IJIREEICE

ISSN (Online) 2321 – 2004
ISSN (Print) 2321 – 5526

INTERNATIONAL JOURNAL OF INNOVATIVE RESEARCH IN ELECTRICAL, ELECTRONICS, INSTRUMENTATION AND CONTROL ENGINEERING
Vol. 4, Issue 6, June 2016

Dynamic and Energy Efficient Resource Allocation Method for Cognitive Radio Networks

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Abstract: The use of the conative radio network (CRN) will increase speedily and therefore leads into the issues like affected of inefficient spectrum allocation additionally spectrum deficiency. economical spectrum allocation technique becomes new analysis disadvantage in use of CRN. Here during this analysis hybrid methodology is an in orthogonal frequency division for resource allocation have several access (OFDMA) retailed with cognitive radio (CR) networks is bestowed as planned, wherever we tend to bear in mind to increase the energy potency & increase the turnout here the thought of the many limitations, just like the budget of transmission power of Cr system, primary user's interference threshold & secondary users traffic demands. There square measure variety of the way given for best allocation of resources in CRN, however quality of such methodology is extremely high. Therefore, in conjunction with efficiency our secondary goal may be a bit of quality. The analysis objectives square measure achieved by introducing hybrid methodology through 3 points such as: 1) once initial power allocation associate accommodative rule subcarriers pre heat output by considering these early powers on behalf of shoppers is employed to assign. within the next part, strength 2) to raised assign subcarriers square measure allotted. 3) Refine the results by victimisation economical barrier methodology to figure out the (near) optimum output with a reasonable quality a lot of. Overall goal of projected methodology is reach the energy economical spectrum allocation. This sensible result analysis of this work is completed victimization Network machine (NS2).

Keywords: Cognitive radio network, Cognitive users, primary users, secondary users, energy efficiency, OFDMA, QoS.

I. INTRODUCTION

Due to the scarcity of spectrum and also the inefficiency of the regular spectrum usage manner, some insightful spectrum utilization schemes have been introduced to enhance spectrum usage potency [1]. A highly promising technique, authorized spectrum, transmission standards, intervention kept the temperature [3] as their tolerance to the primary users (PUs) as long as the modified access cognitive radio (CR) additional and secondary users (SUs) feeling attracted to radio spectrum environment and dynamically over recent years [2], Allows a very attention. Orthogonal frequency division multiplexing (OFDM system prerequisite to get CR) widely an attractive high performance air interface [4] due to its flexibility between radio resource allocation is identified in CR System. Resource allocation in OFDM-based wireless network (RA) is the most important one of the problems. A customized RA theme will have a maximum power output of OFDM system transmission at least or more users support quality of service (QoS) has been guaranteed. CR OFDM-based network, there are several analysis results but to improve system output.

On the other hand, OFDM adaptive modulation technique to form a possible as its versatile ' spectral idle for a co-existence may fill gaps has been known as Thanksgiving. However, due to the non-orthogonality, introducing both the primary and secondary system transmit signals mutual interference and interference from all that does not exceed the total allowable limit subcarriers is important. This project work green wise potential interventions and quality of service (QoS) constraints primary (PUs) users, throughput and QoS constraints secondary power users (SUs) optimizes an energy efficiency down to cognitive radio (CR) system design is our goal. We consider that each have their own QoS needs its own statistical interference Pu on range. Spectrum sharing and all of these separately is pus range of knowledge of applied mathematics intervention. Broadcasting standards, such as different OFDM broadband wireless, digital video broadcasting (DVB), digital audio broadcasting (DAB), etc. several attractive options, such as exploits multipath delay spread tolerance, high spectral efficiency, frequency selective fading channels and cause immune to electrical power already has been posted. However, a broadcasting network is the most consumed of downlink transmitter within. Therefore, it is an energy-efficient broadcast transmission strategy style is very important.

As far as celebrated writers-OFDM based metal systems dedicated to increasing the vote of an oversized amount, compared with energy-in addition to the wireless network is a very important issue that capacity (EE), attracts little attention. Sometimes high-data rate applications development, energy consumption is also a staggering rate nowadays, gas plant and high operating expenses for a great deal of wireless service suppliers is growing. Therefore, in the Green radio, wireless network on stress locations, energy efficiency is becoming increasingly important and new waves and normal development activities, and energy-efficient in the world and each trade

 DOI 10.17148/IJIREEICE.2016.4659

on the agenda RA recently, that future wireless network is the most promising for modulation technique for OFDM-based system in particular has been put. OFDM system differs from conventional classes dynamic RA 2: rate and margin optimization, energy-efficient RA where the goal is usually to maximize wireless system is a special case. Since it is directly related to the decision to adapt a substantial energy-efficient networks primary importance metric style should be given. The most popular one is "bits-per-joule ', which unit energy consumption as the system is called polling. The use of CRNs is increasing worldwide for {various} purposes through various applications. For efficient operating of CRNs, it should be designed by considering 2 main goals such as increasing the throughput and minimizing the energy consumption. Many ways introduced for spectrum allocations in CRNs with aim of improving the throughput, but they unsuccessful to achieve the energy potency. The methods that introduced for energy potency in CRNs unsuccessful to reach the throughput potency. Recent techniques presented are based on adaptive resource allocation. However still there is scope to improve the energy potency in such methods along with throughput potency. Therefore, in this paper, we planned the novel energy economical spectrum allocation technique for OFDMA systems known as ECRRA (Energy efficient cognitive Radio Resource Allocation) methodology. In rest of this paper, section II presented the connected work studies on different ways presented so way for CRN spectrum allocation. In section III, discussed the proposed framework, algorithm steps and design. Section IV, presenting the simulation studies and results achieved with different network conditions. Finally, section V, discussing the conclusion and future work.

II. RELATED WORK

During this section we tend to are discussing different ways of energy efficiency and efficient spectrum allocation in CRNs. In [5], OFDM-based to a RA CR network is flat bag is designed as a drawback. A greedy heuristic algorithm is proposed, who will build the optimal solution. However, computational values will be very high multiple such case. In [6], both the optimal & suboptimal power loading algorithms are single and case. Downlink capacity of total obstruction pus is maximized by the intervention thresholds below. In [7], an economical algorithmic rules CR system in all OFDM channels to be allocated between the bits. In most cases with low computational optimal solution proposed algorithmic program will receive. In [8], a fast algorithm for OFDM-based optimal power flow in the network a CR allocation is developed to tackle the problem. In [9], a low-complexity algorithm while guaranteeing proportional fairness between sus a CR system to maximize throughput. Unlike flourish on enhancing the capability of CR system for energy efficiency has been paid little attention. Nowadays, excessive energy consumption as a result of a significant issue environment problems and operational value [9] [10] is. Green communications, energy awareness emphasizes inclusion in the circulatory system, which is becoming more essential [11]. Throughput-oriented goals RA, the energy efficient RA a wireless system is to maximize energy efficiency. In [12], in QoS requirements, weighted down to users defined energy efficiency is maximized. [13] to optimize energy efficient power have developed a non-cooperative game. In [14], a multi-user distributed antenna system to down link the relationship between energy efficiency and spectral efficiency is examined. In [15], the writer Zhang and Leung, shown OFDMA-based burst consists of a little readier CR power allocation problem in a flat bag problem and to solve it is a greedy algorithm program working. Although the author suffered multiple pus, but they only build a cube is considered in substance. In [16], the average rates of CR link customers power budgets and lack of pus was introduced to a dynamic programming topic most intervention using is maximized. In [17], after an optimal power allocation in OFDM-based CR system, low quality with a suboptimal plan are proposed for allocation of power and their performance was compared with classical schemes. In [18], in a running water fill power during transmission of a non-cooperative game theme dynamically control algorithm design and some management principles time variable conditions below to analyze the performance of the network is used. In [19], the resource allocation problem CR network Nash as the bargain (NB) has developed a cooperative game. It has been shown that the spectrum mask with NB Power and the total resource allocation game high complexity with non-convex optimization problem. NB to find solutions, proposes a two-user systems classification and complexness with a suboptimal algorithm is used. In [19], the author shown survey of EE wireless communication, which depicts several roadmaps starting EE technical survey of major international energy-efficient wireless network and State-of-the-art research comes to discuss this topic. In [20], the authors shown a low-complexity OFDMA system energy-efficient scheme for uplink a metric time-average bits-per-joule is developed by taking. In [21], ee and downlink OFDMA networks examined the spectral efficiency is fundamental between business. In [22], the author made the study approach to wireless communications, where the tradeoff between ee and spectral efficiency is considered interference limited energy-efficient conjointly power optimization studied non-cooperative game. Energy-efficient RA In [23], Author OFDM system starting with the large number of base station, check, where imperfect channel state information and quality of service (QoS) need to take into account. In [24], Authors limited backhaul capacity where energy power, network capacity, and backhaul capacity between open, energy efficient OFDM Systems in RA multi cellular studied.

In [25], Energy-efficient channel CR network sensing, where the best sensing-access strategy and to realize maximum energy force sensing order are designed to offer. In addition, energy-efficient EE spectrum sensing RA CR networks may also reduce the intervention of pus and CR systems and improve QoS of. In short, the energy efficiency CR network spectrum is as necessary as efficiency.

ISSN (Online) 2321 – 2004
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Vol. 4, Issue 6, June 2016

III. PROPOSED METHODOLOGY

3.1. Introduction

The main goal is to present hybrid technique for energy efficient spectrum allocation wherever we are planning to maximize the system energy-efficiency and rising the turnout below the thought of the many sensible limitations, like a transmission power budget of the CR system, interference threshold of primary users and traffic demands of secondary users. Here is a computationally efficient adaptive algorithm for OFDMA-based CR rule resource allocation shown in the network. First of all, we customers and bring into account interference between the pus system model. Then, we lack the uplink resource allocation problem customers most interference transmission power budget and pus down CR network to maximize the total bit rate (flow) ready. This optimization problem is non-linear, non-convex, binary and real variable, and NP-hard in General mixed integer non-linear programming problems that (MINLP) falls within the class. To reduce computational complexity, we treat the problem in 2 separate steps. After initial power allocation, in the beginning, we introduce the planned subcarrier assignment scheme based on an adaptive algorithmic rule to assign the subcarriers to the CUs by using these initial powers such that the cr network throughput is maximized. In addition to this we have further extended this method by adding the efficient algorithm for energy potency. Below we summarized the difference between existing method and our proposed method.

3.1.1. Existing Method

Existing algorithm is having 2 main functionalities for efficient resource allocation such as:

- After initial power allocation, an adaptive algorithmic program is used to assign subcarriers to the CUs toward output maximization by using these initial powers.
- In next step, power is allocated optimally to the allotted subcarriers.

  Below section gives US the details of this method in rule.

3.1.2. Proposed Method

- In existing algorithm, we further adding practicality for improving the energy potency using method known as proposed barrier method. Therefore, below 3 functionalities of proposed rule 2:
- - After initial power allocation, an adaptive rule is used to allocate the subcarriers to the use of initial powers for CUs toward throughput maximization
- - In next step, to allotted subcarriers power is optimally allocated
- - Refine the results by using efficient barrier method to work out the (near) optimal solution with an inexpensive complexity further.

3.2. Algorithms Design

3.2.1. Algorithm 1: Resource Allocation Algorithm

Input: $P_t^k, I_{th}^{\ell}, \gamma_{km}, \mathcal{M}_{av}, q_{km}^{\ell}, \forall_m \in \mathcal{M}_{av}$;

Output: $y_{km}, p_{km} \forall_k, m$;

Initial power allocation:

$\bar{p}_{km} \leftarrow$ Initial power allocation according to (6);

Step 1: subcarrier assignment

$\mu_n \leftarrow \mu \in (0,2)$;

$Y^{(j)}|_{j=0} \leftarrow [\,0\,]_{k\times N_{av}}$;

$R_{tot}^{(j)}|_{j=0} \leftarrow 0$;

$J \leftarrow 0$;

repeat

$j \leftarrow j+1$;

$Y^{(j)}(n)|_{n=0} \leftarrow Y^{(j-1)}$;

Forn : 1 to Ndo

Z(n), x(n), X(n) $\leftarrow$ according to (16),(17),(18);

V(n) $\leftarrow$ random matrix;

X (n) $\leftarrow$ X (n) - V (n);

$d(n) \leftarrow x(n) - \sum_k y_k^{(j)}(n-1)\hat{x}_k(n)^T$;

$e(n) \leftarrow d(n) - \sum_k y_k^{(j)}(n-1)\hat{v}_k(n)^T$;

for k =1 to K do

$y_k^{(j)}(n) \leftarrow y_k^{(j)}(n-1) + \frac{\mu}{||v_{k\,(n)}||^2} v_k(n)e(n)$;

End for

$Y_Q(n) \leftarrow F_Q\left(Y^{(j)}(n)\right)$;

If$\left(\sum_{k=1}^{K} y_k^{Q}(n) r_k^T \geq R_{tot}^{(j-1)} \& \sum_{k=1}^{K} y_k^{Q}(n)\, l_k^{\ell^T} \leq\right.$ Ithℓ, $\forall$l then

$Y^{(j)} \leftarrow Y_Q(n)$;

Break

End if

End for

$R_{tot}^{(j)} \leftarrow \sum_{k=1}^{K} y_k^{(j)} r_k$;

Until$(||R_{tot}^{(j)} - R_{tot}^{(j-1)}|| / R_{tot}^{(j)} \leq \epsilon)$

Step 2: power allocation

$p_{km} \leftarrow$ Solution using an interior point method

3.2.2. Algorithm 2: Energy Efficiency Algorithm

Step 1. Initialization

Step 2. Feasible point $x \in R^{2KN+1\times 1}, \epsilon > 0, \epsilon_n > 0, t = t^{(0)} > 0, \mu > 1, \alpha \in \left(\frac{0{,}1}{2}\right), \beta \in (0{,}1)$.

Step 3. repeat

Step 4. Newton method

Step 5. Starting point x , subject to Bx =1

Step 6. repeat

Step 7. Compute $\Delta_{x_{nt}}$ and $\lambda^2 = -\nabla_{\psi_t}(x)^T \Delta x_{nt}$

Step 8. Backtracking line search

Step 9. s =1;

Step 10. while $\psi_t(x + s\Delta x_{nt}) > \psi_t(x) - \alpha s \lambda^2$

Step 11. $s = \beta_s$

Step 12. end while

Step 13. Update x =x +sΔx_{nt}

Step 14. until $\lambda^2/2 \leq \epsilon_n$

Step 15. $t = \mu t$

Step 16. until (3KN + K + L + 3) /t < ϵ

Step 17. return x

Step 18: Energy Efficient Solution

Step 19: Stop

For proposed work, we have combined both algorithm 1 and 2 for getting efficient spectrum allocation with two objectives QoS efficient and energy efficient.

DOI 10.17148/IJIREEICE.2016.4659

IV. EXPERIMENTAL RESULTS

4.1. Network Configurations

For practical work analysis, we used Network Simulator (NS2). In NS2 we implemented and evaluated the proposed ECRRA protocol for comparative study purpose against existing and CRRA CRN methods. Below is table for network scenario to evaluate comparative study between existing and proposed methods.

Table 1: Simulation Configuration for Scenario: Varying Cognitive users

Number of Nodes	20-100
Traffic Patterns	CBR (Constant Bit Rate)
Network Size (X * Y)	1000 x 1000
Simulation Time	50s
Transmission Packet Rate	10 m/s
Pause Time	1.0s
Routing Protocol	AODV
MAC Protocol	802.11
Channel Data Rate	11 Mbps
Mobility Speed	5 m/s
Spectrum Allocation Method	Existing/CRRA/ECRRA
Initial Energy	100 J
Transmitting Energy	1 J
Receiving Energy	1 J

4.2. Simulation Results

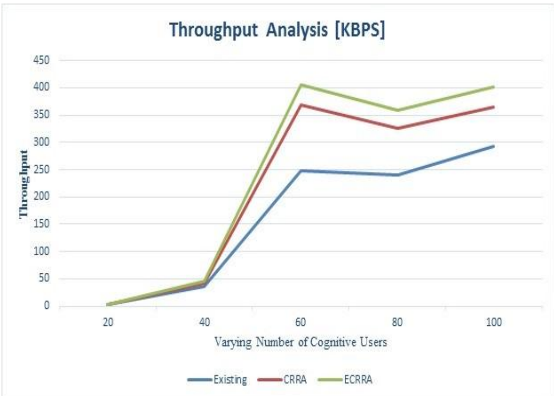

Fig. 1: Average Throughput Analysis for proposed and existing OFDM spectrum allocation technique

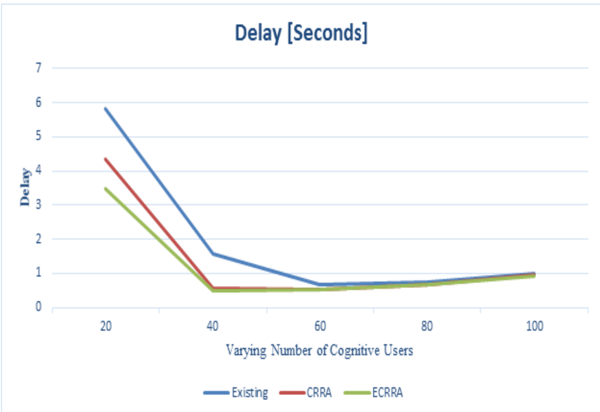

Fig. 2: Average End to End Delay Analysis for proposed and existing OFDM spectrum allocation technique.

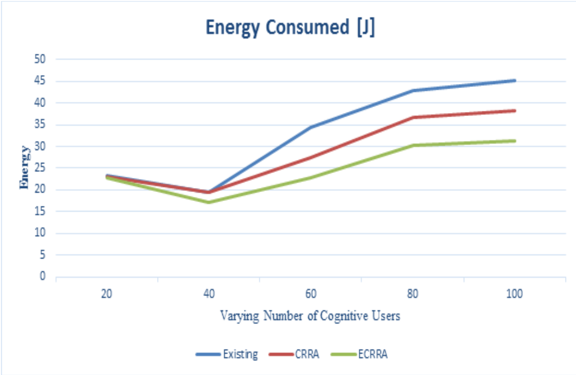

Fig. 3: Average energy consumed analysis for proposed and existing OFDM spectrum allocation technique

There are three performance metrics we considered for evaluation of proposed energy efficient spectrum allocation technique for OFDM systems such as average throughput, average end to end delay and average energy consumption. The throughput and delay used to claim the QoS (Quality of Service) solution and energy is used to claim the energy efficiency for proposed hybrid spectrum allocation method.

Above results showing in figure 1, 2 and 3, showing that proposed approach ECRRA is outperforming the existing CRRA and traditional method of resource allocation. The proposed Energy efficient CRRA method showing throughput improvement for all network conditions. Energy and delay minimization for all varying network conditions as compared to existing methods.

V. CONCLUSION AND FUTURE WORK

For OFDM systems of cognitive radio networks, there are 2 major analysis challenges that we studied throughput this paper such as energy efficiency and spectrum allocation efficiency. There are number of ways presented for efficient spectrum allocation, but having limitations in terms of less QoS performance or worst energy performance. During this thesis we listed range of literature strategies for energy efficiency in CRN and spectrum allocation efficiency in CRN. As energy is critical resource of CRSs, we have presented the connected study over it during this presentation. We proposed new hybrid technique for resource allocation with objectives of minimum energy consumption and maximum throughput. In this method 1st we studied the resource allocation in an OFDM primarily based CRN That dynamically primary users (PUs) spectrum channel available on the senses and uses. Maximum output such that the constraint and psychological intervention pus CR network feature users (clients) transmission power is maximized under budget objective resource allocation. In addition to the current method, we used instant barrier technology resource allocation in CRN to improve energy efficiency. The simulation work is done by using NS2 with different number of cognitive users to check the scalability and reliability of projected approach performance. From the simulation results it showing that proposed technique showing 35 the worries throughput improvement as compared to existing ways, whereas 20

DOI 10.17148/IJIREEICE.2016.4659

the worries delay minimization as compared to existing methods. The energy consumption is minimized by 25 the worries for proposed technique.

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