Chapter 47
Integration of Cognitive Radio Sensor Networks and Cloud Computing: A Recent Trend

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ABSTRACT

Cognitive Radio Sensor Networks (CRSNs) are composed of sensor nodes equipped with Cognitive Radio (CR) technology with limited resources (e.g., storage, computational speed, bandwidth, security, etc.). In order to overcome resource limitation, cognitive radio sensor nodes are integrated with cloud computing, which provides computing resources (e.g., storage, computation, security, etc.) to sensor nodes. Therefore, the focus of this chapter is integration of cognitive radio sensor networks with cloud computing. In this chapter, the authors first provide background on cloud computing, cognitive radio networks, wireless sensor networks, and cognitive radio sensor networks. This chapter also describes benefits of this integration to both cognitive radio sensor networks and cloud computing, followed by advantages of using cloud computing in cognitive radio sensor networks. Furthermore, it provides applications of cloud-based cognitive radio sensor networks. In the end, the authors provide some issues, challenges, and future directions for such integration.

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1. INTRODUCTION

Cognitive Radio (CR) devices are intelligent devices which are capable of adapting their transmission parameters based on the interaction with environment in which they operate (Akyildiz, Lee & Chowdhury, 2009). On the other hand, Wireless Sensor Networks (WSNs) are composed of autonomous sensor nodes which are deployed densely and in large number. They operate on fixed spectrum and have limited resources. WSN can exploit the cognitive radio capability and thus form Cognitive Radio Sensor Network (CRSN). By exploiting cognitive radio capability by WSNs, they can operate under different spectrum bands (Akan, Karli & Ergul, 2009). For example, it is possible that a certain spectrum band is available in one region while it is not available in another region due to varying spectrum conditions. But with cognitive radio capability, sensor nodes can avail different spectrum bands and this operation is not possible without cognitive radios. Also, by exploiting cognitive radio capability, there will be less packet loss and retransmission due to opportunistic use of spectrum bands; therefore it will reduce energy consumption in transmission and reception of sensor nodes.

Cloud Computing is a new paradigm for the delivery and hosting of services over the Internet. In cloud computing, resources (computation, storage etc.) can be leased to users through Internet (Zhang, Cheng & Boutaba, 2010). There are two types of providers in cloud computing. One is infrastructure provider who manages cloud platforms and provides resources on lease to users based on their usage requirements. The other is service provider who takes resources from infrastructure provider and leases them to end users. Microsoft, Amazon and Google are popular cloud platform providers who provide very reliable and powerful platform to users.

In the perspective of CRSNs, cloud computing provides resources e.g., storage, computation, security etc. for resource constraints sensor nodes. This reduces the power consumption of sensor nodes at large extent. Also, it provides global knowledge to CR nodes for taking better decisions for the selection of resources. Because, if CR nodes take decision about channel selection based on their local information, there is very less probability that selected channel has low Primary Radio (PR) user activity and there are more chances of interference to PR nodes. However, if all CR nodes send their local information to the Cloud, then the channel selection decision will be taken after getting complete picture of PR user activity which will reduces interference to PR nodes and optimize network performance.

The rest of the chapter is organized as follows. Section 2 discusses cloud computing models. Subsequently, section 3 explains the integration of CRSNs and cloud computing by providing insights that how cloud computing and CRSNs can get benefit from each other. Also, advantages of cloud computing in CRSNs are explained in this section. In section 4, we describe various applications of cloud based CRSNs. Then in section 5, we illustrate issues, challenges and future directions of cloud based CRSNs. Finally, we conclude this chapter in section 6.

2. BACKGROUND

2.1 Cloud Computing

The success of Internet and quick development of computation and storage technologies results in computing resources to be cheaper, more powerful and more ubiquitous. This technological emergence has resulted in creation of a new paradigm of computing model known as cloud computing for hosting and delivering services over the Internet. Cloud computing referred to either providing services by means of application over the Internet or hardware and software in the data center that provide these services (Armbrust et al., 2010). In cloud computing, processing and