International Journal of Engineering Research & Technology (IJERT)
ISSN: 2278-0181
Vol. 7 Issue 02, February-2018

Implementation of Routing Protocols in Wireless Sensor Network-Comparative Study

Ms. Swati Balaram Wadkar
Dept of Electronics and Telecommunication Engineering,
VESIT, University of Mumbai, India

Mrs. Naveeta Kant
Dept of Electronics Engineering,
VESIT, University of Mumbai, India

Abstract: **A Wireless Sensor Network is composed of a large number of sensor nodes which are densely deployed either inside the network or very close to it. Since the sensor nodes are often inaccessible; the lifetime of a network depend on the battery powered of the nodes. NS2 is an open source event driven simulator designed specifically for research in computer communication networks. This paper presents various routing protocols and evaluates the performance using user friendly software NS2.**

Keywords*: Network lifecycle, Energy consumption, robustness, node mobility*

I. INTRODUCTION

Wireless Sensor Networks (WSNs) [3, 5] has emerged as research areas with a great effect on practical application developments. They permit fine grain observation of the ambient environment at an economical cost much lower than currently possible. In hostile environments where human participation may be too dangerous; sensor network may provide a robust service. Sensor network are designed to transmit data from an array of sensor nodes to a data repository on a server. The advances in the integration of micro-electro-mechanical system (MEMS), microprocessor and wireless communication technology have enabled the deployment on a large-scale. Wireless Sensor Network WSN [15] has potential to design many new applications for handling emergency, military and disaster relief operations that requires real time information for efficient coordination and planning. Sensors are devices that produce a measurable response to a change in a physical condition like temperature, humidity, pressure etc. WSNs may consist of many different types of sensors such as seismic, magnetic, thermal, visual, infrared, acoustic and radar, capable of monitoring a wide variety of ambient conditions. Though each individual sensor may have severe resource constraint in terms of energy, memory, communication and computation capabilities; large number of them may collectively monitor the physical world, disseminate information upon critical environmental events and process the information. Since a wireless sensor network [1-4] is a distributed real-time system, one needs to decide upon number of solutions from distributed and real-time systems that can be used in these new systems. Apart from few prior solutions, new solutions are necessary in all areas of the system because set of assumptions underlying previous work has changed dramatically. Most past distributed systems research has assumed that the systems are wired, have unlimited power, are not real-time, have user interfaces such as screens and mice, have a fixed set of resources, treat each node in the system as very important and are location independent. In contrast, for wireless sensor network, the systems are wireless, have scarce power, are real-time, utilize sensors and actuators as interfaces, have dynamically changing sets of resources, aggregate behaviour is important and location is critical. Many wireless sensor networks also utilize minimal capacity devices which places a further strain on the ability to use past solutions. Since WSN is usually exposed to atrocious and dynamic environments, it is possible for the loss of connectivity of individual nodes. Conventional centralized algorithms need to operate with global knowledge of the whole net work, and an error in transmission or a failure of a critical node will potentially cause a serious protocol failure. On the contrary, distributed algorithms are only executed locally within partial nodes, thus can prevent the failure caused by a single node. It is realized that localized algorithms are more scalable and robust than centralized algorithms.

II. BACKGROUND

In this section, the three algorithms namely, Geographic Random Forwarding (GeRaF),Low-Energy Adaptive Clustering Hierarchical (LEACH), Sequential Assignment Routing (SAR) are discussed and analyzed as follows.

III. GEOGRAPHIC RANDOM FORWARDING PROTOCOL (GERAF)

GeRaF was proposed by Zorzi and Rao [6], which uses geographic routing where a sensor acting as relay is not known a priori by a sender. There is no guarantee that a sender will always be able to forward the message toward its ultimate destination, that is, the sink. This is the reason that GeRaF is said to be best-effort forwarding. GeRaF assumes that all sensors are aware of their physical locations, as well as that of the sink. Although GeRaF integrates a geographical routing algorithm and an awake-sleep scheduling algorithm, the sensors are not required to keep track of the locations of their neighbors and their awake-sleep schedules. When a source sensor has sensed data to send to the sink, it first checks whether the channel is free in order to avoid collisions. If the channel remains idle for some period of time, the source sensor broadcasts a request-to-send (RTS) message to all of its active (or listening) neighbors. This message includes the location of the source and that of the sink. Note that the coverage area facing the sink, called forwarding area, is split into a set of Np regions of different priorities such that all points in a region with a higher priority are closer to the sink than any point in a region with a lower priority. When active neighboring sensors receive the RTS message, they assess their priorities based on their locations and that of the sink. The source sensor waits for a CTS message from one of the sensors located in the highest priority region. For GeRaF, the best relay sensor the one closest to the sink, thus making the largest advancement of

International Journal of Engineering Research & Technology (IJERT)
ISSN: 2278-0181
Vol. 7 Issue 02, February-2018

the data packet toward the sink. In case that the source does not receive the CTS message, implies that the highest priority region is empty. Hence, it sends out another RTS polling sensors in the second highest priority region. This process continues till the source receives the CTS message, which means that a relay sensor has been found. Then, the source sends its data packet to the selected relay sensor, which in turn replies back with an ACK message. The relay sensor will act in the same way as the source sensor in order to find the second relay sensor. The same procedure repeats until the sink receives the sensed data packet originated from the source sensor. It may happen that the sending sensor does not receive any CTS message after sending Np RTS messages. This means that the neighbors of the sending sensor are not active. In this case, the sending sensor backs off for some time and retries later. After a certain number of attempts, the sending sensor either finds a relay sensor or discards the data packet if the maximum allowed number of attempts is reached.

IV. LOW-ENERGY ADAPTIVE CLUSTERING HIERARCHICAL (LEACH)

LEACH [7, 8] is the first and most popular energy-efficient hierarchical clustering algorithm for WSNs that was proposed for reducing power consumption. In LEACH, the clustering task is rotated among the nodes, based on duration. Direct communication is used by each cluster head (CH) to forward the data to the base station (BS). It uses clusters to prolong the life of the wireless sensor network. LEACH is based on an aggregation (or fusion) technique that combines or aggregates the original data into a smaller size of data that carry only meaningful information to all individual sensors. LEACH divides the a network into several cluster of sensors, which are constructed by using localized coordination and control not only to reduce the amount of data that are transmitted to the sink, but also to make routing and data dissemination more scalable and robust. LEACH uses a randomize rotation of high-energy CH position rather than selecting in static manner, to give a chance to all sensors to act as CHs and avoid the battery depletion of an individual sensor and dieing quickly.

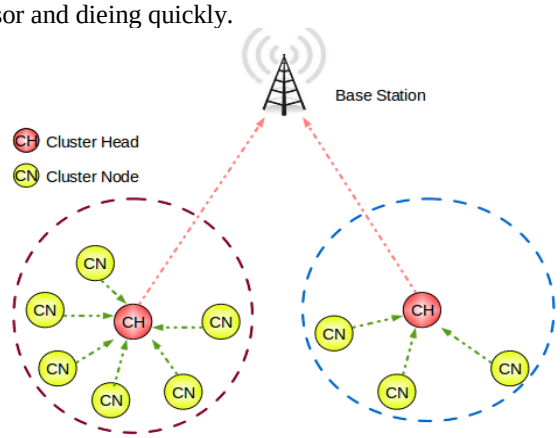

Fig.1. Clustering Process In LEACH Protocol

The operation of LEACH is divided into rounds having two phases each namely (i) a setup phase to organize the network into clusters, CH advertisement, and transmission schedule creation and (ii) a steady-state phase for data aggregation, compression, and transmission to the sink. LEACH is completely distributed and requires no global knowledge of network. It reduces energy consumption by (a) minimizing the communication cost between sensors an d their cluster heads and (b) turning off non-head nodes as much as possible [9]. LEACH uses single-hop routing where each node can transmit directly to the cluster-head and the sink.

V. SEQUENTIAL ASSIGNMENT ROUTING (SAR)

SAR [14] is one of the first routing protocols for WSNs that introduces the notion of QoS in the routing decisions. It is a table-driven multi-path approach striving to achieve energy efficiency and fault tolerance. Routing decision in SAR is dependent on three factors: energy resources, QoS on each path, and the priority level of each packet [10, 11, 12]. The SAR protocol creates trees rooted at one-hop neighbours of the sink by taking QoS metric, energy resource on each path and priority level of each packet into consideration. By using created trees, multiple paths from sink to sensors are formed. One of these paths is selected according to the energy resources and QoS on the path. Failure recovery is done by enforcing routing table consistency between upstream and downstream nodes on each path. Any local causes an automatic path restoration procedure locally. The objective of SAR algorithm is to minimize the average weighted QoS metric throughout the lifetime of the network. If topology changes due to node failures, a path re-computation is needed. As a preventive measure, a periodic re-computation of paths is triggered by the base-station to account for any changes in the topology. A handshake procedure based on a local path restoration scheme between neighboring nodes is used to recover from a failure. Failure recovery is done by enforcing routing table consistency between upstream and downstream nodes on each path. Simulation results showed that SAR offers less power consumption than the minimum-energy metric algorithm, which focuses only the energy consumption of each packet without considering its priority. Although, this ensures fault-tolerance and easy recovery, the protocol suffers from the overhead of maintaining the tables and states at each sensor node especially when the number of nodes is huge.

VI. SIMULATION RESULTS AND DISCUSSIONS

A. Simulation Environment

NS2 is written in the C++ programming language with the Object Tool Common Language (OTCL) as the front-end interpreter. A class of hierarchy supported in C++ is the compiled hierarchy and the interpreter hierarchy for OTCL. The complete simulations are carried out using Network Simulation NS2 [13].

B. Simulation Result And Discussion

The simulation took place with throughput (the total amount of data received), end to end delay, packet delivery ratio and total energy consumption considering 100 number of nodes for GeRaF, LEACH and SAR protocol. Fig 2 shows how transmission takes place in Network Animation Window (NAM).

.

International Journal of Engineering Research & Technology (IJERT)
ISSN: 2278-0181
Vol. 7 Issue 02, February-2018

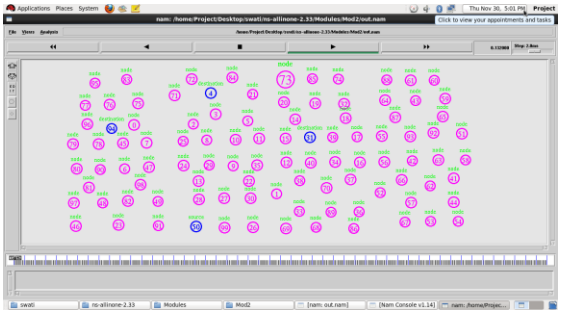

Fig.2. The Node plan

1) End to End Delay Comparison Of GeRaF, LEACH and SAR Protocol

End to end delay is also important for real time application. In order to get the real time data, the delay must be as low as possible. It is been observed that GeRaF protocol has moderate end to end delay but after certain period of time it gives the highest delay as compared to both the Protocols The result in Fig.3, verifies that SAR protocol have lower end to end delay with respect to simulation time than LEACH and SAR algorithm.

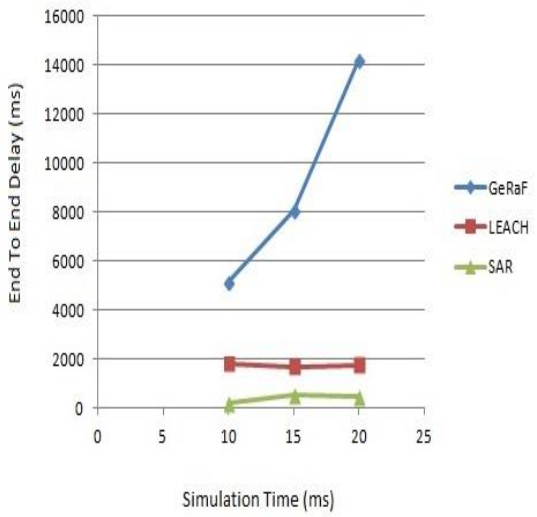

Fig.3. End To End Delay Comparison of GeRaF, LEACH and SAR

2) *Packet Delivery Ratio Comparison of GeRaf, LEACH and SAR Protocol*

Fig.4. shows the packet delivery ratio as the function of simulation time. The ratio of data packet delivered to the destinations to those generated by the CBR source is known as packet delivery ratio.

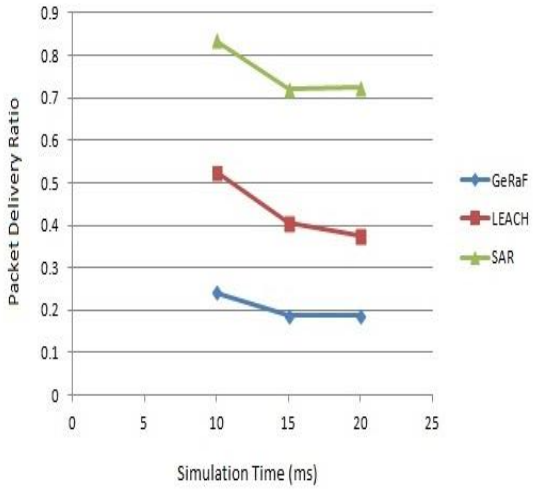

Fig.4. Packet Delivery Ratio Comparison Of GeRaF, LEACH And SAR Protocol

It is been observed that packet delivery ratio of GeRaF protocol is decreasing with respect to time unlike in both LEACH and SAR. But if we compare the amount of packets delivered to the sink in particular time interval, it the SAR protocol who has delivered maximum packets with respect to simulation time.The rate of increase of packets in GeRaF is much lower than SAR protocol. The sharp increase in the SAR protocol is due to, large number of duplicate packets received at the sink

3. Throughput Comparison Of GeRaF, LEACH and SAR Protocol

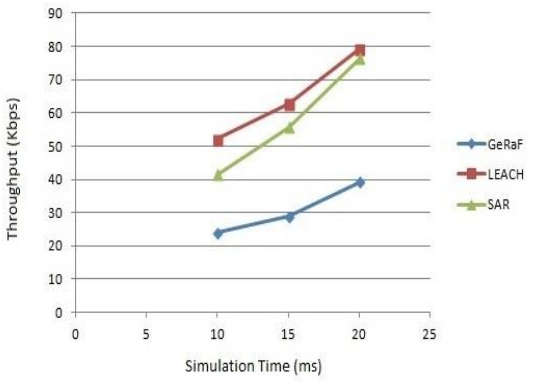

Fig.5. Throughput Comparison of GeRaF,LEACH and SAR Protocol

In order to monitor the performance of protocols, the amount of data received at the base station must be as much as possible. It is been observed that due to clustering process in LEACH protocol it gives the maximum throughput when time is 10ms and even observed after 15ms the throughput is much higher than both the protocols, hence the result of Fig.5., shows that LEACH protocol has much higher received the data in all numbers of sensor nodes with respect to simulation time. This means that LEACH protocol is better than GeRaF and SAR

.

International Journal of Engineering Research & Technology (IJERT)
ISSN: 2278-0181
Vol. 7 Issue 02, February-2018

4. Energy Consumption Comparison of GeRaF, LEACH and SAR Protocol

As sensor nodes are unrechargeable, total energy Consumption of sensor nodes is a considerable fact.

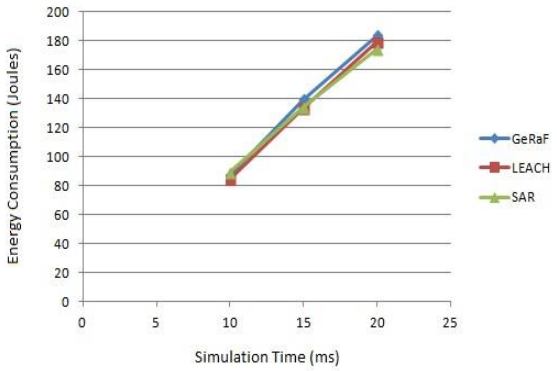

Fig.6. Energy Consumption Comparison Of GeRaF, LEACH and SAR Protocol

LEACH protocol is the cluster based routing protocol and its main advantage is extending network lifetime as much as possible. It is been observed that all the three protocol consume near about same energy but LEACH protocol saves the energy because of clustering process and hence the result of Fig.6, verifies that total energy consumption of LEACH protocol is lower than GeRaF and SAR algorithm.

VII.CONCLUSION

Routing protocol is one of the key technologies of WSN. In this paper, GeRaF, LEACH and SAR algorithm are comparatively studied and simulated by using NS2 software. As LEACH protocol is a cross layer protocol architecture that combines MAC with routing, the results are better than any other MAC design. The results are comparatively studied on four research parameters (packet delivery ratio, throughput, end to end delay and total energy consumption of sensor nodes) with 100 number of sensor nodes. All the results prove that LEACH and SAR protocol are more suitable than GeRaF algorithm. In future, as the energy consumption is important for prolonging network lifetime, reducing of total energy consumption must be research goals.

VIII.REFERENCES

[1] S.K. Singh, M.P. Singh, and D.K. Singh, "Energy-efficient Homogeneous Clustering Algorithm for Wireless Sensor Network", International Journal of Wireless & Mobile Networks (IJWMN), Aug. 2010, vol. 2, no. 3, pp. 49-61.

[2] Jun Zheng and Abbas Jamalipour, "Wireless Sensor Networks: A Networking Perspective", a book published by A John & Sons, Inc, and IEEEE, 2009.

[3] Akyildiz I, Su W Sankarasubramaniam Y et at "A Survey on Sensor Network. IEEE Communication Magazine", 2002, 40(8):102-114

[4] Jamal N. Al-Karaki, Ahmed E. Kamal," Routing Techniques in Wireless Sensor Networks: A Survey", IEEE Wireless Communications, Vol 11, pp. 6–28, December 2004

[5] H.Nakayama, N. Ansari, A. Jamalipour, Y. Nemoto, N. Kato, "On data gathering and security in wireless sensor networks", in :Sarnoff symposium, IEEE, 2007.

[6] M. Zorzi and R. R. Rao, "Geographic random forwarding (GeRaF) for ad hoc and sensor networks: Mutlihop performance", IEEE Transactions on mobile Computing, vol. 2, no. 4, Oct.-Dec. 2003, pp. 337-348.

[7] W.R. Heinzelman, A. Chandrakasan, and H. Balakrishnan, "Energy-efficient Communication Protocol for Wireless Microsensor Networks", in IEEE Computer Society Proceedings of the Thirty Third Hawaii International Conference on System Sciences (HICSS '00), Washington, DC, USA, Jan. 2000, vol. 8, pp. 8020.

[8] W.R. Heinzelman, A. Chandrakasan, and H. Balakrishnan, "An Application-Specific Protocol Architecture for Wireless Microsensor Networks" in IEEE Tmnsactions on Wireless Communications (October 2002), vol. 1(4), pp. 660-670.

[9] Lan Wang and Yang Xiao, "A Survey of Energy-Efficient Scheduling Mechanisms in Sensor Network".

[10] Jamal Al-Karaki, and Ahmed E. Kamal, "Routing Techniques in Wireless Sensor Networks: A Survey", IEEE Communications Magazine, vol 11, no. 6, Dec. 2004, pp. 6-28.

[11] Kemal Akkaya and Mohamed Younis, "A Survey on Routing Protocols for Wireless Sensor..

[12] T. He et al., "SPEED: A stateless protocol for real-time communication in sensor networks," in the Proceedings of International Conference on Distributed Computing Systems, Providence, RI, May 2003.

[13] Network Simulator 2(NS2) website. [Online]. Available:http://www.isis.edu/nsnam/ns

[14] I. F. Akyildiz, W. Su, Y.Sankarasubramaniam, and E. Cayirci, "Wireless sensor networks: a survey", Computer Networks (Elsevier) Journal, Vol. 38, no. 4, Mar. 2002, pp. 393-422

[15] Rajashree.V.Biradar, V.C.Patil , Dr. R. R. Mudholkar , Dr. S. R. Sawant , "Classification And Comparison Of Routing Protocols In Wireless Sensor Networks," Ubiquitous Computing and Communication Journal volume 4, pp.704-711, 2009."