Chapter 27
Mechanisms to Secure Communications in the IoT

Azeddine Bilami
Batna 2 University, Algeria

Somia Sahraoui
Batna 2 University, Algeria

ABSTRACT

The maturity of the IoT depends on the security of communications and the protection of end-user's privacy. However, technological and material heterogeneities, and the asymmetric nature of communications between sensor nodes and ordinary Internet hosts, make the security in this case more problematic. Major problem facing the large deployment of IoT is the absence of a unified architecture and a lack of common agreement in defining protocols and standards for IoT parts. Many solutions have been proposed for the standardization of security concepts and protocols in IoT at different layers. Even though many advances and proposals were made for IoT adaptation as IPv6 for Low Power Wireless Personal Area Network (6LoWPAN), and at application layer with protocols such as XMPP, MQTT, CoAP, etc., security of the IoT remains a very challenging task and an open research topic. This chapter focuses on existing protocols and different proposed mechanisms in literature to secure communications in the IoT.

INTRODUCTION

We are already seeing the launch of a new connected world through the Internet of Things (Atzori et al., 2013) where digitization is not restricted to telecommunication and official management tasks, and Internet connectivity is not the feature of regular Internet hosts (computers, laptops, tablets and smart phones) alone. Rather, digitization will span any of the daily activities (e.g. driving, manufacturing, healthcare …) and Internet connection will invade a huge set of everyday objects (such as vehicles, TV, refrigerator, buildings, etc.), urban and even isolated rural environments. The emergence of that new generation of the Internet is made possible through the convergence between several successful wireless embedded technologies and the advances in networking engineering.

Indeed, wireless senor networks (Akyildiz et al., 2002) are a key technology in the enabling of everything connected paradigm of the future Internet. A wireless sensor network consists of several tiny sensor nodes that collect data of various types from the target field. The collected data help the users to monitor activities, predict events or enhance efficiency in numerous application fields. In the context of the IoT, sensed data representing either behavioral or environmental status are accessed from anywhere and at anytime for ubiquitous monitoring. Tagging, radio identification and contactless technologies (Gubbi et al., 2013) are also considered as important technological bloc that identifies IoT objects and stores different information related to their static features, such as manufacturer name, manufacturing date, expiration date of a product and many other useful information for object tracking purposes. Another important technology is recently joining the Internet of things for new perspectives and optimized efficiency. So, we talk about the drones (Loke, 2015) which brings flying terminal objects or relay points.

Furthermore, it is predicted that more than fifty billions of smart things will be connected via widespread Internet connection by 2020 (Atzori et al., 2010). At this stage, it is worth mentioning that huge storage and processing capabilities will be required to deal with the big data generated by the IoT and injected in the Internet.

The main goal of the Internet of things is to bring high levels of smartness to the world by providing smart and useful services. The IoT offers many advantages that can be described briefly as follows:

- Ubiquitous access to information for a sophisticated and comfortable lifestyle.
- Gain of time: unnecessary trips are therefore replaced by a simple web browsing to order products, check the status of connected objects and/or locations.
- Improved quality of services and remote monitoring in various application fields such as industrial applications, smart cities, smart healthcare, etc.
- Improved productivity and customer experience: the connected objects may send reports to their manufacturer indicating the preferences and habits of customers helping more companies to act proactively in an adapted way to meet the requirements of the customers.
- In some applications, IoT might help us to rationalize our spending and savings because we should consume only as needed, be it for shopping or energy consumption (required for lighting or air conditioning) for example.
- Possibility of leveraging Internet resources for storing and processing IoT's data.

Many architectures of the IoT are presented in the literature with minor differences between them. Basically a generic IoT architecture consists of three principal layers (Gubbi et al., 2013): perception layer, networking layer and application or service layer as illustrated in Figure 1. The scheme indicates how data are collected from the physical world by sensor nodes, communicated and processed throughout the Internet backbone to be finally used by different smart applications.

Depending upon the way smart things are integrating the IoT, data can be either directly extracted from the Internet-connected objects or indirectly from a front-end gateway. In fact, the direct incorporation via the adoption of IP (Internet Protocol) standards is generally much more advantageous as it fulfills the IoT requirements in terms of pervasiveness, interoperability and flexibility. Thus, smart objects interact with each other and with other Internet hosts directly according to several communication models, with different protocols. The main concern in that is to make possible such interactions while enabling efficient end-to-end security and/or good quality of service.

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