Chapter 5
AoSP-Based Secure Localization for Wireless Sensor Network

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ABSTRACT

In wireless sensor network, node localization is helpful in reporting the event's origin, assisting querying of sensors, routing, and various cyber-physical system applications, where sensors are required to report geographically meaningful data for location-based applications. One of the accurate ways of localization is the use of anchor nodes which are generally equipped with global positioning system. However, in range-based approaches used in literature, like Angle of Arrival, the accuracy and precision decreases in case of multipath fading environment. Therefore, this chapter proposes an angle of signal propagation-based method where each node emits only two signals in a particular direction and knows its approximate position while receiving the second signal. Further, a method is proposed to define the coordinates of the nodes in reference to a local coordinate frame. The proposed method does the work with a smaller number of transmissions in the network even in the presence of malicious adversaries.

DOI: 10.4018/978-1-7998-0373-7.ch005

INTRODUCTION

Wireless Sensor Network (WSN) is a set of nodal sensor modules which connect to each other using wireless communication. WSNs can also be classified into: structured WSN and unstructured WSN (Maraiya et al., 2011). In the structured WSN, the sensor nodes are deployed in the network according to some pre-defined pattern giving an organized structure to the network. However, the unstructured WSN is just opposite to the structured. In unstructured WSN, the nodes are randomly deployed in the network. The unstructured WSN are mainly used in the region which is not accessible. In this undefined topology of the network, the sensor nodes have to maintain the topology dynamically by communicating with each other (Gupta et al., 2018). WSN is one of the significant area due to its major contribution in many applications. Main application areas for WSNs are healthcare applications, battlefield surveillance, forest fire detection, routing applications and monitoring environmental conditions (Fadel et al., 2015; Han et al., 2016; Rashid et al., 2016; Noel, 2017; Li, 2017). However, due to some of the limitations of the WSN, they are constrained in some areas as compared to traditional networks. These limitations of the WSNs are generally low power constraint, due to large number of applications it's heavy processing requirement and low memory constraint (Vijay et al., 2013).

Localization is one of the most important technology in WSNs (Chelouah, 2018; Boukerche et al., 2017; Halder & Ghosal, 2016; Chowdhury, 2016; Paul, 2017). Nodes in WSNs are randomly deployed, not planned & it is required to know their location to inform about events (Kumari, 2019; Tuna et al., 2017). This method of determining the location of the unknown nodes in the network is known as localization. Location of nodes provide various support for many location-based protocols such as routing algorithms to make efficient data routing decisions (Cadger et al., 2013; Ndiaye, 2017; Kumar, 2017). The location of the nodes can be found out using Global Positioning System (GPS) but it's not feasible for this case due to its large cost and large number of nodes (Xiao, 2016; Yassin, 2016). GPs unit is unable to work correctly inside buildings or dense forested areas and it may also expose to jamming and spoofing thereby creating a threat to many military applications (Bandiera et al., 2015). Basically, the localization is done using the information of the nodes whose location is already known or by using the communication information between the two unknown nodes in the network. The localization algorithm in WSNs has been classified in many ways. Zhu et al. (2014) has classified the localization as: direction-based approach and distance-based approach. In direction-based approach mainly the direction related parameters like received signal strength (RSS) are taken into

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Chau Thi Minh Nguyenand Doan B. Hoang (2020). *International Journal of Smart Sensor Technologies and Applications (pp. 42-64).*
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