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Review

Cognitive radio network security: A survey

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ABSTRACT

Recent advancements in wireless communication are creating a spectrum shortage problem on a daily basis. Recently, Cognitive Radio (CR), a novel technology, has attempted to minimize this problem by dynamically using the free spectrum in wireless communications and mobile computing. Cognitive radio networks (CRNs) can be formed using cognitive radios by extending the radio link features to network layer functions. The objective of CRN architecture is to improve the whole network operation to fulfil the user's demands anytime and anywhere, through accessing CRNs in a more efficient way, rather than by just linking spectral efficiency. CRNs are more flexible and exposed to wireless networks compared with other traditional radio networks. Hence, there are many security threats to CRNs, more so than other traditional radio environments. The unique characteristics of CRNs make security more challenging. Several crucial issues have not yet been investigated in the area of security for CRNs. A typical public key infrastructure (PKI) scheme which achieves secure routing and other purposes in typical ad hoc networks is not enough to guarantee the security of CRNs under limited communication and computation resources. However, there has been increasing research attention on security threats caused specifically by CR techniques and special characteristics of CR in CRNs. Therefore, in this research, a survey of CRNs and their architectures and security issues has been carried out in a broad way in this paper.

Contents

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1. Introduction

Of the different kinds of wireless technology supporting Internet access and other services, a very effective idea is to merge different wireless networks and to use one of them appropriately, depending on the communication environments and various application requirements. At first, cognitive radio was pioneered by Mitola (2000) from software defined radio (SDR). The main objective of this idea was originally to improve spectrum utilization. There is an ever-increasing demand for spectrum for emerging wireless applications and there is a spectrum shortage for the wireless applications. In view of this, the Federal Communications Commission (FCC) has considered making the licensed spectrum available to unlicensed users. This will allow unlicensed users to use the empty spectrum, provided they cause no interference to licensed users. Most radio systems today are aware of the radio spectrum. Cognitive radio is a new research area for wireless communication in which either a network or a wireless node is able to change its transmission or reception parameters to communicate efficiently by avoiding interference with licensed or unlicensed users. Basically, the parameters that are used in CRNs are based on the active monitoring of several factors, either in the external or internal radio environment, such as radio frequency spectrum, user behavior and network state. A cognitive radio senses available spectrum, occupies it and can vacate the spectrum on sensing the return of the primary user (PU). We call future wireless networks 'cognitive radio networks' (CRNs), which is quite consistent with Haykins's definition of cognitive radio (Haykin, 2005): "*Cognitive radio is an intelligent wireless communication system that is aware of its surrounding environment (i.e., the outside world), and uses the methodology of understanding-by-building to learn from the environment and adapt its internal states to statistical variations in the incoming RF stimuli by making corresponding changes in certain operating parameters (e.g., transmit power, carries-frequency, and modulation strategy) in real time, with two primary objectives in mind: highly reliable communication, whenever and wherever needed, and efficient utilization of the radio spectrum*". The authors in Chen et al. (2008a) stated that whenever cognitive radios can find opportunities for communication using the "spectrum holes", cognitive radio transports packets on top of cognitive radio links in order to successfully facilitate useful applications and services. A mobile terminal with cognitive radio capabilities can always sense the communication environments (e.g. spectrum holes, geographic location, available wire/wireless communication system or networks, and available services), analyze the environment and learn information from the environments with the user's requirements and reconfigure itself by adjusting system parameters to conform to certain policies and regulations. The authors provided an example in Chen et al. (2008a), where a cognitive radio mobile terminal senses that there are WiFi and GSM systems nearby while spectrum holes exist in the frequency band of digital TV, hence, it may decide to download files from a certain WiFi AP, make a phone call through the GSM system and communicate with other cognitive radio