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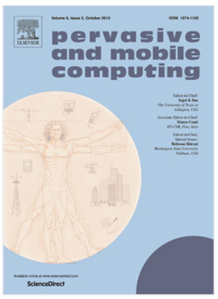

Signaling game based strategy for secure positioning in wireless sensor networks

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Signaling game based strategy for secure positioning in wireless sensor networks

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Abstract

Sensor localization is demanded by wireless sensor networks, since the collected sensor data are meaningless if the position of the generating sensor is not available. The traditional approach of using GPS for location determination is not suitable for sensor networks, due to the increased costs and resource usage. For this reason, sensors exchange Radio Frequency messages, so as to measure their respective distances and determine their location by means of multilateral triangulation with sensors of known position, called anchors. Such an approach, however, is particularly vulnerable to several kinds of attacks aiming at causing wrong position estimations with a malicious intention. Such attacks can be tolerated with proper countermeasures, belonging to the so called secure localization, but at the expenses of high costs in terms of exchanged messages and exhausted sensor resources, such as the battery. For this reason, it is crucial to use the secure localization only when needed in order to extend considerably the life span of the sensors. Therefore, we propose to model the interaction of an anchor with a sensor as a signalling game, and to use such a formalization to discipline the use of secure positioning methods based on the received messages from the anchors. We have proved with simulations that such a solution is more efficient than a naive one of always applying secure localization.

Keywords: Wireless sensor networks; Localization algorithms; Security; Game theory.

1. Introduction

Currently, context-awareness [1, 2] is a strategic feature of smart applications available in our smartphones, or belonging to the up-coming vision of the Internet-of-Things (IoT), since it allows the applications to adapt their behavior and/or the provided information accordingly to their context of execution. Context-aware systems constitute a unmissable and valuable component of a ubiquitous and/or pervasive computing environment. The context can be defined according to different aspects and features, and the literature presents a variety of context formulations of an execution context for an application, but in any of these formulations we can always find that location is a primary component. Therefore, it is of pivotal importance for these applications to achieve the ability of a hosting device to determine its exact location in terms of the geographic coordinates within a given building (indoor positioning) or open-air environments (outdoor positioning). In the current and upcoming software platforms for smart environments, we are witnessing the progressive proliferation of location-sensitive applications also due to the fact that the information that they generate may be meaningless if a location is not tagged to them. Apart from the issue of user localization, which has been successfully resolved by means of satellite positioning technologies such as Global Positioning System (GPS) [3], there is a strong demand of effective and efficient solutions for positioning of tiny devices forming the so-called Wireless Sensor Networks (WSN) [4], supporting the future applications of IoT. If we consider the applications that are being developed under the umbrella of the smart city buzzword, localizing sensors within a given WSN is a crucial requirement in real scenarios. In facts, sensors

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