ISSN 2394-3777 (Print)
ISSN 2394-3785 (Online)
Available online at www.ijartet.com

International Journal of Advanced Research Trends in Engineering and Technology (IJARTET)
Vol. 4, Special Issue 11, March 2017

ENERGY EFFICIENT RESOURCE ALLOCATION BASED ON MULTI RADIO ACCESS TECHNOLOGY

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Abstract:

Cognitive radio (CR) is one of the new long term communication technology developments taking place on the radio receiver devices. Due to the Software Defined Radio (SDR) approach realization cognitive radio technology will be the next major step forward enabling more effective radio communication systems to be developed over the multi access radio service providers. Multi-radio access technology (multi-RAT) can improve network capacity due to the data transmission by multiple RANs (radio access networks) simultaneously such as WIFI LTE network topologies. In this concept, the network is considered as a new CRN model in heterogeneous multiple PU and secondary spectrum model is overlaid below the femto and macro cell networks. The energy-efficient resource allocation (EERA) problem for CR users with multiple primary user networks overlapping coverage region the concept proposes a equal power sensing algorithm-based search scheme to obtain an optimal solution in terms of the power and bandwidth. Various resource management processes also implemented to deduce the network overloading over the cognitive base network topology.

Index term- 5G, OFDMA , Licensed users and unlicensed users, spectrum allocation.

I. INTRODUCTION

High data rate, high energy efficiency, and ubiquity are basic requirements for 5-th generation (5G) wireless communication systems. Multi-radio access technology (multi-RAT) can improve network capacity due to the data transmission by multiple RANs (radio access networks) simultaneously such as WIFI LTE network topologies. In cognitive radio intelligent devices that can coexist with licensed users without affecting their quality of service. Licensed users have higher priority and are called **primary users**. Cognitive radios access the spectrum in an opportunistic way and are called **secondary users**. We consider a spectrum overlay-based cognitive radio wireless system with one primary user and N secondary users. The primary user is willing to share some portion of the spectrum (bi) with secondary user i. The primary user charges a secondary user for the spectrum at a rate of c per unit bandwidth, where c is a function of the total size of spectrum available for sharing by the secondary users. After allocation, the secondary users transmit in the allocated spectrum by using adaptive modulation to enhance the transmission performance. For wireless networks, power allocation is an

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important factor influencing the efficiency of communication, because power allocation will influence the interference among different channels and the consumption of energy. In cognitive radio networks, a well-organized power allocation is necessary with large numbers of secondary users communicating with each other. Research has also focused on the potential offered by CR networks for bringing Dynamic Spectrum Access (DSA) to reality, thanks to the ability to identify spatial and temporal spectrum gaps not occupied by primary users, and to place secondary/unlicensed transmissions within such spaces.OFDM stands for Orthogonal Frequency Division Multiplexing. It is the multicarrier modulation technique in which data is split up into chunks and every chunk are modulated using closely spaced orthogonal subcarriers. The orthogonal subcarriers have the property that they do not have any mutual interference between them. So, this scheme is very useful for high bit-rate data communication. One of the serious problems of high data rate transmission is time dispersion of pulses resulting in Inter-symbol Interference (ISI). In OFDM, the data is split into several low-rate data chunks and are modulated in overlapping orthogonal subcarriers. These splitting increases the symbol duration by the number of subcarriers used, thus reducing the ISI due to multipath.

OFDM is adapted as the best transmission scheme for Cognitive Radio systems. The features and the ability of the OFDM system makes it fit for the CR based transmission system. OFDM provides spectral efficiency, which is most required for CR system. This is because the subcarriers are very closely spaced and are overlapping, with no interference. Another advantage of OFDM is that it is very flexible and adaptive. The subcarriers can be turned on and off according to the environment and can assist CR system dynamically. OFDM can be easily implemented using the Fast Fourier Transform (FFT), which can be done by digital signal processing using software. We will discuss the several controls possible on the algorithm and the possible extension of this algorithm for multicarrier OFDM based CR systems. Traditional water-filling algorithm is inefficient for OFDM-CR networks due to the interaction with primary users

II. RELATED WORKS

A. Dynamic Spectrum Sharing

Zhu Ji and K. J. Ray Liu proposed Dynamic Spectrum sharing in May 2007 and in order to fully utilize the scarce spectrum resources, with the development of cognitive radio technologies, dynamic spectrum sharing becomes a promising approach to increase the efficiency of spectrum usage. Game theoretical Dynamic spectrum sharing has been extensively studied for more flexible, efficient, and fair spectrum usage through analyzing the intelligent behaviors of network users equipped with cognitive radio devices. This article provides a game

Theoretical overview of dynamic spectrum sharing from several aspects: analysis of network users' behaviors, efficient dynamic distributed design, and optimality analysis.

B. Secure Collaborative Sensing

Omid Fatemieh, Ranveer Chandra, Redmond, W.A Carl A. Gunter proposed on May 2007 that collaborative sensing is an important enabling technique for realizing opportunistic spectrum access in white space (cognitive radio) networks. They consider the security ramifications of crowd sourcing of spectrum sensing in presence of malicious

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users that report false measurements. They propose viewing the area of interest as a grid of square cells and using it to identify and disregard false measurements. The proposed mechanism is based on identifying outlier measurements inside each cell, as well as corroboration among neighboring cells in a hierarchical structure to identify cells with significant number of malicious Nodes. They provide a framework for taking into consideration inherent uncertainties, such as loss due to distance and shadowing, to reduce the likelihood of inaccurate classification of legitimate measurements as outliers. They use simulations to evaluate the effectiveness of the proposed approach against attackers with varying degrees of sophistication. The results show that depending on the attacker-type and location parameters, in the worst case can they nullify the effect of up to 41% of attacker nodes in a particular region. This figure is as high as 100% for a large subset of scenarios

C. Cognitive Radio Network Tomography

Chung-Kai Yu, and Shin-Ming Cheng, explains cognitive radio network (CRN), as a promising technique in future wireless communication networks in 2010. that shall executed some critical functionalities to enhance existing wireless networks, such as network reconfigurability to adaptively select networks (e.g., in IEEE P1900.4 and ETSI-RSS), spectrum opportunity utilization for transmissions over opportunistic links to enhance spectrum efficiency (e.g., in IEEE 802.22), and further cooperative relays among cognitive radios (CRs) and nodes of coexisting multi radio systems, including heterogeneous primary systems. To support multilink operations and networking functions in CRN, traditional spectrum sensing is not enough, and they thus develop CRN tomography to meet the general needs of CRN, operations at both the link and network levels, borrowing the concept from medical/Internet tomography via statistical inferring. They establish the framework and methodology of CRN tomography that can be passive monitoring or active probing defined over link or network-level parameter inference. Generally speaking, conventional CR spectrum-sensing techniques belong to the category of the passive link-level monitoring. Multiple-system sensing and identification can be considered as a sort of passive network-level CRN tomography. They further propose active link-level CRN tomography by examining the radio resource for transmissions.

Finally, CRN tomography using active network-level probing is illustrated by the estimation of successful packet-transmission probability in network operations. This paper initiates explorations of CRN tomography obtaining the required parameters at the link and network levels for successful CRN operations.

D. Joint Sensing-Channel Selection

Xin Wang describes joint optimization for sensing-channel selection and ensuing power control problem with cognitive radios over time-varying fading channels in 2011. It is shown that this joint design can be judiciously formulated as a convex optimization problem. Optimal joint sensing-channel selection and power control scheme is then derived in closed-form under the constraints of average power budget and maximum allowable probability of collisions with the primary communications. In addition, we develop a stochastic optimization algorithm that can operate without a-priori knowledge of the fading channel statistics. It is rigorously established that the proposed stochastic scheme is capable of dynamically learning the intended wireless channels on-the-fly to

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approach the optimal strategy almost surely. Numerous results are also provided to evaluate the proposed schemes for cognitive transmissions over block fading channels.

E. Mac Protocol Identification

Sanqing Hu, Yu-dong yao, and Zhuo Yang, describes MAC protocol identification in2014.Cognitive radio is regarded as a potential solution to address the spectrum scarcity issue in wireless communication. In CR, an unlicensed network user (secondary user) is enabled to dynamically/adaptively access the frequency channels considering the current state of the external radio environment. In this article, they investigate the medium access control protocol identification for applications in cognitive MAC. MAC protocol identification enables CR users to sense and identify the MAC protocol types of any existing transmissions (primary or secondary users). The identification results will be used by CR users to adaptively change their transmission parameters in order to improve spectrum utilization, as well as to minimize potential interference to primary and other secondary users. MAC protocol identification also facilitates the implementation of communications among heterogeneous CR networks. In this article, they consider four MAC protocols, including TDMA, CSMA/CA, pure ALOHA, and slotted ALOHA, and propose a MAC identification method based on machine learning techniques. Computer simulations are performed to evaluate the MAC identification performance.

F. low-complexity cyclostationary spectrum sensing

Andrea Tani, Romano Fantacc, Dania Marabissi proposed low-complexity cyclostationary spectrum sensing in 2015.This correspondence focuses on a new spectrum sensing algorithm based on the exploitation of the primary signal cyclostationarity property, used to avoid the inter-cell interference in a heterogeneous LTE-A network. The performance of the proposed spectrum sensing method will be evaluated by means of a suitable analytical approach whose accuracy will be validated by comparing analytical predictions with simulation results under different communication channel propagation conditions. Furthermore, it will be shown that the proposed approach requires the lowest computational complexity among the cyclostationarity based methods and allows better performance, even in the case of noise uncertainty, in terms of false alarm, detection probability and deflection coefficient.

G. Energy-Efficient 5G Outdoor-to-Indoor Communication:

Derrick Wing Kwan , Marco Breiling , Christian Rohde, Frank Burkhardt, and Robert Schober describes Energy-Efficient 5G outdoor-to-indoor communication in *2015.*In this paper, we study the design of the user selection, the time allocation to uplink and downlink, and the transceiver processing matrix for uplink and downlink multicarrier transmission employing a shared user equipment (UE)-side distributed antenna system (SUDAS). The proposed SUDAS simultaneously utilizes licensed frequency bands and unlicensed frequency bands with large available bandwidths (e.g. the millimeter wave bands) to enable a spatial multiplexing gain for single-antenna UEs to improve the energy efficiency and throughput of 5-th generation (5G) outdoor- to-indoor communication. The resource allocation algorithm design is formulated as a non-convex optimization problem for the

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maximization of the end-to-end system energy efficiency (bits/Joule). The non-convex matrix optimization problem is converted to an equivalent non-convex scalar optimization problem for multiple parallel channels, which is solved by an asymptotically globally optimal iterative algorithm. .[7] discussed about amplifier power relation, impedance , T π and microstripline matching networks. Besides, They propose a suboptimal algorithm which finds a locally optimal solution of the nonconvex optimization problem. Simulation results illustrate that the proposed resource allocation algorithms for SUDAS achieve a significant performance gain in terms of system energy efficiency and spectral efficiency compared to conventional baseline systems by offering multiple parallel data streams for single-antenna UEs.

III. PROPOSED SYSTEM

A. *Water filling Algorithm*

For wireless networks, power allocation is an important factor influencing the efficiency of communication, because power allocation will influence the interference among different channels and the consumption of energy. In cognitive radio networks, a well-organized power allocation is necessary with large numbers of secondary users communicating with each other. The optimal power allocation algorithm for conventional OFDM systems that maximizes the channel capacity is the well known water-filling, which is derived by solving a convex optimization problem subject to the sum transmit power constrain. Water filling algorithm provides an optimal solution for the problem of maximizing the throughput of a time varying channel by adjusting the transmitted power based on channel gain. Water filling algorithm follows the simple strategy of pouring water into a vessel with its surface defined by the inverse channel gain (hj-1).When hj-1 is small, more power is transmitted in the corresponding sub carrier and when hj-1 increases, the transmitted power in the corresponding sub carrier is significantly reduced. In other words more power is allocated to a better channel to maximize the throughput of the system. In OFDM-based cognitive radio systems, the band of the SU can be divided into several sub channels, each of which is corresponding to a licensed band of one PU system. Since the interference limit of each PU introduces the sub channel transmit power constraint for the SU, the power allocation in OFDM-based cognitive radio systems should not only satisfy the sum transmit power constraint but also the sub channel transmit power constraints. Therefore, the conventional water-filling algorithm is not applicable in such a scenario. The transmit power in each sub channel is comprised of the power allocated to the subcarriers inside the sub channel and the side lodes power of the subcarriers in other sub channels.

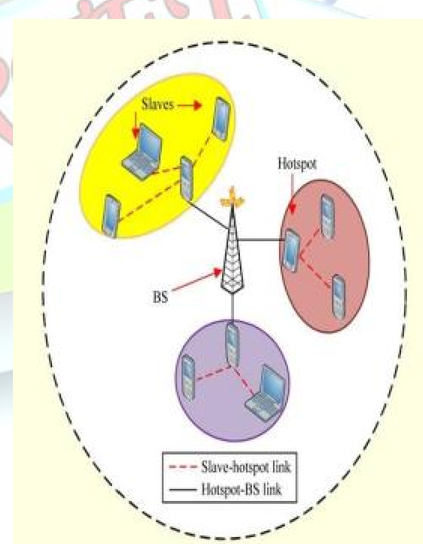

Fig 1. Water filling

A. Spectrum Sensing Algorithm

It is one of the most important task performed by cognitive radio and the performance of the other functions of cognitive radio is based on the spectrum

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sensing. So it is very necessary for cognitive radio to perform this task very efficiently. This paper presents an overview to the spectrum sensing techniques on the basis of research, limitations and challenges related to its different aspects. Spectrum sensing could be an important enabling technology for future opportunistic spectrum sharing

Spectrum Mobility:

It is defined as the process when a cognitive radio user exchanges its frequency of operation.

Spectrum Sensing:

It detects the unused spectrum and shares it without harmful interference with other licensed users (e.g. Cellular Networks, TV).

Spectrum Management:

It is the task of selecting the best available spectrum to get user communication requirements.

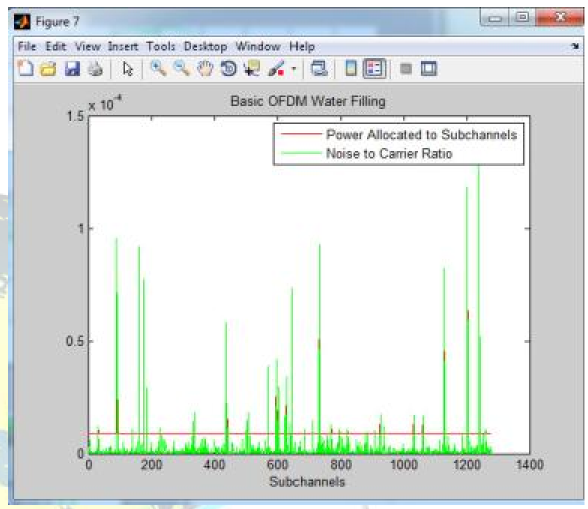
Spectrum sensing techniques:

With Cognitive Radio being used in a number of applications, the area of spectrum sensing has become increasingly important. As Cognitive Radio technology is being used to efficiently, spectrum sensing is a key to this application.

scenarios. Various spectrum sensing methods with their challenging issues and limitations are discussed in detail.

IV. EXPERIMENTATION AND RESULT

Power allocation



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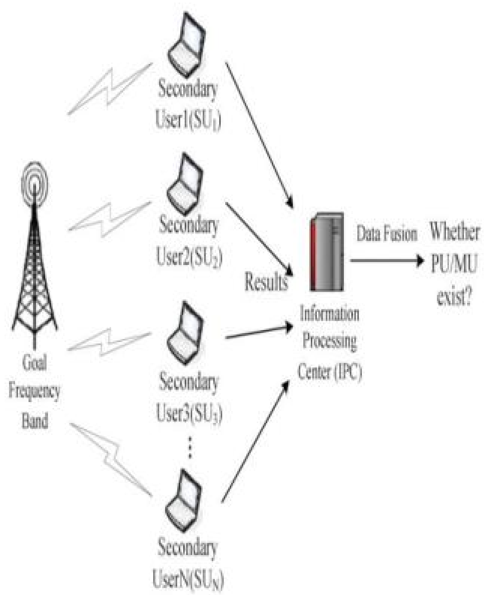

Fig 2.

V. CONCLUSION

In this paper, we proposed an optimal power allocation algorithm for OFDM-based cognitive radio networks with low computational complexity. By exploiting some properties of the water-filling method, we proposed power increment water-filling and power decrement water- filling algorithms with much lower computational complexity than traditional water-filling. Thus, the algorithm can be used to solve the power allocation problem with high efficiency. In the future, we will study how to apply the proposed algorithms to realistic cognitive radio networks.

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