Dogo Rangsang Research Journal
ISSN : 2347-7180
UGC Care Group I Journal
Vol-08 Issue-14 No. 01 February : 2021

A Review on Modified Teen Protocol to Improve the Network Lifetime of WSN

Mr.GYANA PRAKASH BHUYAN*, MR. BIJAY KUMAR SAHOO
Dept. OF Computer Science and Engineering, NIT , BBSR
gyanprakash@thenalanda.com*, bijaykumar@thenalanda.com

Abstract: *WSNs are used in environmental monitoring, security, medical applications, etc. The sensor nodes are usually randomly deployed in a specific region. These sensor nodes collect their data and send it to the Base Station (BS) via some routing protocol. These nodes cannot be recharged from time to time to keep them alive. They must follow a protocol which must ensure the efficient use of their power, so that those nodes may serve as long as possible without any external assistance. A routing technique plays a key role in their energy consumption. Many of the routing protocols use clustering as their routing technique. So clustering plays a very important role in prolonging the stability period and network life time. The Cluster Heads (CHs) collect the data from all the nodes in their cluster, aggregate it and then finally send it to the BS. These sensor nodes must follow a certain routing protocol to send their data efficiently to the BS. The main objective of all routing protocols is to minimize the energy consumption so that the network lifetime and particularly the stability period of the network may be enhanced. By network lifetime we mean the time duration from the start of the network till the death of the last node, whereas, stability period means the time duration from the start of the network till the death of the first node. This has object to develop an energy efficient increased lifetime threshold sensitive clustering algorithm by dynamic selection of cluster heads using multi-hops and multi-path, that leads to load balancing on different-different clusters. This results in the enhancement of cluster heads or normal nodes network lifetime and comparison of performance of the proposed protocol with TEEN. In this work we propose an energy efficient multipath routing algorithm in WSN. This protocol is designed to improve the latency, resiliency and efficiency through discovering multiple paths from the source to the destination.*

Keywords: *Teen protocol, WSN, energy-efficient, delay, network life time, Average energy*

I. INTRODUCTION

Advances in wireless communication made it possible to develop Wireless Sensor Networks. Wireless Sensor Networks, also abbreviated as WSN, are the new fast evolving technology that have been successfully utilized to perform the function of monitoring of the socio-economic areas, environmental conditions, in military applications, home applications and many more commercial applications. They consist of spatially distributed sensors which supervise physical or environmental conditions, such as temperature, sound, pressure, etc. The information collected by these sensors is then passed to the main location through their whole network by using the interaction amongst themselves. (Fig. 1).

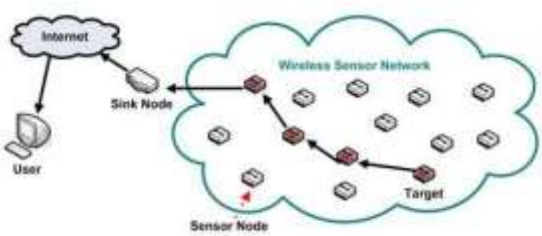

Fig. 1 Wireless Sensor Network [1]

These small sensing devices named sensors are also called nodes and consist of a sensing unit (for sensing the data and converting it into digital form), processing unit (for data processing and data storage), power unit (for energy) and transceiver unit (for receiving and sending signals or data from one node to another) (Fig. 2). There are also other subunits, which are application dependent. Most of the sensor network routing techniques and sensing tasks require a location finding system to have the knowledge of location with high accuracy. A mobilize may sometimes be needed to move sensor nodes when it is required to carry out the assigned tasks [2]. These nodes must [3]

- consume extremely low power,
- operate in high volumetric densities,
- have low production cost and be dispensable,
- be autonomous and operate unattended,
- be adaptive to the environment.

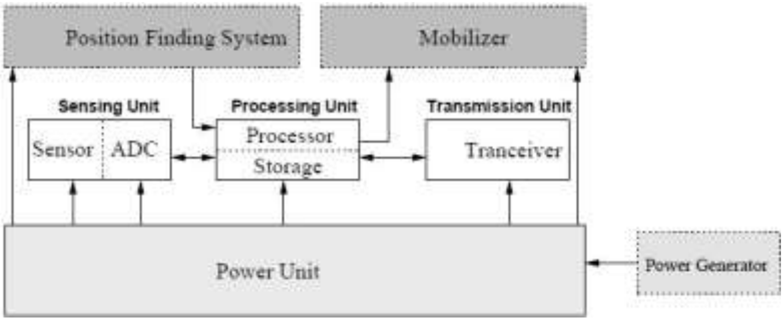

Fig. 2: The components of a sensor node [4]

Today, wireless sensor networks are widely used in the commercial and industrial areas. The employment of wireless sensor networks is increasing day by day but even after all the advancements it faces the problem of limited battery lifetime. And since each node depends on energy for its activities as it alone defines that for how long that node can play an active part in that network, it has become a major subject to deal with in wireless sensor networks. The energy is consumed by the sensing nodes either during the processing of the sensed data or during the communication amongst themselves or during idle-listening by the nodes. Now the energy consumed during the processing of data or during idle-listening cannot be reduced but the energy consumed during the communication in wireless sensor networks can be scaled down. The different ways which can be followed for the same are as follows [5]

- To schedule the states of the nodes (i.e. transmitting, receiving, idle or sleep).
- Changing the transmission range between the sensing nodes.
- Using efficient routing and data collecting methods.
- Avoiding the handling of unwanted data as in the case of overhearing.

Therefore, many researchers are trying to find the power- aware protocols and are also trying to implement the above stated ways in these protocols for the wireless sensor networks in order to overcome energy efficiency issues.

II. LITERATURE SURVEY

Despite the multitudinous applications of WSNs, these networks have several limitations, e.g., limited energy supply, and limited bandwidth available to each sensing node for communication etc. It has been noticed that one of the main design goals of WSNs has been to carry out data communication while trying to sustain the nodes for a longer period and also to prevent the connectivity abjection by employing belligerent energy management techniques. The design of routing protocols in WSNs hence faces many challenging factors. These factors must be overcome for efficient communication Wireless Sensor Networks.

Therefore, some of the routing protocols used in Wireless Sensor Networks can be studied. Routing in WSNs can be divided into

- Flat-based routing (all nodes hold the same functionality)
- Hierarchical-based routing (the whole network is divided into different levels with nodes in each level performing a different role)
- Location-based routing (the position of the nodes define their functionality)

2.1 Data-Centric Protocols

These were the first set of protocols defined which helped reduce redundancy. In data-centric routing, the sink or the base station sends queries to certain region nodes in a network and awaits the data from the sensor nodes in the selected regions where event occurred. Hence if this protocol is used then data is requested through queries. Many data-centric protocols have been proposed so far such as SPIN, Directed Diffusion etc. but only some have been described by the author below.

2.2 Sensor Protocols for Information via Negotiation (SPIN): It was the first data-centric protocol [6] which was proposed to eliminate redundant data by taking the advantage of the data negotiation between the nodes which thereafter helped reduce the energy consumption. These protocols make use of the property that nodes in propinquity have alike data, and hence there is a need to distribute only the data that other nodes do not posses. It includes a process of exchange of three messages

- ADV message
- REQ message
- DATA message

2.3 Directed Diffusion: Later another data-centric protocol, Directed Diffusion [7] was developed which become a breakthrough in data-centric routing. This was because thereafter many other protocols were proposed which either were based on Directed Diffusion or followed the similar concept. The idea behind this protocol was to eliminate redundancy by diffusing data coming from different sensor nodes which also helped in the minimization of the number of transmissions, hence saving the energy and prolonging the network lifetime. This protocol consists of three phases

- Interest Propagation
- Initial Gradients Setup
- Data Delivery

2.4 Energy Aware Routing: This data-centric protocol [8] was proposed to provide a set of optimal paths rather than just one optimal path. This set of paths is chosen by means of probability whose value depends upon the energy consumption of each path. This protocol consists of three phases

a) Setup Phase
b) Data Communication Phase
c) Route Maintenance Phase

2.5 COUGAR: Another data-centric protocol called COUGAR [9] views the network as a huge distributed database system. The key idea is to use declarative queries in order to abstract query processing from the network layer functions such as selection of relevant sensors and so on. COUGAR utilizes in-network data aggregation to obtain more energy savings.

2.6 Location-based Protocols

In this kind of routing, sensor nodes are addressed by means of their locations. The distance between neighbouring nodes can be estimated by using the location information thus helping in estimating the amount of energy consumption by the sensor nodes. In these protocols, the location information is utilized in routing data instead of the addressing scheme for sensor networks like IP-addresses. Relative coordinates of neighbouring nodes can be obtained by exchanging such information between neighbours. Alternatively, the location of nodes may be available directly by communicating with a satellite, using GPS (Global Positioning System), if nodes are equipped with a small low power GPS receiver. To save energy, some location based schemes demand that nodes should go to sleep if there is no activity. More energy savings can be obtained by having as many sleeping nodes in the network as possible. The problem of designing sleep period schedules for each node in a localized manner was addressed in [10]. Some of the location-based protocols are MECN and SMECN, GAF, GEAR etc.

2.7 Hierarchical Protocols

The optimal number of cluster heads in a network in one round is estimated to be around 5% of the total number of nodes.

The sink calculates a threshold value using the following equation

A single-tier network is not scalable for a larger set of sensors as it caused the gateway to overload. As a result, the concept of hierarchical routing was introduced. It allowed energy-efficient routing in the networks. The hierarchical architecture basically meant to form a two-layer network where the one layer consisted of the cluster head and the other layer consisted of the similar sensor nodes but they were considered to have lower energy as compared to that of the cluster head. The second layer basically involved routing. The higher energy nodes are used to process and send the information. The creation of clusters and assigning special tasks to cluster heads greatly contributes to the overall system's scalability, lifetime, and energy efficiency. The few hierarchical protocols have been discussed below.

2.7.1 Power-Efficient Gathering in Sensor Information Systems: It is an improvement of the TEEN protocol and is a near optimal chain-based protocol [11]. In TEEN protocol all the nodes had to send the data gathered to the cluster head irrespective of their distance from the cluster head, hence leading to the wastage of large amount of power because as the distance increases, the amount of power required to transmit data also increases. Hence rather than forming multiple clusters as in TEEN protocol, PEGASIS forms chains among all the sensor nodes in the network such that each node receives the data from a neighbour, aggregates that data with its own data which it has to transmit and forwards it to its next immediate neighbour. Also only one node is selected in that whole chain depending upon its proximity to the sink and its own power which transmits the whole aggregated data to the base station (sink).

2.7.2 Threshold-sensitive Energy Efficient Protocols (LEACH, TEEN and APTEEN): Two hierarchical routing protocols called TEEN (Threshold-sensitive Energy Efficient sensor Network protocol), and APTEEN (Adaptive Periodic Threshold-sensitive Energy Efficient sensor Network protocol) are proposed in [12] and [13], respectively. These protocols were basically designed in such a way that they were reactive enough to sudden changes in the sensed attributes such as temperature. And since responsiveness is important for time-critical applications, this protocol was used for all applications which are solely dependent upon time.

2.7.3 Low-Energy Adaptive Clustering Hierarchy (LEACH and TEEN): TEEN and LEACH are two of the most popular hierarchical routing algorithms for sensor networks [14]. It assigns a few sensor nodes the job of cluster heads (CHs) where this selection is based on the received signal strength and rotates this role to evenly distribute the energy load among the other sensors in the network. The idea is to form clusters of the sensor nodes and use the local cluster heads as routers to the sink. This saves energy since the transmissions is done by such cluster heads rather than all the sensor nodes.

Where p is the desired percentage of cluster heads
r is the current round
G is the set of nodes that have not been cluster heads in the last 1/p rounds
Now the sensor nodes with a value greater than this threshold value are chosen as the cluster heads while the rest become the sensor nodes in the cluster. The operation of TEEN is separated into two phases
Setup Phase: In this phase, cluster heads are selected and clusters are formed. Once cluster heads are selected, they transmit ADV message to all the sensor nodes around. Depending upon the signal strength of this message, the non cluster head sensor nodes confirm their cluster head hence forming the clusters.
Steady State Phase: Once the clusters are formed, the actual data transfer takes place in this phase.

With the advancement in technology, various efforts have been put to evolve better results from TEEN protocol. In improved-TEEN (I-TEEN) [15], both the residual energy of the node and its distance from the base station (also called sink) are used as the parameters for the cluster head selection. For the same, the procedure is carried out by dividing the network equally into four quadrants. If the node lies in the same quadrant as that of the base station, then residual energy is given more weightage than the distance. If the node lies in the quadrant diagonally opposite to the quadrant of base station, then distance is given more weightage. But if the node lies in the other left two quadrants, then both are given equal weightage and the resulting selection is done on the basis of the threshold value chosen. I-TEEN outperforms TEEN in terms of network lifetime, amount of data transferred to base station and the energy consumed.
Energy efficient optimized TEEN-C [16], provides an improved energy consumption model. TEEN-C (TEEN Centralized) is a kind of improved TEEN in which before the set-up phase starts, the local information and the residual energy value of all the nodes of the network are sent to the base station. In this paper, authors have based the threshold value on the estimated largest energy consumption value for a single cluster head. Optimized TEEN-C involves selecting a group of cluster heads using TEEN-C following which a model of cluster head energy consumption is created by considering the retransmission and acknowledgment.

In TEEN-R [17], a relay node is used to diminish the gain in energy and thereby prolonging the network lifetime. The relay node selection is based on both the residual energy and the distance to base station, as using these two parameters, the relaying node is chosen from the list of decided cluster heads which relays all the data from the other cluster heads to the base station. TEEN-R on simulation proves that it is more energy efficient as compared to the TEEN protocol.

In the proposed optimal energy adaptive algorithm [18], the TEEN's random cluster head election protocol is modified to ensure balanced energy dissipation over the entire network. The proposed algorithm involves modified duty cycle for the sensor nodes and to ensure the same, MANET approach is optimized through sleep wake-up based decentralized MAC protocol. Battery health condition of the nodes has been taken up as a parameter in the cluster head selection, hence increasing the network lifetime. Results show that the proposed algorithm outperforms TEEN by around 30%.

III. PROPOSED ENHANCED TEEN PROTOCOL TEEN

protocol basically involves the rotation of the high- energy cluster-head position among all the sensor nodes of the wireless sensor network so as to not allow the drainage of the battery of a single sensor node. Once all the cluster heads are chosen and clusters are formed, each cluster-head forms a MANET schedule for the nodes in its cluster, hence allowing the non-cluster-head node to remain inactive at all times except during its transmit time, thereby minimizing the energy dissipation of non cluster head sensor nodes in each cluster. Upon receiving the data from all the nodes contained in the cluster, the cluster-head node aggregates the data and transmits the aggregated data to the sink. However, advancement in technology demanded variations in the basic TEEN protocol for the improved energy consumption which lead to the development of new protocol framework or improvements in the existing one. One such variation has been done in the TEEN protocol in which the MANET schedule which is created by the cluster heads in every round which indicate the fashion in which the non cluster head sensor nodes will sense and transmit the information to the cluster head, is made dependent upon the distance of the cluster head from these non cluster head nodes within the cluster. Depending upon the signal strength received by the cluster head during the cluster formation phase, the cluster head forms the defined schedule. The cluster member nodes at a larger distance are provided less number of time slots as compared to the nodes at a smaller distance hence helping in reducing the amount of energy dissipation in the member nodes. Also a modified sleep-wake up based duty cycle is used for the cluster member nodes during intra-cluster communication period which further help in reducing the energy consumption. However, sometimes in event-driven networks, there is a possibility that the sensor nodes at a larger distance from the cluster head may hold more amount of data which is to be sent to their respective cluster heads. But due to the less number of slots allotted to those nodes, this setup may lead to the delay of data. So this drawback needs to be addressed. However, MANET schedule for the event-driven networks can be made dependent upon the traffic demand which can allow the networks with TEEN protocol be used in event based situations.

IV. CONCLUSION AND FUTURE SCOPE

While designing protocol architectures for WSN, it is very important to consider the severe energy constraints of the sensor nodes, the delay of the network, data aggregation and constraints of wireless channel. These features are taken into account in TEEN to some extent, where the amount of data transmitted is reduced by data aggregation at the cluster- head, energy saving is done by introducing multipath and multihop in existing wsn. Since each cluster-head in TEEN assigns equal number of slots to all its member nodes, it could lead to delay of the whole network during event driven situations. Various approaches can be adopted to overcome this problem of delay and can be considered as future work. However, in this paper an approach based on the traffic demand is proposed.

REFERENCES

[1]. http://monet.postech.ac.kr/research.html
[2]. I.F. Akyildiz, W. Su*, Y. Sankarasubramaniam, E. Cayirci, "Wireless sensor networks: a survey", Computer Networks: The International Journal of Computer and Telecommunications Networking,
[3]. Volume 38 Issue 4, 2002, pp. 393-422
[4]. J.M. Kahn, R.H. Katz, K.S.J. Pister, "Next century challenges: mobile networking for smart dust", Proceedings of the ACM MobiCom'99,
[5]. Washington, USA, 1999, pp. 271–278
[6]. M.A. Matin and M.M. Islam (2012). Overview of Wireless Sensor Network, Wireless Sensor Networks -Technology and Protocols, Dr. Mohammad Matin (Ed.), ISBN: 978-953-51-0735- 4, InTech, DOI: 10.5772/49376. Available from: http://www.intechopen.com/books/wireless-sensor- networks-technology-and-protocols/overview-of- wireless-sensor-network
[7]. V. Raghunathan, C. Schurgers, S. Park, and M. B. Srivastava, "Energy-Aware Wireless Microsensor Networks", IEEE Signal Processing Magazine, 19 (2002), pp. 40-50
[8]. W. Heinzelman, J. Kulik, and H. Balakrishnan, "Adaptive protocols for information dissemination in wireless sensor networks," Proceedings of the 5th Annual ACM/IEEE International Conference on Mobile Computing and Networking (MobiCom'99), Seattle, WA, August 1999.
[9]. C. Intanagonwiwat, R. Govindan, D. Estrin, "Directed diffusion: a scalable and robust communication paradigm for sensor networks", Proceedings of the ACM Mobi-Com'00, Boston, MA, 2000, pp. 56–67
[10]. R. Shah and J. Rabaey, "Energy Aware Routing for Low Energy Ad Hoc Sensor Networks", Proceedings of the IEEE Wireless Communications and Networking Conference (WCNC), Orlando, FL, March 2002.
[11]. Y. Yao and J. Gehrke, "The cougar approach to in- network query processing in sensor networks," in SIGMOD Record, September 2002.
[12]. Jamal N. Al-Karaki and Ahmed E. Kamal, "Routing
[13]. Techniques in Wireless Sensor Networks: A Survey", Journal of IEEE Wireless Communications, Volume: 11, Issue: 6, pp. 6 – 28, 2004
[14]. S. Lindsey, C. Raghavendra, "PEGASIS: Power- Efficient Gathering in Sensor Information Systems", IEEE Aerospace Conference Proceedings, 2002, Vol. 3, 9-16 pp. 1125-1130.
[15]. A. Manjeshwar and D. P. Agarwal, "TEEN: a routing protocol for enhanced efficiency in wireless sensor networks," In 1st International Workshop on Parallel and Distributed Computing Issues in Wireless Networks and Mobile Computing, April 2001.
[16]. A. Manjeshwar and D. P. Agarwal, "APTEEN: A hybrid protocol for efficient routing and comprehensive information retrieval in wireless sensor networks," Parallel and Distributed Processing Symposium., Proceedings International, IPDPS 2002, pp. 195-202.
[17]. W. Heinzelman, A. Chandrakasan and H. Balakrishnan, "Energy-Efficient Communication Protocol for Wireless Micro-sensor Networks," Proceedings of the 33rd Hawaii International Conference on System Sciences (HICSS '00), January 2000.
[18]. S.H. Gajjar, K.S. Dasgupta, S.N. Pradhan, K.M. Vala, "Lifetime improvement of TEEN protocol for Wireless Sensor Network", Nirma University International Conference on Engineering, pp. 1-6, 2012
[19]. Shuo Shi, Xinning Liu, Xuemai Gu, "An energy- efficiency Optimized TEEN-C for wireless sensor networks", International ICST Conference on Communications and Networking in China, pp. 487- 492, 2012
[20]. H.Srikanth.Kamath, "Energy Efficient Routing Protocol for Wireless Sensor Networks", International Journal of Advanced Computer Research, Volume 3, Issue 10, pp. 95-100, 2013
[21]. Ritwik Banerjee, Chandan Kr. Bhattacharyya, "Energy Efficient Optimization in the TEEN Architecture", International Conference on Microelectronics, Communication and Renewable Energy, pp. 1-6, 2013

