Handover based spectrum allocation in cognitive radio networks

Conference Paper · December 2013

DOI: 10.1109/ICGCE.2013.6823431

2 authors:

M. Suganya

1 PUBLICATION **92** CITATIONS

SEE PROFILE

Anandakumar Haldorai

Sri Eshwar College of Engineering

128 PUBLICATIONS **2,182** CITATIONS

SEE PROFILE

Handover Based Spectrum Allocation In Cognitive Radio Networks

Suganya.M,
PG Scholar,
Department of Information Technology,
SNS College of Engineering, Coimbatore.
msuganyait@gmail.com

Anandakumar.H,
Assistant Professor,
Department of Information Technology,
SNS college of Engineering, Coimbatore.
anandakumar.psgtech@gmail.com

Abstract*—There is a rapid development in wireless technologies with the increase of congestible frequency spectrums, research study reveals that there is a problem in spectrum management and spectrum allocation. To overcome this problem there is a new technology known as cognitive radio technology in wireless sensor networks called as CWSNs. The first standard for cognitive radio networks is IEEE 802.22, but this standard cannot overcome the problem of spectrum management and spectrum allocation. In this paper we propose a novel protocol in which spectrum allocation can be done by increasing the transmission range and communication quality, lowering the energy consumption and delays.

Index terms- Cognitive Radio, Handover, Spectrum Allocation, Spectrum Management, IEEE 802.21.

I. INTRODUCTION

The wireless sensor networks (WSNs) is one of the rapid growing wireless network technology in recent years and it is facing a more network traffic. In wireless sensor networks, thousands of tiny sensor nodes are distributed to detect the surrounding data. The data congestion is increasing by 50 percent per year [1]. The wireless spectrum is limited and there is a lot of wastage in spectrum resources which are valuable. The frequency bands which are unused can be used in an efficient way with the help of technology known as cognitive radio (CR). The term "cognitive radio" is based on the concept of software defined radio.

The primary network and the cognitive network were the components of cognitive radio architecture, as shown in the figure 1. The primary network is referred to as the legal network that can access the spectrum band to a certain extent, whereas the cognitive network does not have a license to operate in a desired band. Primary and unlicensed network have some basic elements: (i) primary user, (ii) primary base- station, (iii) cognitive radio user and (iv) cognitive radio base- station.

As shown in the figure 1, cognitive radio network architecture has three different access types over heterogeneous network: the first is primary network access, second is the cognitive radio network access and third is the cognitive radio ad hoc access. Thus the CR user can either communicate with each other in a multihop manner.

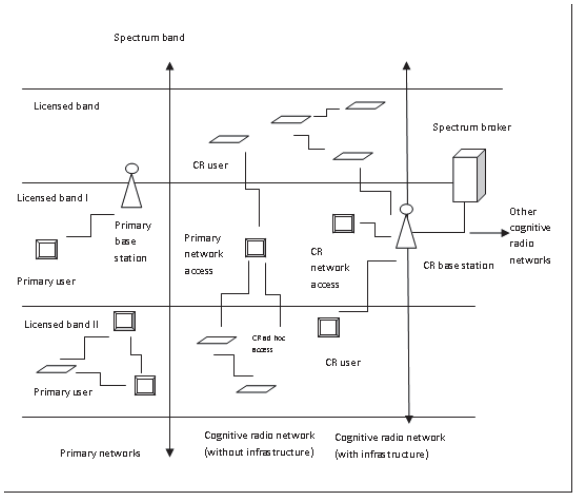

Figure 1: CRN Architecture

Spectrum sensing is the main functionality of cognitive radio; it provides the spectrum holes which are available in the spectrum bands. Spectrum analysis is the spectrum sensing, in which it defines the spectrum bands characteristics through sensing. There is inefficiency in spectrum usage and demand for the radio spectrum; due to this the research studies focus on new communication referred as Dynamic Spectrum Access [2].

Based on the federal communications commission (FCC) spectrum is utilized in some frequency bands, but it is overcrowded in other frequency bands [3]. Dynamic spectrum access method is put into practice by means of cognitive radio, it can be defined as a fully reconfigurable and

sense the environment autonomously and automatically provides users demands by changing its communication parameters [4].

The following were some of the advantages of cognitive wireless sensor networks:

(1) Higher transmission range
(2) Better use of the spectrum
(3) Better communication quality
(4) Lower energy consumption and delays
(5) Fewer sensor node required to cover specific area

A cognitive radio network has primary user (PU) and secondary users (SU). The former is a licensed user which has rights to access the radio spectrum, whereas the latter is an unlicensed user which can access only the free spectrum bands. Mitola proposed cognitive radio in a paper [7] it is published in 1999.

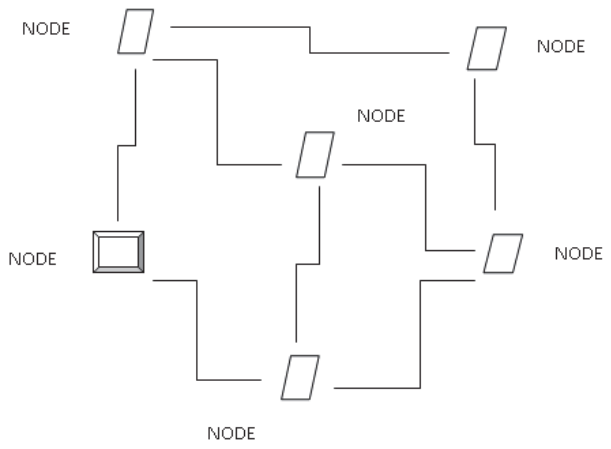

Figure 2: CWSN Construction

The cognitive radio concept is proposed to boost the spectrum utilization by allowing secondary users to access the licensed channel so that interference to licensed user is kept to a minimum. In this paper, we propose a protocol that addresses the problem of spectrum management and spectrum allocation as well as the handover issues in cognitive network.

The cognitive wireless sensor networks (CWSNs) is a new network of cognitive radio based on wireless sensor networks. The information interaction and data transmission by wireless communication has been achieved, as the sensor nodes have been around, as shown in the figure 2. The two main objective of cognitive wireless sensor network (CWSN) is: to improve the utilization rate effectively, to improve the communication reliability effectively.

The remaining paper is discussed as: Section II gives the literature review, whereas Section III consists of our proposed protocol. In section IV the problem is defined. Then in Section V the paper is concluded.

II. RELATED WORK

A. Spectrum allocation for secondary users

There is a problem for allocating the spectrum for secondary users (SUs). To overcome this problem a new algorithm "the last diminisher" is introduced. A trust value in reputation management is also introduced to overcome the problem [1].

B. Spectrum utilization and mobility

The research study reveals that the spectrum utilization is unevenly distributed. IEEE 802.22 standard is introduced but it cannot overcome the problem of network entry and initialization as well as the hidden incumbent problem. Mobility is also an issue that is unexplored in cognitive radio networks. A novel protocol is introduced that over the hidden incumbent problem during network entry, initialization and handover, at the same time the mobility pattern of the cognitive device is also considered [2].

An unexplored issue in cognitive radio is the mobility and this can be overcome by an interesting architecture that suggests a LEO-satellite assisted cognitive radio architecture [10].

c. Handover

In cognitive radio system the handover technique is applied by secondary users, if the primary user arrived then the secondary user have to vacate a channel. To limit the forced termination of secondary users a fraction guard channel reservation scheme is applied but this reservation parameter cannot be adequately adjusted as a result of maximizing throughput of secondary users. The proposed method is based on the optimization problem, the target that is existing the trade-off between blocking new session of secondary users and dropping ongoing ones [5].

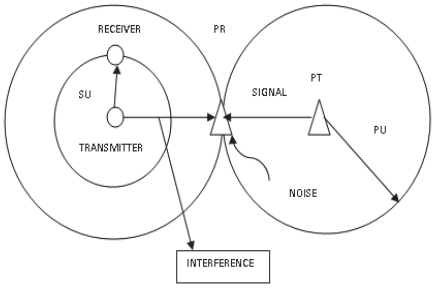

Figure 3: Handover Management

As shown in the figure 3, the capacity of the cognitive radio network is maximized by coordinating SUs handover decision optimally in the PU-SU coexisted cognitive radio networks. The spectrum handover problem is formulated , based on the interference temperature mode as constrained optimization problem in which it can be solved by the branch and bound technique [9].

d. Spectrum sharing

The problem of spectrum sharing among primary users and secondary users carries out the centralized spectrum allocation with two goals: (1) maximize systems bandwidth reward, and (2) maximize second user's access fairness by using swarm intelligence algorithm. Spectrum allocation is the optimization problem and it optimize the system overall performance and reducing to a graph coloring problem [6]. The graph coloring problem is a NP-hard problem and swarm intelligence algorithm (particle swarm optimization (PSO)) solves this problem. The proposed method provide a good trade-off between secondary users access fairness, systems sum bandwidth reward and has a system overall performance.

III. PROPOSED WORK

In this paper, we propose a protocol IEEE 802.21. 802.21 is an IEEE standard published in 2008, the standard enables handover between networks of the same types and handover between different network types also called as media independent handover. It helps in initiation of handover, selection of network and activation of interface. This protocol also provides spectrum allocation that can be done by increasing the transmission range and communication quality, lowering the energy consumption and delays. The main purpose of IEEE 802.21 is to enable handover between heterogeneous technologies without service interruption.

This protocol provides a framework which allows interacting the higher levels with lower layers to provide session connectivity without dealing with specifies of each technology. To achieve the goals, IEEE 802.21 defines the media- independent entity that provides a generic interface between the different link layer technologies and the upper layers. IEEE 802.21 maps this generic interface to a set of media-dependent service access points (SAPs) and its aim is to collect information and control link behavior during handovers.

The following were the set of secondary goals of IEEE 802.21:

(1) Service continuity
(2) Handover- aware applications
(3) Quality of service (QOS)
(4) Network discovery
(5) Network selection assistance
(6) Power management

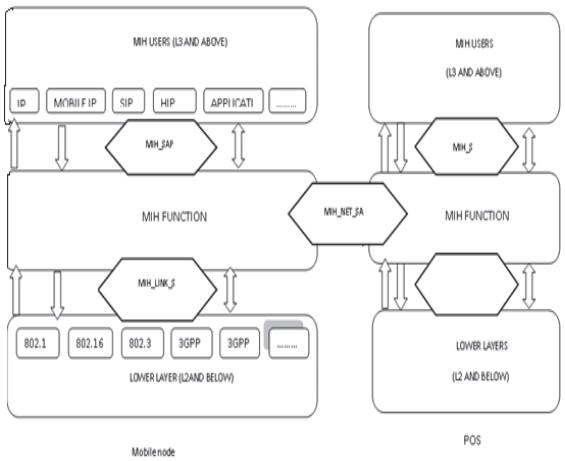

Figure 4: IEEE 802.21 standard general architecture

The figure 4 shows the general architecture of the different nodes in an 802.21 network. This architecture has a mobile node with an 802 interface and a 3GPP one, which is currently connected to the network through 802 interface. The above figure

shows the mobile node internal architecture, the 3GPP network, the 802 network, and the core network. As observed from the figure, all 802.21-compliant nodes have a common structure that is surrounding a central entity called media-independent handover function (MIHF).

The main function of MIHF is to coordinate the information that are exchanged and commands between the different devices that are involved in handover decisions made by the devices and executing handovers. The MIHF is an intermediate layer between the upper and lower layers.

The following were the SAPs included in the 802.21 standard:

(1) MIH_SAP: This is a interface that allows communication between the MIHF layer and the higher layer MIHF users.
(2) MIH_LINK_SAP: This interface is present between the MIHF layer and the lower layers of the protocol stack.
(3) MIH_NET_SAP: This is the interface that supports the information exchange between remote MIHF entities.

IV. PROBLEM DEFINITION

The cognitive radio network performance can be increased by minimize the interference between the Pus and SUs. These interference causes noise at the receiver, which leads to: (i) the wireless resources are utilized at the minimum range, (ii) The transmission rate is decreased in the wireless interface, (iii) Frame loss is increased, and (iv) Packet delay is higher. Due to the interference at the sender and recipient; there is a less transmission rate at the sender, and the packet reception at the receiver will be unsuccessful [8]. Secondary users can access any available frequency bands, since the user has a device which is reconfigurable. The secondary users may cause problems to the primary users, if they select a licensed band.

The main function of CRNs is the spectrum assignment because it will cause problem in the normal operation that occurs in the network. The frequency band(s) can be assigned by the spectrum assignment (SA) which are most appropriate at the interference of a CR device based on some criteria (i.e., spectral efficiency, throughput is maximized, etc.), while the occurrence of interference should be avoided to primary networks working in same area.

Cognitive SA has some of the challenges that are different from the CA which is conventional in wireless networks. The splitting of spectrum occurs between the channels with fixed frequency and bandwidth in primary wireless networks. The "channels" has no standard definition in CRNs. For each transmission the frequency and bandwidth can be dynamically changed by the SUs.

V. CONCLUSION

CR is a forthcoming technology for future wireless networks. CR utilizes the unused spectrum bands and solves the problem of excess utilization of available bands. It allows the user's to access the spectrum that is not used. The Cognitive Radio device helps to find the spectrum bands that are not used and it allows to access of spectrum bands whenever needed. The primary objective of cognitive radio is assigning the spectrum bands to avoid interference with the primary users and there is an increase in the performance.

The spectrum assignment problem is defined in this paper. The IEEE 802.22 standard cannot overcome the problem of spectrum management and spectrum allocation. So we proposed a protocol IEEE 802.21 which can solve the above mentioned problem by increasing the transmission range and communication quality, lowering the energy consumption and delays.

Some of the expectations of this standard is that it allows roaming between 802.11 and networks and 3G cellular networks, it enables the users to engage in ad hoc teleconferencing, the will not be defined in There is no standard, authenticated and authorized security algorithms and security protocols, but the protocol supports network detection and selection.

REFERENCES

[1] Qing-qi Pei, Zili, and Li-chuna ma, "A Trust Value – Based Spectrum Allocation Algorithm in CWSNs", Hindawi Publishing Corporation, International Journal of Distributed Sensor Networks, volume April 2013.

[2] Didem Gozupek, Suzan Bayhan, and Fatih Alagoz, "A Novel Handover Protocol to Prevent Hidden Node Problem in Satellite Assisted Cognitive Radio Networks", satellite networks research laboratory (SATLAB), dept of computer engineering, Bogazici University, TURKEY, 2008.

[3] FCC, ET Docket No 03-222 Notice of proposed rulemaking and order, December 2003.

[4] J.Mitola III, "cognitive radio: an integrated agent architecture for software defined radio", PhD. Thesis, KTH Royal Institute of Technology, 2000.

[5] Diego Pacheco-Paramo, Vicent Pla and Jorge Martinez-Bauset, "optimal admission control in cognitive radio networks", dept. of communication, Universidad Politecnica de Valencia(UPV), 2009.

[6] Zhang Beiwei, "spectrum allocation in cognitive radio networks using swarm intelligence", second international conference on communication software and networks, 2010.

[7] J. Mitola, "cognitive radio for flexible mobile multimedia communications", in proceedings of the IEEE international workshop on mobile multimedia communications, pp. 3-10, 1999.

[8] A. Kashyap, S. Ganguly, and S. Das, "characterizing interference in 802. 11-based wireless mesh networks", Stony Brook University, Tech. Rep., 2006.

[9] Dianjie Lu, Xiaoxia Huang, Weile Zhang and Jianping Fan, "interference- aware spectrum handover for cognitive radio networks, Article first published online: 17 Sep 2012.

[10] S.Bayhan, G.Gur, F.Alagoz, "satellite assisted spectrum agility concept", proceedings of military communications conference (MILCOM'07), Orlando, Florida, USA, 2007.