



## Wireless Sensor Network: Challenges and Issues

*Sonia Vatta*

*Department of Computer Science Engineering, Rayat Bahra University, Mohali-140104, India*

e-mail: [sonia.vatta@rayatbahrauniversity.edu.in](mailto:sonia.vatta@rayatbahrauniversity.edu.in)

---

**Abstract:** *The wireless sensor network is the self-configuring network in which the sensor nodes configure and communicate with each other. Wireless sensor network is used in military and health applications. They are also used in robot control, automatic manufacturing, office and home automation. This work presents the information on wireless sensor networks. Various challenges and issues in wireless sensor networks are also presented here. This work will open the ways for further investigations into the field and help researchers in new developments.*

**Keywords:** *Wireless sensor network, challenges, issues, base station, sensor nodes, security*

## 1. Introduction

A wireless sensor network (WSN) consists of sensor nodes which are interconnected and communicate wirelessly with each other. Sensor nodes collect data about the surrounding environment. These nodes are generally low power nodes and distributed in an ad hoc, decentralized manner. A wireless sensor network is a network of small sensors which are self-deployed in different locations to serve many applications. In spite of being used in military, health, robotics and automation applications, wireless sensor networks (WSNs) also serve many upcoming areas such as ubiquitous computing, smart systems, and the Internet of Things. Whereas wireless sensor networks are very popular and find their applications in many fields, there are some challenges and issues which affect the practicability of wireless sensor networks.

## 2. Wireless Sensor Network (WSN)

Wireless sensor network (WSN) is a network of sensor nodes and base station. There are large numbers of small, low power, low cost sensor nodes with limited memory, computational, and communication resources, to monitor the physical aspects. The spatially distributed autonomous sensors and a base station are present in wireless sensor network to pass its

data through the network to a main node or central location [1].

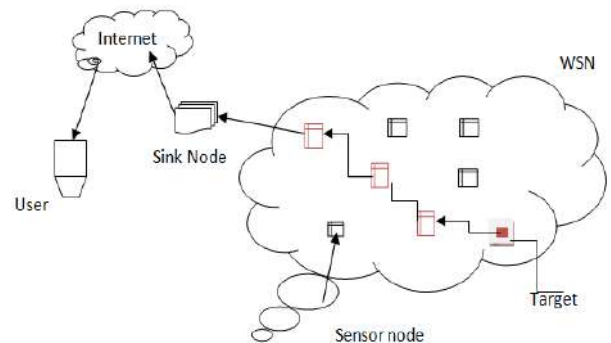


Fig. 1. Wireless Sensor Network

The nodes of wireless sensor network continuously monitor the environmental conditions to get the detailed information about the physical environment in which the nodes are installed. This information is then transmitted to the base station (BS). The base station plays the role of gateway between the sensor networks and the outside world. The BS also has very large storage and large data processing capabilities. The main work of BS is to pass the data it receives from the sensor nodes to the server from where end user can access them. The lifetime of sensor nodes is very short as they work on batteries and the batteries cannot be recharged once the nodes are deployed [2].

Modern wireless sensor networks are bi-directional. They allow monitoring of transmission of information from nodes to base station, as well as from base station to sensors [3]. One of the major advantages of WSN is that

it can be operated unattended in the environment, where it can be dangerous and unsafe to monitor by the human. The unique characteristics of WSNs include low duty cycle, power constraints and limited battery life, mobility of nodes, dynamic network topology, etc. Earlier, the wireless sensor networks were used mainly by military applications such as battlefield surveillance but now WSN is also used in many other applications such as robot control, automatic manufacturing, office or home automation. WSN is also useful in detecting forest fires based on temperature information it receives from large number of distributed sensor nodes. Wireless sensor networks also find their usage in many upcoming areas which cover ubiquitous computing, smart systems, and the Internet of Things.

### 3. Challenges in Wireless Sensor Networks

The wireless sensor networks have many challenges which are as given below:

- **Ad hoc deployment:** A large portion of sensor nodes are sent in regions which have no infrastructure by any means. A typical method for deployment in a forest would hurl the sensor nodes from an airplane. In such a situation, it is up to the nodes to identify its connectivity and distribution [4].
- **Unattended Operation:** In sensor network, the sensor nodes are deployed without human

interaction. This type of sensor network can easily reconfigure itself and adopt the changes in environment, if any changes do occur [5].

- **Untethered:** In a sensor network, the sensor nodes are not connected to any energy source. There is only a finite source of energy to a sensor node, which must be optimally used for processing and communication like battery power. In order to make the prop make the proper use of energy, communication should be as less as possible.
- **Dynamic Changes:** Sensor network is dynamic in nature. The sensor nodes are configurable themselves [6]. Sensor nodes are easily adopting the changes in the sensor network due to addition of more sensor nodes in the network.
- **Fault Tolerance:** The fault tolerance means to maintain the infrastructure in a form that if one node dies then it cannot affect the other nodes. To maintain the other network unaffected, it is required to develop the adaptive protocols [7].
- **Security Issues:** The greater part of the threats and attacks against security in wireless networks are verging on like their wired partners while some are exacerbated with the inclusion of wireless connectivity. Actually, wireless networks are typically more helpless against different security threats as the unguided transmission medium is more susceptible to security attacks than those of the

guided transmission medium. The broadcast nature of the wireless communication is a straightforward candidate for eavesdropping. It has been observed that various security issues and threats related to wireless ad hoc networks are pertinent for wireless sensor networks [8].

- **Synchronization and Localization:** In some applications, the data acquired in all nodes makes sense as a whole and therefore needs to be synchronized. In a sensor framework, a worldwide clock prepares and breaks down the data correctly and predicts future framework conduct. This is not as important as it could show up in light of the fact that there are delays in transmission and there is no broadcasting clock to synchronize nodes.

The localization of sensor nodes utilizing only the relative positions of the sensors is likewise a noteworthy test in sensor networks. This is a critical research area in which numerous methodologies have been made, for example time of arrival, time difference of arrival, or angle of arrival. Distributed algorithms are assuming a great part in increasing precision.

- **Short Range Transmission:** In order to reduce the possibility of being eavesdropped, it is needed to consider the short transmission range in wireless sensor networks. As we need high transmission power in long range transmission due to the point to point transmission between the nodes to reach the

destination which increases the chance of being eavesdropped.

- **Energy Consumption:** The energy consumption is a noteworthy test in WSN. As the sensor nodes are little in size and furnished with a predetermined number of power source, the sensor nodes are dependent on the battery which is extremely hard to replace because of the physical constraints. Because of this reason, lots of researchers are concentrating on the configuration of power aware protocols and algorithms. As the ease, deployment is one acclaimed advantage of sensor network.

#### 4. Issues in Wireless Sensor Networks

There are many issues which affect the functioning of wireless sensor network. These issues include:

- Energy Conservation
- Security
- Self-Organization
- Time Synchronization
- Quality of Service (QoS)
- Node Localization

From the above mentioned issues, it has been found that the energy conservation is one of the main issues, which affects wireless sensor networks [9]. The other issues include synchronization, quality of service, security, architecture and node localization. This section provides an insight into such issues for the better understanding of this field.

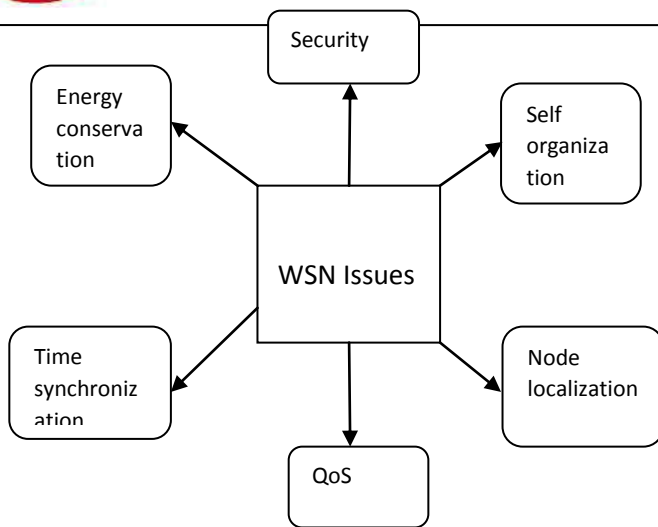


Fig. 2. Issues in WSN

These issues are explained as below:

- **Energy Conservation:** Power is required by sensor nodes for performing various operations. Energy is getting consumed in data collection, data processing, and data communication; also, for faithful operations, a continuous listening to the medium is required which needs a large amount of energy by node components (CPU, radio, etc.) even if they are not doing any task [10]. It is required to change or recharge the batteries after the consumption of the power. Because of the demographic conditions, it becomes difficult to recharge or change the batteries. Hence, it is difficult to develop and implement energy efficient hardware and software protocols for wireless sensor networks.
- **Self-Organization:** The wireless sensor network is a self-organized network. In wireless sensor network, each sensor node needs to be independent and flexible enough to become self-organizing in different situations [13]. The nodes in WSN opt the topology and implementation strategy their own as there is no fixed structure available for the network management.
- **Time Synchronization:** Time Synchronization is very important in wireless sensor networks. Time synchronization is demanded by many WSN applications for execution. Time synchronization helps in saving energy by setting nodes into sleeping mode. It has been found that in wireless building monitoring, burglar alarms and robot control applications. It is required to protect the information which travels between the sensor nodes of the network or between the sensors and the base stations so that the eavesdropping can be avoided [11]. In a wireless sensor network, each sensor node and the base station verifies that the data received is only sent by a trusted sender and not by an attacker who can send the false data and affect the performance. The integrity of data should be maintained. Data should not change and the data which is accurate must only reach at user end. It has been noticed that there are many threats to the sensor networks which needs to be handled to protect the security [12].
- **Security:** It is observed that security is one of the challenging issues in WSN. Besides of being used in battlefield applications, wireless sensor network is also used for surveillance,

sensor networks, time synchronization is very much essential for proper functioning, specifically when high sampling-frequency sensors are being used [14].

- **Quality of Service (QoS):** The quality of service is defined by the delivery of data from end-to-end node, reliability and conserving energy. The QoS can be termed as measurement of service quality offered to the user by application and it perceived by the user in the community of networking. For the improvement in field of coverage and signal transmission, the above mentioned technique is used. The care of quality of service (QoS) and coverage uniformity has to be taken regularly [15]. The QoS can also be defined as a ratio between covered area by sensors and total field area. The area is supposed to depend upon the node placement of nodes with respect to and coordinates in the coverage field. The quality of service can also be measured through energy consumption of the sensor nodes [16].
- **Node Localization:** Node localization is one of the interesting areas of research in wireless sensor networks. Localization is basically a method to find the location of sensor nodes. The localization methods are wide and varied in several applications by considering the widespread adoption on the wireless sensor network [17]. Some challenges are there in case of using some special scenarios. There is

an evaluation criterion for localization in wireless sensor networks. It has been found that in sensor network applications, measured data is meaningful only if the location is accurately known. There are many research problems associated with node localization in wireless sensor networks [18]. The wireless sensor network localization problems are described in terms of detection and estimation framework.

## 5. Conclusion

The aim of this work is to provide the information about wireless sensor networks. Wireless sensor network contains sensor nodes which communicate wirelessly with each other. The major benefit of wireless sensor network is that it can operate unattended in the environment, where the human monitoring can be risky and unsafe. Wireless sensor networks are used in many applications which include automation, health, military, robot control etc. There are many challenges and issues in wireless sensor networks which are also covered here. This work will enhance the knowledge of researchers and help them in further investigations and developments in this field. This work will also support in bringing up the improvements in wireless sensor networks.



## References

- [1] Sukhwinder Sharma, Rakesh Kumar Bansal, Savina Bansal, "Issues and Challenges in Wireless Sensor Networks", IEEE, International Conference on Machine Intelligence Research and Advancement, vol 4, pp.58-62, 2013.
- [2] M.H. Anisi, A.H. Abdullah, S.A. Razak, "Energy-Efficient Data Collection in Wireless Sensor Networks", Wireless Sensor Networks, vol. 3, pp. 329-333, 2011.
- [3] Gouvy, N., Hamouda, E., Mitton, N., & Zorbas, D., "Energy Efficient Multi-flow Routing in Mobile Sensor Networks", IEEE, Wireless Communications and Networking Conference (WCNC), Vol. 3, pp. 1968-1973, 2013.
- [4] Kaur, K., & Kumari, N. Evaluation and Analysis of Active RFID Protocol in Wireless Sensor Networks, vol. 3, pp. 121-129, 2010.
- [5] Jiang, L., Bing Fang, & Li., "Energy optimized approach based on clustering routing protocol for wireless sensor networks", CCD Conference, IEEE, vol. 5, pp. 181-190, 2011.
- [6] Wang, Y., & Guo, S., "Optimized energy-latency cooperative transmission in duty-cycled wireless sensor networks", In Mechatronics and Automation (ICMA), IEEE International Conference, vol. 5, pp. 185-190, 2013.
- [7] Neamatollahi, P., Taheri, H., Naghibzadeh, M., & Yaghmaee, M., "A hybrid clustering approach for prolonging lifetime in wireless sensor networks", IEEE, Computer Networks and Distributed Systems (CNDS) International Symposium, vol. 6, pp. 170-174, 2011.
- [8] Gowrishankar.S, T.G.Basavaraju, Manjajiah D.H, Subir Kumar Sarkar, "Issues in wireless sensor networks", WCE, vol.1, pp 5-15, 2008.
- [9] M.K. Jain, "Wireless Sensor Networks: Security Issues and Challenges", International Journal of Computer and Information Technology, vol. 2, pp. 62-67, 2011.
- [10] G. Anastasi, M. Conti, M.D. Francesco, and A. Passarella, "Energy Conservation in Wireless Sensor Networks: A Survey", Ad Hoc Networks, Vol. 7, no. 3, pp. 537-568, 2009.
- [11] P. Mohanty, S. Panigrahi, N. Sarma, and S.S. Satapathy, "Security Issues In Wireless Sensor Network Data Gathering Protocols: A Survey", Journal of Theoretical and Applied Information Technology, vol. 13, pp. 14-27, 2010.
- [12] A.K. Pathan, "Security in Wireless Sensor Networks: Issues and Challenges", Proc. 8th International Conference on Advanced Communication Technology, vol. 2, pp. 1043-1048, 2016.
- [13] Tarun Bala, Varsha Bhatia, Sunita Kumawat, Vivek Jaglan, "A Survey: Issues and Challenges in Wireless Sensor Networks", International Journal of Engineering & Technology, vol 7, pp. 53-55, 2018.
- [14] F. Sivrikaya and B. Yener, "Time Synchronization in Sensor Networks: A Survey", IEEE Network Magazine, vol. 18, no. 4, pp. 45-50, 2004.



- 
- [15] D. Chen and P.K. Varshney, "QoS Support in Wireless Sensor Networks: A Survey", Proc. 2004, International Conf. on Wireless Network (ICWN 2004), pp. 227-233, 2004.
- [16] Dheyab Salman Ibrahim, Abdullah Farhan Mahdi, Qahtan M. Yas, "Challenges and Issues for Wireless Sensor Networks: A Survey", Journal of Global Scientific Research, vol 6, pp 1079-1097, 2021.
- [17] Nabil, Maryam, Bilal, "Localization Techniques in Wireless Sensor Networks", International Journal of Distributed Sensor Networks, vol. 4, 2013.
- [18] A. Jangra, Swati, Richa and Priyanka, "Wireless Sensor Network (WSN): Architectural Design issues and Challenges", International Journal on Computer Science and Engineering, vol. 2, no. 9, pp. 3089-3094, 2010.