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Internet of Things and Cognitive Radio: Motivations and Challenges

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ABSTRACT

Internet of things (IoT) is a worldwide network of interconnected objects. However, the things-oriented, internet-oriented, semantic-oriented, and tactile-oriented versions of IoT are meaningless if the IoT objects are not equipped with intelligence. For this, current research trends are oriented towards cognitive radio. This paper presents IoT, its definition, its potential applications, its challenges, as well as its enabling technologies. Among these technologies, particular importance is given to cognitive radio. The overall objective of this paper is to make a global synthesis on the motivations as well as on the challenges to be raised by the integration of cognitive radio in IoT in order to serve as self-reconfigurable solutions for a certain number of IoT applications.

KEYWORDS

Cognitive Radio, Energy Harvesting, Internet of Things, Sensing, Spectrum Allocation, Wireless Sensor Networks

1. INTRODUCTION

Internet of Things (IoT) is the term used for ubiquitous, intelligent and interconnected objects that interact with each other using standard communication protocols. IoT means the ubiquity of various objects around us, such as sensors, Radio Frequency Identification (RFID) tags, mobile phones, and others. It will have a strong impact on daily life in the future, such as assisted living, automation, industrial manufacturing, logistics, process management, intelligent transportation of people/materials, real-time monitoring of industrial processes, online health facilities, etc ... (Aijaz et al. (2015)).

The IoT objects will be interconnected via wired and wireless communication technologies. However, accessibility issues for remote users make wireless communication the most attractive solution. Since wireless spectrum is a precious resource, we can therefore suffer from the scarcity of spectrum for IoT applications.

To solve spectrum problems, IoT objects should have cognitive abilities (Tragos et al. (2013)). Thus, trends are evolving towards the adaptability of cognitive radio networks (CRN) to IoT. The radio spectrum is largely underused most of the time, something that has created spectrum shortage issues. The underused spectrum is called the spectrum hole or white space (Khan et al. (2016)). To take advantage of these white spaces, cognitive radio (CR) becomes essential and promising in various fields of applications such as intelligent networks (Amraoui et al. (2014) and Zhang et al. (2012a)) and cognitive radio sensor networks (CRSNs) (Rawat et al. (2016) and Lin et al. (2013)).

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CR nodes are intelligent wireless devices with cognitive capabilities to search for gaps in the spectrum and make opportunistic decisions to transmit without interfering with legitimate users.

The main contributions of this paper are as follows:

- resent a comprehensive study on the challenges and enabling technologies of the IoT.
- Present a comprehensive study on the motivations and challenges of the application of cognitive radio in IoT. For this last point, taxonomy of challenges is presented.
- Categorizes the papers studied according to the challenges, the type of network as well as the used validation tool.

The rest of the paper is organized as follows:

Section 2 presents the internet of things, we present its definition, its applications, its challenges as well as its enabling technologies.

Section 3 presents cognitive radio; we are obviously interested in its motivations and its challenges of application in the internet of things.

Finally, the last section is devoted to the conclusion.

2. INTERNET OF THINGS

2.1. Definition of IoT

According to Perera et al (2013), "The IoT is a global network of interconnected, uniquely addressable objects, based on standard communication protocols, and allows people and things to be connected anytime, anywhere, with anything and everyone, ideally using any network and any service. "

As shown in Figure 1, the IoT has four specific visions; things-oriented, internet-oriented, semantic-oriented and tactile-oriented. The motivation behind the things-oriented vision is tracking objects using a network based on ubiquitous sensors and technologies using RFID, because each object can be uniquely identified by its EPC (electronic product code).

The Internet-oriented vision has gained interest thanks to the already developed IP network.

Figure 1. The four visions of IoT (Akinyoade et al. (2019))