

Wireless Sensor Networks of PEGASIS-Based Communication Protocol Classification in Environmental Monitoring



K. ArunKumar, J.Karthikeyan

Abstract: A comparative research includes a protocol comparison based on certain parameters of performance. It allows researchers to gain insight into the different appropriate parameters with the protocols which ultimately lead to further advancement in the field. In the wireless sensor networks sector, improvements are taking place day after day. PEGASIS is a bond-oriented protocol for WSN routing. Some significant protocols based on PEGASIS architecture are studied in this document; PEGASIS, EEPB, IEEPB, PDCH, PEG-Ant, PEGASIS-PBCA, PEGASIS-IBCA, MH-PEGASIS, Multi-bond PEGASIS and Modified-PEGASIS are explored and comparison is made based on parameters that are essential to consider when selecting methodology for a specific implementation of WSNs.

Keywords : PEGASIS ; networks of wireless sensors ; TOKEN ; chain formation ; node of the leader ; data transmission.

I. INTRODUCTION:

Wireless Sensor is a small electronic device with unique sensing capacities that are powered by batteries. They shape Wireless Sensor Network (WSN) when these sensors are deployed in any region for a particular implementation. WSNs are currently commonly used. Significant areas of application include environmental monitoring (temperature, humidity, pressure, pollutants, direction and wind speed), traffic monitoring, air traffic control, medical device monitoring, video surveillance, industrial automation, structural health monitoring, defense (border area monitoring, detection of intrusion, explosive detection, tracking), Agriculture (monitoring of soil heat) etc.[11, 12, 13, 14].Most of the network's sensor energy is consumed by data transmission. So how information is transferred from one node to another in the network is essential to extend the life of the network for balanced energy consumption. Two significant architectures for WSNs are the cluster based and chain based routing.

In 2002, PEGASIS[2] proposed a number of other enhanced protocols based on it, such as EEPB[3], IEEPB[4], PDCH[5], PEG-ANT[6], PEGASIS/PBCA[7], PEGASIS-IBCA[8], MH-PEGASIS[9],Multi-bond PEGASIS[10] and Modified-PEGASIS[11].Great wait at the time due to token-based information gathering, elevated probability of long loops

being created due to greedy strategy, few high restrictions with PEGASIS architecture are poor load excess and the problem of long links. So later suggested, enhanced protocols attempted to overcome some of the above-mentioned PEGASIS constraints. As EEPB[3] prevents the development of lengthy link connections, IEEPB[4] increases the guide selection method and enables users to choose energy and range priorities. In the choice of the leader link, they are considered as parameters. PDCH[5] utilizes primary CH to collect bond and secondary CH information in order to transfer information to base station. PEG-Ant[6] utilizes optimization of Colony Ant to construct bonds that outperform PEGASIS's greedy strategy and balances the energy consumption of each node. PBCA and IBCA-based PEGASIS[7]-[8] enables Some links only involve servers in efficient shape to enter the meditation and connection building technique. MH-PEGASIS[9] is a hybrid loop and stack forming a one unit within a cluster accompanied by the transmission of its data to use a multi-hop technique of base station. Modified-PEGASIS[11] increases PEGASIS ' handle handling capacities by taking into account the remaining power, link level and base station range to pick the chief link in each round.

II. PEGASIS: BASIC PROTOCOL OF ARCHITECHTURE

PEGASIS[2] Is a hierarchical routing mechanism depending on a wireless sensor network connection. This algorithm contains some assumption:

- The base station (BS) is static from the nodes at a range. The strength of the original link is equal.
- Link is aware of the global positioning of detectors.

In three steps, that is, this algorithm operates. Establishment of the chain, election of the leader node and transmission of information.

Revised Manuscript Received on November 30, 2019.

* Correspondence Author

K. ArunKumar*, Scholar in School of Information Technology in VIT University Vellore , TamilNadu, India.

J.Karthikeyan, Assistant Professor in School of Information Technology and Engineering in VIT University,Vellore , TamilNadu, India

© The Authors. Published by Blue Eyes Intelligence Engineering and Sciences Publication (BEIESP). This is an [open access](https://creativecommons.org/licenses/by-nc-nd/4.0/) article under the CC-BY-NC-ND license <http://creativecommons.org/licenses/by-nc-nd/4.0/>.

A. Establishment of the chain

The technique of chain construction is close and begin with the connection that is ultimate from the base station Then joined link selects next link to be added into the bond by choosing next bystander based on the adjacent nodes ' wave intensity'. The links that are already connected to bond can't be visit again, i.e. bond are not permitted to be branched. This method proceeds until the last link in the bond is added. This stage creates a single bond composed of all the links of the network.

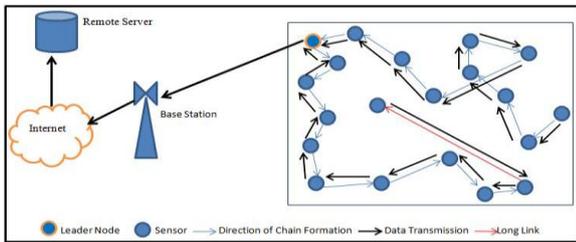


Figure.1. Wireless Sensor Network Illustration with PEGASIS without connecting bonds (not more than two link degrees.)

B. Selection of the Leader link

Initially, irregular link is choosing the leader. The leader link will be in the irregular place of the bond, which is essential for link death at irregular place, which helps to make the detector network strong. During bond organization, some detectors may have comparatively remote neighbors along the chain forcing these links to diffuse comparatively more strength in each round compared to other links. Thus, when selecting the leader links, a bystander distance limit is taken into consideration. If a link dies, the bond is restored and the beginning can be changed to define the link of the guide. In each circular, a fresh leader is chosen to the equal weight of strength consumption in the interface.

C. Data forwarding

The data collection and fusion begins later to choose the leader link. Similar route is implemented to gather information. Leader link is passing through the similar end node along the chain. Next the similar link has been collected, and it passes similar information along the chain to its next link. This method goes on until the information is received by the ruler. Fusing information from the bystander with the own fuses data at every medium link and creates a one package of the similar length. The subsequent package of information is transferred to the base station by the last leader link. Data transmission occurs in the case of bonds with leader link at the starting of the bond as shown in figure.2. N1 is at the beginning of the bond in this leader link. N1 passes TOKEN (small control packet) through the bond to the end link N7. Link N7 passes the data after receiving TOKEN and TOKEN to its later link in the bond i.e. N6. Link N6 on gathering information pack and TOKEN from link N7, fuses information with the parcel obtained and convey it to the next point, i.e. N5.

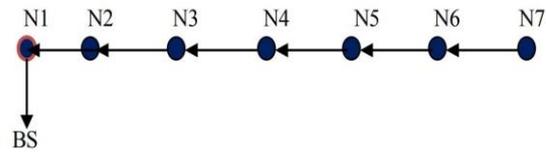


Figure.2. Data forwarding illustration (TOKEN passing) in bond at the beginning of the bond with the leader.

N5 transmits the package to N4, N4 to N3, N3 to N2, and N2 to N1 in the same way. At last, Leader link N1 on received package from N2 fuses the received package with its own sensed information and then it sends to the base station. In this situation the guide connection is at long bond link, data forwarding takes place as shown in figure.3. The leader link here is N4. As the creator doesn't mention any right way requirements in[1]. This is because the leader will convey information packages to the base station only when it gets streams of both the N3 and N5 neighbors. So, N4 is passing TOKEN either one or two of the end links, i.e. N1 and N7.

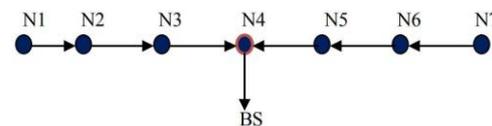


Figure.3. Any intermediate node is an illustration of information forwarding (TOKEN passing) in the leader bond.

Let N4 first pass TOKEN to N1. N1 transmits felt information after obtaining TOKEN and TOKEN to the N2 link after the bond. N2 fuses its own information with the obtained set information and then it passes the N3 together with TOKEN and then N3 to N4. Similarly, N4 moves TOKEN to the bonds other end link, i.e. N7. Now, N7 transmits information to TOKEN and N6, N6 fuses with its own sense information and transmits to N5, together with TOKEN, to N5 and N4. N4 fuses got information with its own sensed information after obtaining information from N3 and N5, and then transmitted it to the base station. In this manner we can see that a link forwards one information package in each round irrespective of the leading link position, chain length or any other factor.

III. PEGASIS BASED PROTOCOLS ANALOGIZE

Most PEGASIS-placed protocols operate in three phases including bond creation, leadership selection, and forwarding of information. In the forming of the bond, some protocols vary. Certain protocols such as PEGASIS[2], PEG-Ant[6], PEGASIS-PBCA[7], PEGASIS-IBCA[8] and MH-PEGASIS[9] shape the bond as shown in figure 1.1 whereas EEPB, IIEPB, Multi-bond PEGASIS and Modified-PEGASIS form connecting bonds as shown in figure.4.

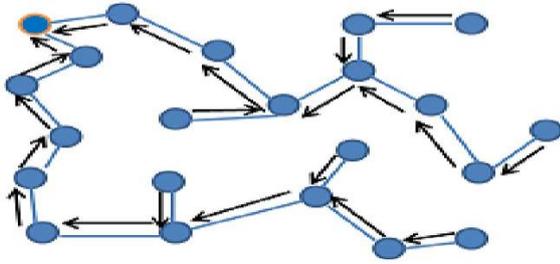


Figure.4: Bonds formation and information transmission illustration in bonds with branched bonds.

PDHC[5] requires a layered approach and forms a only one branching bond on each zone as shown in figure.5 and Multi-bond PEGASIS includes the development of the four

bonds[10]. Few protocols permit crossed bonds, while others cannot do. Among these protocols, the choice of leaders varies slightly. The fundamental PEGASIS irregular and periodically depending on sensor range from base station selects the Leader link. EEPB chooses the leader by taking node remaining energy and distance from base station into consideration. IEEPB[4] select the Leader by designing total load for every connection based on intensity and variety as:

TABLE I. PEGASIS BASED PROTOCOLS CLASSIFICATION

Parameter	Modified	PEGASIS	EEPB	IEEPB	PDHC	PEG-ANT	PEGASISP BCA	PEGASISI BCA	MHPEGASIS	Multi-Chain
Long Links Evitement	good	None	None	Good	None	Good	None	None	None	None
Modified	Irregular	Irregular	Irregular	Irregular	Irregular	Irregular	Irregular	Irregular	Irregular	Irregular
Classification	Chain Based	Bond Based	Bond Based	Bond Based	Bond Based	Bond Based	Bond Based	Bond Based	Bond + group	Bond Based
Number of trans actions	Only one	Only one	Only one	Only one	One chain at all level	Only one	Only one	Only one	Only one chain for each cluster	4
CH number per chain	1	1	1	1	2	1	1	1	1	2
Data transfer to BS	Node of the Round Leader	The Round Leader link	The Round Leader link	The Round Leader link	Secondary CH	The Round Leader link	The Round Leader link	The Round Leader link	Multi-hop routing CHs	Depending on the situation, primary and secondary CHs
Mobility of BS	No Mobility	No Versatility	No Versatility	No Versatility	No Versatility	No Versatility	No Versatility	No Versatility	No Versatility	Fine with a solid path
Next chain node selection (Chain Formation)	Nearest distance-based neighbor is permitted to connect to the already visited node	Nearest Signal Strength neighbor	Distance Threshold with Constant alpha specified by the user	Nearest distance-based neighbor	Established on EEPB	The staying strength of the neighboring link, strength consumed, pheromone amount	Only working links establish on PEGASIS	Only working link establish on PEGASIS	In-group PEGASIS	PEGASIS established on individual chains
Selection of CH	Weight based on certain strength, link level and distant from Base station	Based on BS distance	Link and gap residual energy from Base station	Established on the calculating weight using residual energy and BS distance	Degree of node and energy	Node Energy	Only Active Nodes based on PEGASIS	Only Active Nodes based on PEGASIS	Established on PEGASIS	Established on the calculating weight using certain strength and BS distant
Postponement	wide	Highly big	Highly big	Highly big	Average	Highly big	Wide	Wide	Wide	Medium
Energy Efficiency	wide	Low	Average	Average	Average	Average	Wide	Wide	Average	Wide
Charge Balancing	Average	below	Below	Average	Average	Wide	Below	Below	Below	Below
QoS	None	None	None	None	None	None	None	None	None	None

QueryEstablished	None	None	None	None	None	None	None	None	None	None
Detector types	Homogeneous	Homogeneous	Homogeneous	Homogeneous	Homogeneous	Homogeneous	Homogeneous	Homogeneous	Homogeneous	Homogeneous
Protocol type	Active Role	Active Role	Active Role	Active Role	Active Role	Active Role	Active Role	Active Role	Active Role	Active Role
Algorithmic Approach	Close	Close	Close	Close	Close	ACO	Close	Close	Close	Close
Chains of the branch	No	No	Yes	Yes	Yes	No	No	No	No	Yes
Connectivity of nodes (Degree)	1, 2 or better	One or two	1,2or better	Close	1, 2or better	1	1	1	1	1, 2 or better
Chain data transmission	Token Based	Token Based	Token Based	Token Based	Token Based	Token Based	Token Based	Token Based	Token Based	Token Based

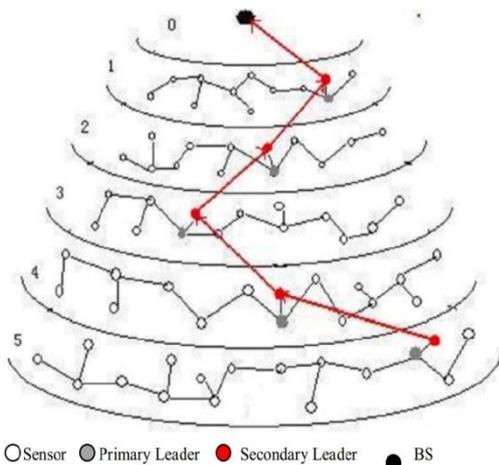


Figure.5. Selection of dual leaders and transmission of information in PDHC[4]

$$W_i = w_1 E_p + w_2 D_{BS}$$

Where

$$w_1 + w_2 = 1$$

$$D_{BS} = d_{4toBS} / d_{4avg}$$

Where, the median distance between nodes and BS is David.

$$E_p = E_{initial} / E_{residual}$$

Comparison of weights calculated for all links and Leader for this round is the minimum weight link [3].

PDHC[4] chooses two initial and lower leaders per bond in every round. Considering the level of linkage and the modern force, the initial leader is selected from the main bond while the secondary leader is selected from connected sections connected to the initial boss connection depending on the range from the base station. While the initial leader gets information from the initial bonds and fuses it, the derived leader transfers this information to the base station is as shown in figure.5.

PEG-Ant is as similar as fundamental PEGASIS except that it appeals more effective than close ACO approach to bond development. Leader link [6] becomes the node with maximum present strength. PEGASIS based on PBCA and IBCA selects a Leader link comparable to fundamental PEGASIS. MH-PEGASIS utilizes PEGASIS to communicate intra-group and the multi-hop approaches to intra-group communication and send information to the base station. Modified-PEGASIS enables various links and selects the leader established on the designing weight as:

$$W_i = Energy_i / \text{staying}(\text{DistanceToBS}_i * \text{NodeDegree}_i)$$

The highest W node will be chosen as the Leader link. Creator in [11] said that this is 50% more balanced weight than PEGASIS because links with a wide range of connection and a greater distance to base station have less random of becoming a leader.

Routing protocol select a specific implementation relies on the application's demands. For instance, if the uses are liberally delay then PEGASIS routing construction will be implemented otherwise, few real-time protocol architecture is required to keep the results precision. In the above table, comparative protocol comparison is made on the basis of certain important parameters that are essential for evaluating the relative superiority of protocols.

IV. CONCLUSION

Maximum protocols established on PEGASIS are suffering from the issue of big time delay in packet transmission. They are therefore not appropriate for real-time apps in the present form. Other issues are greedy chain formation strategy and bad capacity for weight balance. IEEPB, PEG-Ant and Modified- PEGASIS prevent lengthy link connections, but this capacity is lacking in other comparative protocols. All protocols are proactive and there is a need for more jobs to render them appropriate for defensive uses. They also lack service quality. However, these protocols are somewhat effective in terms of resistance, but there is a need for more research to decrease the period limit, to improve weighting ability and performance of delivery.

BIBLIOGRAPHY

1. Akkaya, Kemal, and Mohamed Younis. "A survey on routing protocols for wireless sensor networks." *Ad hoc networks* 3.3(2005): 325-349.
2. S. Lindsey, and C. Raghavendra, "PEGASIS : Power-efficient gathering in sensor information systems," *IEEE Aerospace Conference Proceedings*, 2002, pp.1125-1130.
3. YU Yong-chang, WEI Gang, "An Improved PEGASIS Algorithm in Wireless Sensor Network," *Acta Electronica Sinica*, vol.36, pp.1309-1313, July 2008.
4. Feng Sen, Qi Bing and Tang Liangrui, "An Improved Energy-Efficient PEGASIS-Based Protocol in Wireless Sensor Networks," *Eighth International Conference on Fuzzy Systems and Knowledge Discovery (FSKD)*, 2011, pp.2230-2233.
5. WANG Lin-ping, BI Wu, CAI Zhen and WANG Zu-feng, "Improved algorithm of PEGASIS protocol introducing doublecluster heads in wireless sensor network," *International Conference on Computer, Mechatronics, Control and Electronic Engineering*, 2010, pp.148-151.

6. GUO Wen-yu, ZHANG Wei, and LU Gang, "PEGASIS protocol in wireless sensor network based on an improved ant colony algorithm," Second International Workshop on Education Technology and Computer Science, 2010, pp.64-67.
7. Young-Long Chen, Neng-Chung Wang, Chin-Ling Chen and Yu-Cheng Lin, "A Coverage Algorithm to Improve the Performance of PEGASIS in Wireless Sensor Networks," 12th ACIS
8. International Conference on Software Engineering, Artificial Intelligence, Networking and Parallel/Distributed Computing, 2011, pp.123-127.
9. Young-Long Chen, Yu-Cheng Lin and Neng-Chung Wang, "an intersection-based coverage algorithm for pegasis architecture in wireless sensor networks," Proceedings of the 2012 International Conference on Machine Learning and Cybernetics, Xian, 15-17 July, 2012, pp.1727-1731.
11. Zibouda Aliouat and Makhlof Aliouat, "Efficient Management of Energy Budget for PEGASIS Routing Protocol," 6th International Conference on Sciences of Electronics, Technologies of Information and Telecommunications (SETIT), 2012, pp.516-521.
13. Mohsin Raza Jafri, Nadeem Javaid, Akmal Javaid and Zahoor Ali Khan, "Maximizing the Lifetime of Multi-Chain PEGASIS Using Sink Mobility," World Applied Sciences Journal 21, 2013, pp.1283-1289.
15. Madhuri Gupta and Laxmi Saraswat, "Energy Aware Data Collection in Wireless Sensor Network Using Chain Based PEGASIS," IEEE International Conference on Recent Advances and Innovations in Engineering (ICRAIE-2014), May 09-11, 2014, Jaipur, India.
16. R. K. Yadav and Arpan Jain, "CHATSEP: Critical Heterogeneous Adaptive Threshold Sensitive Election Protocol for Wireless Sensor Networks," IEEE International Conference on Advances in Computing, Communications and Informatics (ICACCI), 2014, pp.81-86.
17. Lewis, Franck L. "Wireless sensor networks." Smart environments: technologies, protocols, and applications (2004): 11-46. [14]. Akyildiz, Ian F., et al. "Wireless sensor networks: a survey." Computer networks 38.4 (2002): 393-422.
18. Akkaya, Kemal, and Mohamed Younis. "A survey on routing protocols for wireless sensor networks." Ad hoc networks 3.3 (2005): 325-349.

AUTHOR PROFILE:



K. Arun Kumar is a scholar in school of Information Technology in VIT University Vellore , TamilNadu, India. His areas of interest include internet of things.



Dr. J. Karthikeyan is working as a Assistant professor in School of Information Technology and Engineering in VIT University, Vellore , TamilNadu, India. He was awarded his Ph.D in the area of Learning Algorithms. His areas of interest include internet of things BigData, Learning Algorithms..