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Review

Neighbor discovery in traditional wireless networks and cognitive radio networks: Basics, taxonomy, challenges and future research directions

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ABSTRACT

Cognitive radio network is designed to opportunistically exploit the licensed band. To deploy a cognitive radio network, nodes need to perform the neighbor discovery process in order to enable communication and connectivity in the network. Neighbor discovery not only helps in successful and efficient communication in cognitive radio networks but also provides solutions to a majority of other traditional wireless network problems, such as gossiping or broadcasting a message, a global common control channel allocation, etc. In this paper, we provide a survey on neighbor discovery for traditional wireless networks and cognitive radio networks. In this perspective, we first provide basics and features of neighbor discovery, as well as, the challenges when moving from traditional wireless networks towards cognitive radio networks, in order to pave the way for a better understanding of the neighbor discovery in cognitive radio networks. We provide detailed taxonomy of neighbor discovery protocols in traditional wireless networks and cognitive radio networks. Finally, open issues, challenges, and future research directions have been highlighted for neighbor discovery in cognitive radio networks.

Contents

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1. Introduction

In recent times, with the increasing applications in wireless communication, there is a possibility of an acute shortage of bandwidth in the near future. The available spectrum is becoming extremely populated due to various applications, such as television transmission, microwave communication, and cellular communication. However, it has been observed that a significant portion of this allocated spectrum is not properly utilized (Mittal et al., 2009). Cognitive Radio (CR) is a promising technology likely to be adopted in the very near future to alleviate the spectrum under-utilization problem (Asterjadhi and Zorzi, 2010). Equipped with highly flexible spectrum sensing capabilities, CR technology enables wireless nodes to change their transmission parameters, so that they can dynamically adapt to spectrum availability in their geographical region. A Cognitive Radio Network (CRN) comprises of CR nodes scattered geographically, which can opportunistically perform spectrum access (Krishnamurthy et al., 2009). CR nodes scan and identify unused spectrum resources in the licensed bands without causing interference to the legitimate users, assigned to these frequency bands (Mittal et al., 2009; Asterjadhi and Zorzi, 2010). A channel is believed to be available if CR nodes can communicate on this channel for a reasonable amount of time without causing any interference with the legitimate users (Mittal et al., 2009).

The legitimate users assigned to communicate on the licensed frequency bands are called Primary Users (PUs) and all other looking for opportunistic spectrum access are called Cognitive Radio (CR) nodes or Secondary Users (SUs). An SU scans unused channels in the operating environment and after identification of these channels, starts its communication over these channels. If PU returns to this channel, the SU has to vacate it and switch to some other available channel for communication (Arachchige et al., 2008). This mechanism is known as spectrum handoff.

A SU node maintains the set of locally available channels after scanning the spectrum usage. This set of channels may be different for different SUs, leading to follow layer-2 auto-configuration issues i.e., *without any central authority, how do nodes know about their potential neighbors, and what is the set of available channels to form a communication infrastructure (Mittal et al., 2009; Arachchige et al., 2008)*. Hence, the problem of Neighbor Discovery (ND) comes forward.

To be more precise, in order to ensure successful communication in CRN, SUs have to adapt to certain mechanisms, such as information sharing about neighborhood and spectrum availability. But it is possible only if SUs are aware of each other and a network of trusted users has been formed. First step in this regard is the successful completion of neighbor discovery phase and knowledge of available channels that can be used for communication among neighbors. The dynamic and challenging wireless