes can be member of one cluster only when they can be communicated with the cluster header in the distance less than r. r is called the radius of the cluster. In DEED protocol, the communication between member and header or between header and header is free-space based low-power attenuation. Compared with LEACH, DEED protocol consumes less energy, since the cluster is limited in the area whose radius is r, and the nodes in the cluster work on free-space transmission mode [10, 16].

GAF Algorithm (Geographic adaptive fidelity)

The name Geographic Adaptive Fidelity states that it locates nodes in the network and makes the best use of them to have a better fidelity. All the nodes use a location-identification technique to locate itself within the network along with its nearest neighbors by using location-information systems like GPS. In GAF, all the nodes arrange themselves according to grids also called virtual grids. All the nodes in the network divide themselves in virtual grids and all those nodes which are under a same grid coordinate among themselves to see who will go into sleep state and for how long. Load balancing is performed and a single node will not get drained with extraneous work. It can also be very simple to define virtual grids as all the nodes which are in grid A can communicate with all the nodes in grid B that are adjacent. The time for sleeping is decided or depends on the application and systeminformation.GAF has three state

transitions, namely discovery, active and sleeping. Initially every node starts with the discovery state. In this state the node turns on its radio and starts sending discovery messages to find the adjacent nodes in the same grid. Every discovery message is a combination of certain parameters, such as:
Node State: - Discovery, Active or Sleeping
Node ID: - The node itself or its current location
Grid ID: - Every node in the network uses its location information from GPS and its grid size in order to determine its grid id (enat):- Estimated node active time, this value can be set equal to node lifetime, which means that the nodes keeps on using the energy until it dies or drains out of energy[16,17].

V. SIMULATION RESULT

A. Simulation Results by Varying Pause Time

The following table gives the simulation parameters used for first scenario i.e. varying the pause time from 0, 1, 2, 3, 4, 5, 6 Sec . TCP traffic is used in this scenario.

Table 1 Simulation Parameters using TCP traffic

Parameter	Value
Simulator	NS-2.34
Simulator Area	450mX450m
No. of Mobile Nodes	50
Pause Time	0, 1, 2, 3, 4,5 Sec.
Max. Speed	20 m/s
Packet Size	512bytes
Simulation Time	6 Sec.

B. Throughput

The figure 1 shows the result of throughput for three energy efficient routing protocol i.e. low energy adaptive clustering hierarchy, geographic adaptive fidelity and distributed high energy-efficient data communication routing algorithms by varying pause time. Figure 1 represents that with respect to varying pause time; throughput is comparatively low in low energy adaptive clustering hierarchy, and distributed high energy-efficient data communication routing algorithms.

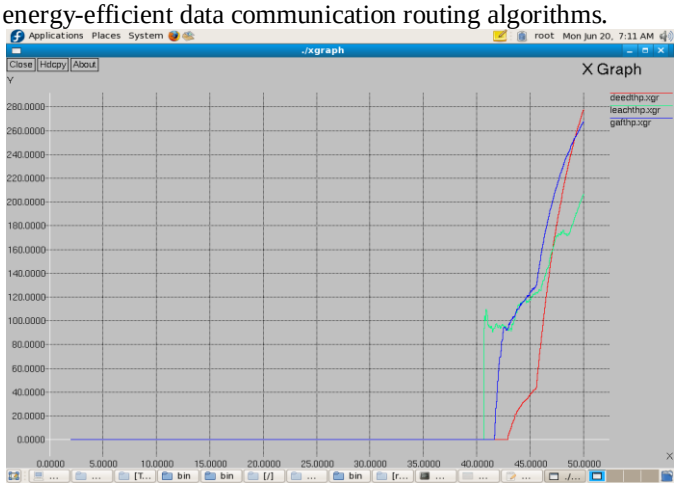

Figure 1:Throughput Vs Pause Time

C. Packet delivery fraction

Figure 2gives the packet delivery fraction for three energy efficient routing protocol i.e. low energy adaptive clustering hierarchy, geographic adaptive fidelity and distributed high energy-efficient data communication routing algorithms by varying pause time. Also Figure 2 shows it in graphical form. It is clear from that the packet delivery fraction for enhance light weight route optimization scheme are more than Liebsch's route optimization scheme & light weight route optimization scheme i.e. more packets are delivered successfully to the destination. If we compare the performance of two scheme Liebsch's route optimization & light weight route optimization, it is clear from the above data that packet delivery fraction for light weight route optimization scheme is slightly greater than scheme Liebsch's route optimization scheme.

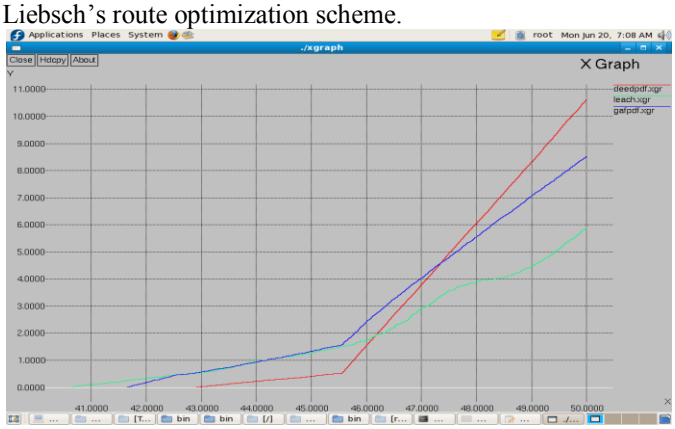

Figure 2: Fraction delivery vs paus time

D. End to end delay

Figure 3 gives the values of end to end delay for three energy efficient routing protocol i.e. low energy adaptive clustering hierarchy, geographic adaptive fidelity and distributed high energy-efficient data communication routing algorithms by varying pause time. And 3 shows it in graphical form. It is clear from the figure that end to end delay is lowest for the distributed high energy-efficient data communication routing protocol. The low energy adaptive clustering hierarchy is less then geographic adaptive fidelity energy efficient routing algorithm because less ro message are used.

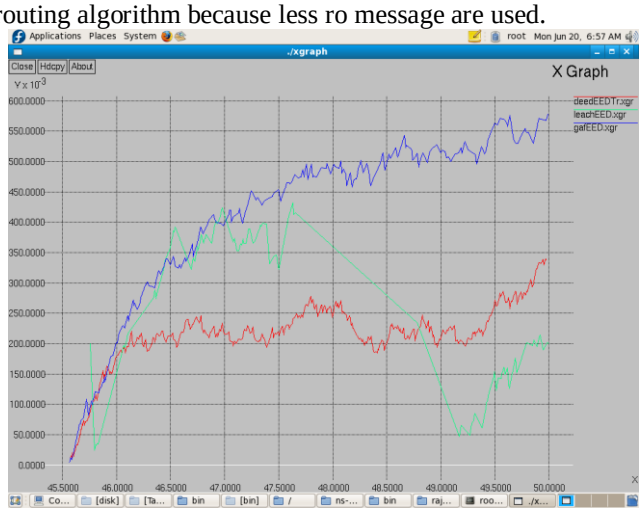

Figure 3:End to End Vs Pause Time

VI. CONCLUSION

Wireless sensor networks play a significant role in setting up the communication network at a take off without any fixed infrastructure most important them to be a potential candidate for handling defense and emergency applications. In this paper, studies the literature survey of efficient wireless sensor networks were studied. We have concentrated here on different energy efficient routing protocols like LEACH (low-energy adaptive clustering hierarchy), DEED (Distributed Energy Efficient Data Communication Protocol) and GAF (Geographic Adaptive fidelity protocols).Energy control and prolonging the whole networks lifetime continue to remain the biggest challenges faced by wireless sensor networks. So in all the protocols, the problem about energy consumption should be firstly considered. One of the most active areas of research in WSNs networks is design of an efficient energy strategy for prolonging the networks lifetime.

REFERENCES

[1] Yu Wang, "Study on Energy Conservation in MANET". IEEE Journal of Networks, Vol.5, No.6, J pp.708-715.une 2010.

[2] Pawan deepkaur, "Performance evaluation of Energy-aware routing algorithm for wireless sensor networks", International Journal Of Engineering And Computer Science, ISSN:2319-7242 ,Volume 4 Issue 4, Page No. 11507-11513, April 2015.

[3] Pankaj Kumar, Dr. N. C., "BarwarPerformance Evaluation of Distributed Energy Efficient Clustering Protocols in Wireless Sensor Networks" International Journal on Recent and Innovation Trends in Computing and Communication, Volume: 3 Issue: 12,pp. 6833 – 6838, December 2015.

[4] Deepak Simaiya Utkarsh Sharma ; Abhishek N. Tripathi, "Tenth International Conference on Wireless and Optical Communications Networks (WOCN) ",ISSN 1811-3923 ,pp.1-5, 26-28 July 2013.

[5] Hla Yin Min and Win Zaw,, "Performance evaluation of Energy efficient cluster based Routing protocol in Wireless sensor networks", International Journal of Computer Science Engineering (IJCSE), Vol. 3 No.02 ,pp.71-76,Mar 2014.

[6] Danyan Luo, Decheng Zuo and Xiaozong Yang, "An Energy-Saving Routing Protocols for WSNs". IEEE Conference on4th International Conference on Wireless Communications, Networking and Mobile Computing, pp.1-4,July 2008.

[7] Jean-Lien C. Wu (IEEE Member) & Shan-Te Wang, "Comparison of Power Schemes for Sink Nodes in WSNs". In IEEE International Conference on Advanced Information Networking and Application, 2004, pp.011-013.

[8] Chao Wang(IEEE Member), Halling Wang, XiangyuJia "The Studies on Energy Control of Protocols in Wireless Sensor Networks". IEEE, Jan 2006.

[9] His-Feng Lu, Yao-Chung Chang, Hasing-Hasien Hu and Jiann-Jiang Chen,"Power Efficient Scheduling Method in Sensor Networks". In IEEE International Conference on System, Man and Cybermetics,pp. 4705-4710, July 2004.

[10] Giuseppe Anastasi, Marco Conti , Mario Di Francesco, Andrea Passarella, "Energy Conservation in wireless sensor networks: A survey". Science Direct, 2009,pp. 535- 543.

[11] M. Babazadeh, I. Lal, W. Lang, "Energy Saving by using Floating Input Approach in a Wireless Sensor Network". IEEE, June 2009,pp. 595-599.

[12] Herman Sahota, Ratnesh Kumar, Ahmed Kamal, Jing Huang, "An Energ- Efficient Wireless Sensor Network fo Precision Agriculture". IEEE, 2010, pp.347-350.

[13] Nader F Mir, "Computer and communication Networks", PearsonEducation, 2007.

[14] Cauvery N. K., and K. V. Viswanatha, "Enhanced Ant Colony Based Algorithm for Routing in Mobile Ad Hoc Network", International Journal of Electrical, Computer, Energetic, Electronic and Communication Engineering Vol:2, No:10, 2008.

[15] Yao-Jung Wen and Alice M. Agogino, "Wireless Networked Lighting Systems for Optimizing Energy Savings and User Satisfaction". In IEEE Proceedings of Wireless Hive Networks Conference, Austin, Texas, USA, August 07-08, 2008.

[16] Rajnish Manwall et al., "Performance evaluation of energy saving in WSN by using simulator NS2", International Journal of Data & Network Security, Volume 1 No.1,pp.6-9, Aug, 2012.

[17] Amit Mangalekar,Suhas Mudgal,Sarjerao Masal, "Energy Efficient Routing Protocol in MANET Using NS-2", International Journal Of Core Engineering & Management (IJCEM) Volume 1, Issue 10, pp.163-175,January 2015

[18] Pankaj Kumar and Dr. N. C. Barwar. "Performance Evaluation of Distributed Energy Efficient Clustering Protocols in Wireless Sensor Networks", International Journal on Recent and Innovation Trends in Computing and Communication, Volume: 3 Issue: 12,pp 6833 – 6838,2015.

[19] Nishita Payar, Prof. Chandresh R. Parekh, " Ee-Leach(Low Energy Adaptive Clustering Hierarchy) Modified Protocol", Int. Journal of Engineering Research and Applications, Vol. 4, Issue (Version 7), pp.05-10, May 2014.

[20] Jyoti Kumari, Prachi, "An Energy Efficient Routing Algorithm for Wireless Body Area Network", I.J. Wireless and Microwave Technologies, 5, 56-62, 2015.

[21] Joni Birlaa and Basant Sah, "Energy Efficient Routing Protocols in Wireless Sensor Network", International Journal of Engineering, Science and Metallurgy, Vol.2, No.3, pp.676-680, 2012.

[22] Mark Stemm and Randy H. Katz. "Measuring and reducing energy consumption ofnetwork interfaces in hand-held devices". IEICE Transactions on

Communications, Special Issue on Mobile Computing.

[23] Tang, ShaoJie, et al. "DAWN: energy efficient data aggregation in WSN with mobile sinks." Quality ofService (IWQoS), 2010 18th International Workshopon. IEEE, 2010.

[24] J. Yick, B. Mukherjee and D. Ghosal, "Wireless sensor network survey", (2008), pp. 2292–2330 .

[25] Rahul Tiwari and Amit saxena, "A Review on Energy Efficient Routing in Wireless Sensor Networks", nternational Journal of Engineering Trends and Technology (IJETT) – Volume 19 Number 1,pp.29-34,Jan 2015.

