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Resource Allotment Approach for Multi-user Cognitive Radio Systems: Position-Alert Field Access

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Abstract

This paper considers a new power strategy and channel allocation optimization for secondary users (SUs) in an OFDM based cognitive radio network where the coverage area of the secondary network is divided into an Overlay Region and a Hybrid Region. SUs in the Overlay Region can adopt the overlay spectrum access method while SUs in the Hybrid Region may adopt underlay or sensing free spectrum access. We first present a general resource allocation framework that optimizes the power and channel allocation to secondary users who adopt these different spectrum access methods depending on their locations. In order to enable sensing free spectrum access, we then propose a new algorithm that incorporates an interference violation test to decide the parameters in the general framework. The proposed scheme intelligently utilizes frequency and space opportunities, avoids unnecessary spectrum sensing and minimizes the overall power consumption while maintaining the quality of service of a primary system. Simulation results validate the effectiveness of the proposed method in terms of energy efficiency and show that enhanced performance can be obtained by utilizing spatial opportunities.

Index Terms— Cognitive radio, energy efficiency, resource allocation, location-aware strategy, OFDM.

I.INTRODUCTION

By permitting secondary users (SUs) to opportunistically access or share the underused spectrum of primary authorized networks, psychological feature radio (CR) has been distinguished as a promising technology to enhance the spectrum utilization potency and meet the tight needs in future wireless networks [1], [2]. Reckoning on the spectrum policies set by a primary system, the dynamic spectrum access mechanism is typically classified as overlay spectrum access and underlay spectrum access. In associate degree overlay-based system, mammal genus access the spectrum only it's not being employed by the first system [3] whereas in associate degree underlay-based system, mammal genus exist with the first system and transmit with power constraints to avoid unacceptable interference and guarantee the standard of service (QoS) of the first system [4], [5]. Recently, power and channel allocation in orthogonal frequency-division multiplexing (OFDM)-based chromium systems have received an excellent deal of attention [6]–[13]. Completely different spectrum access strategies need distinct resource allocation ways. For the overlay-based systems, hard-decision resource allocation (HDRA) and probabilistic resource allocation (PRA) taking into consideration spectrum sensing errors are studied in [14] and references in this. For the underlay-based system, interference management among mammal genus and first users (PUs) play a key role within the resource allocation. So as to guard the first system, most literature constrains the interference caused by mammal genus below a threshold in either average (long term) or fast (short term) sense, e.g., [4], [15] and [7]. in contrast to the previous literature that takes into consideration the number of interference to the first system because the protection criterion, the authors of [11] rethink the protection to the first system and mammal genus through completely different levels of protection in signal to interference-and-noise magnitude relation (SINR). Besides, several researchers think about resource allocation with joint overlay and underlay spectrum access. for example, subcarrier-and-power-allocation schemes for a joint overlay and underlay spectrum access mechanism are planned in [8] for a downlink transmission state of affairs in an exceedingly centralized multi-user chromium network, wherever each unused and underused spectrum resources are used and also the interference introduced to the chemical element is unbroken below given thresholds with an explicit chance. In [12], the authors use a hybrid overlay/underlay spectrum sharing theme for a distributed chromium network, permitting associate degree SU to adapt its means of accessing the authorized spectrum consistent with the standing of the channel. If the chosen channel is detected to be unoccupied, the SU works in associate degree overlay mode, otherwise it works in spectrum underlay. Associate degree auction-based power allocation theme is planned to resolve power competition of multiple mammal genus. These aforesaid works are supported the most rate style subject to associate degree overall power constraint. On the opposite hand, energy-efficient style attracts a lot of attention from researchers recently. The energy-efficient power allocation drawback of OFDM-based chromium systems is studied in [13], wherever energy potency outlined because the magnitude relation of knowledge rate to power is taken because the objective perform within the improvement for the aim of holding the promise of advancing inexperienced communications. All told these aforesaid work, each SU uses identical kind of spectrum access strategies, be it overlay, underlay or hybrid. In reality, it's natural for mammal genus at completely different locations to use different spectrum access strategies. As an example, SU`s close to or within the first system cannot share the channels with PUs and thus ought to use overlay spectrum access, whereas mammal genus settled far away from the chemical element system could use underlay spectrum access additionally to overlay, or perhaps sensing free spectrum access planned in [16]. In fact, area chance, which might enhance the spectrum and energy potency, wasn't thought-about in most of the prevailing work. In our previous work [14], a completely unique location-aware power allocation framework that showing intelligence utilizes frequency and is opportunities of the spectrum was planned. However, in this work, we have a tendency to solely thought-about the facility allocation for the one SU case. Resource allocation ways for a secondary network consisting of mammal genus with location dependent heterogeneous spectrum access haven't been studied within the literature. The primary contribution of this paper is to increase [14] to contemplate multiple mammal genus detached in an exceedingly secondary network and devises a general drawback formulation that comes with all the spectrum access strategies and permits completely different modes for clearly settled mammal genus by setting the parameters during this formulation. In contrast to the one user case, channel allocation likewise as power allocation ought to be enclosed during this formulation. Meanwhile, to attain associate degree energy efficient style, we have a tendency to minimize the entire power consumption with a given date rate demand during this drawback formulation. Our resource allocation incorporates the hard-decision primarily based approach for overlay spectrum access, the spectrum sharing primarily based approach for underlay spectrum access, and also the sensing free primarily based approach. The performance of those approaches extremely depends on the constellation, and above all, the gap between the SU transmitter and also the chemical element receiver. In general, it's not simple to determine whether or not spectrum sensing for every channel is needed or not notwithstanding the situation data is understood. Therefore, the second contribution of this paper is to propose a completely unique interference violation check to seek out the channels that don't have to be perceived and additional avoid inessential spectrum sensing to enhance energy potency. supported the interference violation check result, the planned location-aware style then incorporates location data to access the spectrum adaptively and achieves improved energy potency (cf. formula 1). The rest of the paper is organized as follows. In Section II, system model and drawback formulation are represented and Section III describes the location-aware multi-user resource allocation. In Section IV, associate degree interference violation check for every sub-channel is mentioned and also the formula for overall resource allocation is given. In Section V, many numerical examples are provided let's say the performance improvement of the planned theme over ancient resource allocation schemes. Finally, conclusions are drawn in Section VI.

II. SYSTEM MODEL AND PROBLEM FORMULATION

This paper considers a state of affairs that one metal system coexists with one primary system, wherever K mobile SU`s area unit human activity with a psychological feature base station (CBS) within the transmission and PUs area unit receiving signals from

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a primary base station (PBS) within the downlink, as portrayed in Fig. 1, the circle to the left represents the service vary of the first system and therefore the shaded circle to the proper represent that of the metal system.

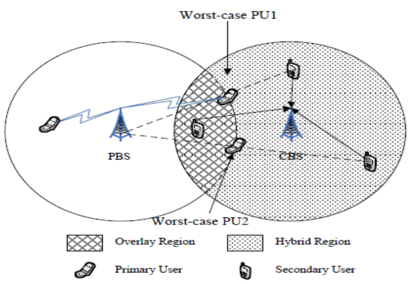

Fig. 1: A CR system coexisting with a primary system (uplink scenario for the CR system). Two regions are highlighted for the CR system to operate different spectrum access methods.

The intersection of the 2 circles constructs what we tend to decision the Overlay Region. The remaining a part of the metal service region is termed the Hybrid Region. to make sure the effectiveness of the theme planned during this paper, we tend to assume that for every SU within the Hybrid Region, there's a corresponding worst case element location (located at the intersection of the PBS service region boundary and therefore the line between the PBS and therefore the SU itself), that is that the nearest to the present SU. We tend to believe that if the worst case element (regardless whether or not this element is really gift or not) is protected, all the PUs inside the coverage space of the first system are protected against the transmission of the corresponding SU in future. The matter formulation and analysis thenceforth apply equally to the secondary downlink state of affairs and thus this paper focuses on the secondary transmission. We tend to assume that the first system and metal system area unit OFDM-based systems, with the licensed spectrum being divided into N sub-channels of similar information measure with every sub-channel experiencing flat attenuation. It's additionally assumed that there's no spectrum sensing error, and thus the case of imperfect sensing is out of the scope of this paper. As we tend to shall show, betting on the situation of SU`s, resource allocation style ought to exhibit associate adaptative structure, permitting various spectrum access ways once the SU`s comprise completely different service regions 1. so as to avoid mutual interference among SU`s, we tend to assume that every sub-channel is at the most allotted to at least one SU and every SU could also be allotted over one sub-channel. additionally, it's assumed that N ≥ K and therefore the variety of unoccupied channels is larger than the amount of SU`s settled within the Overlay Region. Finally we tend to assume that the CBS coordinates channel and power allocation and spectrum sensing (if necessary) in a very centralized manner.

Transmit power management plays a vital role in energy economical communication to prolong the life of the network and come through the goal of inexperienced communication. Therefore, rather than maximizing the system rate over restricted power resource [18] as most of the relevant works do, we tend to formulate here a complementary QoS drawback [19] .

1 The location information of the network can be obtained using, e.g., the cognitive positioning system [17].

TABLE I: Parameter Definitions in Problem **P1**

	Overlay	Underlay	SFRA
$\mathcal{A}$	the set of detected unoccupied sub-channels		N/A ($=\emptyset$)
$\mathcal{N}$	the set of detected occupied sub-channels		$\{1, 2, ..., N\}$
$P_{i,k}$	transmit power allocated on the ith sub-channel for the kth SU		
P_p	transmit power of the PBS		
$R^{\min}$	minimum rate requirement of the SUs		
$P_k{}^{\max}$	power budget of the kth SU		
$I_i^{\max}$	QoS threshold of the ith sub-channel for the primary system		
h_i^{PS}	instantaneous channel gain on the ith sub-channel from PBS to CBS (path loss, shadowing, and small scale fading)		
$h_{i,k}^{SS}$	instantaneous channel gain on the ith sub-channel from the kth SU to CBS (path loss, shadowing, and small scale fading)		
$L_{i,k}^{SP}$	average channel gain on the ith sub-channel from the kth SU to the worst-case PU (path loss and shadowing)		
σ^2	noise power of each sub-channel at the CBS		
$\alpha^{(k)}$	spectrum sharing indicator of the kth SU ($\alpha^{(k)} = 0$ for Overlay Region user and $\alpha^{(k)} = 1$ otherwise)		
$\rho_{i,k}$	channel allocation indicator ($\rho_{i,k}$=1 represents allocating the ith sub-channel to the kth SU)		

with the target of minimizing the general power consumption subject to a minimum rate demand. The psychological feature resource allocation drawback allowing completely different spectrum access ways for SU`s is developed by a general framework as

$$(\mathbf{P1}) \quad \min_{P_{i,k}, \rho_{i,k} \forall i,k} \quad \textstyle\sum_{k=1}^{K} \sum_{i \in \mathcal{A} \bigcup \mathcal{N}} \rho_{i,k} P_{i,k}$$

$$\text{s.t.} \ \ R_k = \sum_{i \in \mathcal{A}} \rho_{i,k} \mathcal{C}\left(\frac{P_{i,k} h_{i,k}^{SS}}{\sigma^2}\right)$$

$$+\alpha^{(k)} \sum_{i \in \mathcal{N}} \rho_{i,k} \mathcal{C}\left(\frac{P_{i,k} h_{i,k}^{SS}}{\sigma^2 + P_p h_i^{PS}}\right) \geq R^{\min}, \forall k \tag{1}$$

$$\textstyle\sum_{i \in \mathcal{A} \bigcup \mathcal{N}} \rho_{i,k} P_{i,k} \leq P_k{}^{\max}, \forall k \tag{2}$$

$$\alpha^{(k)} \rho_{i,k} P_{i,k} L_{i,k}^{SP} \leq I_i^{\max}, \qquad \forall i \in \mathcal{N}, \forall k, \tag{3}$$

$$\sum_{k=1}^{K} \rho_{i,k} \leq 1, \rho_{i,k} \in \{0, 1\}, \forall k, i, \tag{4}$$

wherever the parameters area unit explained in Table I, the perform C(x) = log2 (1 + x) denotes the Claude

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E. Shannon rate, the information measure of every sub-channel is assumed to be unitary, the minimum knowledge necessities for all the users area unit assumed to be identical and Pp is assumed to be proverbial. the common channel gains from system A to system B, L AB, area unit obtained supported path loss attenuation model d −r for a distance d with exponent r, i.e., L AB = d −r AB, wherever d_{AB} denotes the gap between the transmitter in system A to the receiver in system B. The overlay-based approaches utilize solely unoccupied sub channels supported sensing results associated therefore the spectrum sharing indicator α (k) = zero for an SU within the Overlay Region. The underlay-based approaches enable spectrum sharing associated therefore we've got α (k) = one for an SU within the Hybrid Region. Not like ancient overlay systems, underlay-based systems additional utilize those occupied sub-channels with further protection to the PUs. Note that for underlay-based systems, the interference constraint (3) in P1 guarantees protection to the first system on a median sense and thus supports primary system QoS. Another resource allocation theme termed sensing-free resource allocation (SFRA), relies on sensing free spectrum access, that lets SU`s treat all the sub-channels while not spectrum sensing whereas incorporating the interference constraint (3). Once the matter P1 is employed to represent SFRA, the spectrum sharing indicator α (k) = one and therefore the alternative parameters area unit set in step with Table I with A = ∅, and $\mathcal{N}$ ={1,2,….N} . The resource allocation drawback P1 wants the sub-channel availableness info, i.e., the sets A and N , which may be obtained by spectrum sensing. For a given configuration, CBS calculates every SU's distance to PBS and determines that region the SU falls into. Associate SU within the Overlay Region solely accesses sub-channels in an SU within the Hybrid Region is assigned sub-channels in each A and N.

III. LOCATION-AWARE MULTI-USER RESOURCE ALLOCATION

With the placement info of the SU`s, the key a part of the planned resource allocation theme during this paper is deciding the acceptable parameters for P1, e.g., A, N and $\alpha^{(k)}$, and determination it. During this section, we have a tendency to concentrate on determination P1 with the belief that everyone the parameters are determined.

Problem: P1 are often impossible because of the presence of the entire power constraint (2) and interference constraint (3). This happens once the entire power budget P_k grievous bodily harm or interference capped power cannot support the target minimum rate R^{min} for a given set of channel realizations. We will add a slack variable in (2) or (3) to seek out the minimum P^{max} or I_i^{max} that produces P1 possible [20]. Once P1 is possible, it can't be solved directly since it's a non-convex downside. To unravel P1, we have a tendency to utilize the twin decomposition approach [21] and also the dual downside of P1 are often given as

$$\textbf{(P2)} \quad \underset{\mu}{\text{maximize}} \quad \min_{P_{i,k},\rho_{i,k}\forall i,k} \mathcal{L} \qquad \text{s.t.} \quad \mu_{\mathbf{k}} \succeq 0, \tag{5}$$

Where µk could be a vector of non-negative Lagrangian multipliers for user k and L is that the Lagrangian.

Since P1 isn't biconvex, the twin downside P2 provides an answer that is an edge to the answer of P1. The edge isn't invariably tight, and also the distinction between the edge and also the true optimum is termed the "duality gap." once the duality gap is zero, they need identical solutions. To point out the duality gap between P1 and P2 is zero, we have a tendency to initial introduce the definition of time-sharing condition [21].

Definition 1[2]. Let $P1^*_{i,k}$ and $P2^*_{i,k}$ be optimum solutions to the optimization downside P1 with $R^{min} = R_1^{min}$ and $R^{min} = R_2^{min}$, severally (for ∀i, k). The corresponding channel allocation results area unit $\rho1_{i,k}$ and $\rho2_{i,k}$, severally. An optimization downside of the shape P1 is claimed to satisfy the time-sharing condition if for any R_1^{min} , R_2^{min} and for any $0 \leq v \leq 1$, there invariably exists a possible answer $P^*_{i,k}$ and channel allocation $\rho_{i,k}$ specified for ∀k, $Rk(P^*_{i,k}, \rho_{i,k}) \geq vR_1^{min}+(1-v)R_2^{min}$, and

$$\sum_{k=1}^{K}\sum_i \rho_{i,k}P^*_{i,k} \leq v\sum_{k=1}^{K}\sum_i \rho1_{i,k}P1^*_{i,k} + (1-v)\sum_{k=1}^{K}\sum_i \rho2_{i,k}P2^*_{i,k}.$$

Then we've the lemma as shown below:
Lemma 1. The optimization downside P1 satisfies the timesharing property once the info rate needs for the entire users are identical, and it's a zero duality gap, i.e., the primal downside P1 and also the twin downside P2 have an equivalent optimum worth.

Proof: once the info rate needs for all the users area unit identical, the channel allocation results ρi,k keep constant as R^{min} varies. For every R^{min} , R_k could be a summation of some index functions of the allotted power. Thus, it's easy that for the optimum power answer, R_k could be a biconcave operates of the optimum overall power consumption of user k with any channel allocation result. For P1, with the optimum power allocation, the achieved rate is really adequate the minimum rate demand. Therefore, for any $0 \leq v \leq 1$, $Rk(P^*_{i,k}) \geq vR_1^{min} + (1 - v)R_2^{min}$ when

$$\sum_i \rho_{i,k} P^*_{i,k} = \sum_i \rho_{1i,k} v P1^*_{i,k} + \sum_i \rho_{2i,k}(1-v) P2^*_{i,k}.$$

.this means that P1 satisfies the time-sharing property. From [21], if the optimization downside satisfies the timesharing property, then it's a zero duality gap that completes the Proof 3 .

Problem P2 then are often solved by the algorithmic program and also the sub gradient methodology introduced in Section IV of [21].

IV. ADAPTIVE RESOURCE ALLOCATION WITH INTERFERENCE VIOLATION TEST

Instead of deciding A and N before determination P1, we will conjointly think about employing SFRA to avoid uncalled-for spectrum sensing. The thought relies on the actual fact that if the first system QoS may be maintained (constraint (3) in P1 holds) despite whether or not the according channels being occupied or not, it's not necessary to perform spectrum sensing. To be additional specific, CBS calculates the resource allocation answer by determination P1 with changed interference constraints shown below.

$$\rho_{i,k} P_{i,k} L^{SP}_{i,k} \leq I^{\max}_i, \quad \forall i \in \mathcal{V}, k \in \text{Hybrid Region} \quad (6)$$
$$\rho_{i,k} P_{i,k} \leq 0, \quad \forall i \in \mathcal{V}, k \in \text{Overlay Region} \quad (7)$$

Where V could be a channel set representing those sub-channels that can't support primary system QoS. At the start of the repetitive improvement procedure, V is initialized to Ø that is such as assumptive all sub-channels may be used while not sensing. it's value noting that I grievous bodily harm i for the sub-channels allotted to the mammal genus situated within the Overlay Region ought to be set to zero, and therefore the according sub-channels ought to be perceived. With the obtained power and channel allocation results, the generated interference to PUs for those sub-channels in N

Will be checked to seek out whether or not the first system QoS in (6) and (7) is maintained. This is often referred to as the interference violation check. Those sub-channels that can't support the first system QoS are further into the channel set V. SFRA isn't applicable for those sub-channels happiness to V. As a result, spectrum sensing is needed. Consistent with the spectrum sensing results, A and N are updated. Conjointly if a sub-channel in V is perceived to be unoccupied by PUs, it may be aloof from V. Then next iteration of improvement is needed with interference constraints (6) and (7) so the new improvement answer satisfies the first systems QoS in antecedently desecrated sub-channels. the next interference violation check can update V if new unsensed sub-channels are found to violate the interference constraints, followed by spectrum sensing for the new members of the set V and also the update on A and N consistent with the sensing result. This repetitive improvement procedure stops once there's no sub-channel being further into V when the interference violation checks. Then the best answer for resource allocation may be obtained. The rule for the planned adaptive resource allocation theme is given in rule one as shown below. Once rule one converges, the obtained answer satisfies all the constraints in P1. Therefore, this answer is a minimum of a suboptimal answer (the best answer is obtained by determination P1/P2 with all the sub-channels sensed). The planned rule avoids uncalled-for spectrum sensing and thence cut back the energy consumption, at the value of additional improvement computation. This provides a trade-off between sensing energy consumption and signal process power consumption. Once the amount of channels is massive, it's believed that the planned rule is less dimmed.

V. NUMERICAL EXAMPLES

In this section, we tend to gift simulation results to demonstrate the performance of the projected resource allocation strategy and algorithms. We tend to take into account a situation shown in Fig. 1, wherever the secondary links decide to access the spectrum of the first system. each the service radius of the first system, R1, which of the atomic number 24 system, R2, are set to be 1000m. The coordinates of CBS and PBS are (0, 0) and (−1500, 0), respectively.

There are five genus SU`s existing during this space with completely different coordinates, and that they have identical y coordinate of −200. we tend to assume that the information measure of the first system is 1.5 MHz, that are divided into 12 sub-channels, every having a information measure of 125 KHz. The entire path-loss of every transceiver try is assumed to be tormented by each small-scale John William Strut weakening and large-scale path-loss, wherever the path loss exponent r is three. The chance of every sub-channel being unoccupied is five hundredth, the utmost transmission power of the SU P_{max} is 20 W, and also the transmission power of the

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PBS P_p is 50 W. Unless expressed otherwise, the minimum rate demand for every user is identical and R_k^{min} is 0.2 Mb/s, the noise power at CBS σ^2 and also the QoS threshold of the first system I_i^{max} set to be −20 dBmW and −25 dBmW, severally.

Algorithm 1 Proposed resource allocation algorithm

Initialize:

$\mathcal{A} = \emptyset$, $\mathcal{N} = \{1, 2, ..., N\}$, $\alpha^{(k)} = 1$ for all the users, iteration-counter $l = 0$;

P_k^{max}, R^{min}, I_i^{max}, violated channel set is initialized as $\mathcal{V}^l = \mathcal{V}^0 = \emptyset$;

Initially assume all channels are occupied by the primary network and no channels violate the interference criterion.

Repeat:

1. $l = l + 1$. For the l-th iteration, solve **P1** with modified interference constraints (6) and (7) for those channels belonging to $\mathcal{V}^{(l-1)}$ to get the corresponding power allocation $\mathbf{P}^l$ and channel allocation result $\rho_{i,k}^l$.
2. Check the interference generated to the worst-case PU for each allocated channel in $\mathcal{N}$. Those channels that can not support the primary system QoS in (6) and (7) will be added into the channel set $\mathcal{V}$ and we get $\mathcal{V}^l$.
3. If $\mathcal{V}^l = \mathcal{V}^{(l-1)}$, $\mathbf{P}^* = \mathbf{P}^l$ and $\rho_{i,k}^* = \rho_{i,k}^l$; If $\mathcal{V}^l \neq \mathcal{V}^{(l-1)}$, spectrum sensing should be performed for those channels added into $\mathcal{V}$ in this iteration. Update $\mathcal{A}$ and $\mathcal{N}$. Remove the channels in $\mathcal{A}$ from $\mathcal{V}^l$.

Until

$\mathcal{V}^l = \mathcal{V}^{(l-1)}$, $\mathbf{P}^l = \mathbf{P}^{(l-1)}$, $\rho_{i,k}^l = \rho_{i,k}^{(l-1)}$.

Output:

Optimal solution $\mathbf{P}^*$ and $\rho_{i,k}^*$;

TABLE II: Channel allocation results

	SU 1	SU 2	SU 3	SU 4	SU 5	violate
channel 1	0	0	0	0	1	NO
channel 2	0	1	0	0	0	YES
channel 3	0	0	0	1	0	NO
channel 4	0	1	0	0	0	YES
channel 5	0	0	0	0	1	NO
channel 6	0	0	1	0	0	YES
channel 7	1	0	0	0	0	YES
channel 8	0	0	0	1	0	NO
channel 9	1	0	0	0	0	YES
channel 10	0	0	0	1	0	NO
channel 11	0	0	0	0	1	NO
channel 12	0	0	1	0	0	NO

The genus SU`s find in numerous regions as shown in Fig. one and also the distance between genus SU`s locating within the Hybrid Region to the cell-edge element will be calculated by $d^{(k)}_{SP} = D_k - R_1$, wherever D_k denotes the space between the Kth SU to the PBS. The ends up in the simulation area unit obtained by employing a same set of random channel realizations for every price of $d^{(k)}_{SP}$. Fig. 2 shows the facility consumption of genus SU`s versus user ID with completely different resource allocation methods once R_k^{min} = 0.2 Mb/s. With the overlay-based theme, solely the channels being perceived idle area unit utilized. we tend to don't offer the results with the underlay-based theme since the resource allocation results victimization the underlay-based and also the projected theme area unit identical for users within the Hybrid Region, that is that the case in Fig. 3. The sole distinction lies within the power spent on spectrum sensing. The x coordinates of those genus SU`s area unit set to extend from −300 to 900 with the space of the adjacent genus SU`s being three hundred m as shown in Fig. 3. From the coordinates of the genus SU`s, we all know that everyone the genus SU`s find within the Hybrid Region.

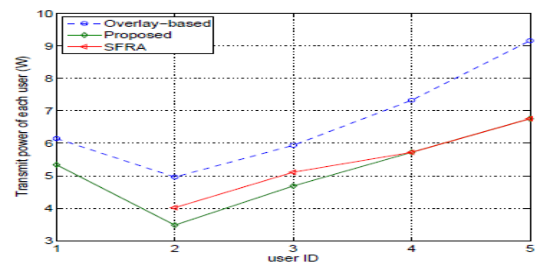

Fig. 2: The transmit power of SUs versus user ID with different resource allocation strategies (x coordinates increase from −300 to 900).

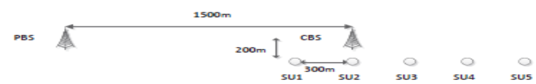

Fig. 3: The location information for simulation.

The corresponding channel allocation results with the projected theme victimization rule one area unit shown in Table II. during this table we will see that SU 4 and SU 5 are allotted another channel since they're comparatively distant from the CBS compared to alternative genus SU`s that results in less channel gain thanks to the big scale weakening. The amount of iterations for execution rule one is three, and also the interference violation check results are shown in Table II. “YES” represents that the channel has ever been within the profaned channel set V. It will be seen that spectrum sensing was performed under 5 channels which suggests we tend to saved 58% energy for spectrum sensing.

For the genus SUs being near to the worst-case element ($d^{(k)}_{SP}$ = 217 m), the interference constraints translate into terribly demanding transmit power constraints, so SFRA provides no answer to ensure the minimum knowledge demand as shown in Fig. 2. For the SU that's closest to the CBS ($d^{(k)}_{SP}$ = 513 m), the consumed power curves for each the projected theme and overlay-based theme decrease speedily as a results of less path loss, attaining the minimum price around 3.5 W and 5 W, severally. For the genus SU`s settled distant from the worst-case element, the consumed power curves for all the schemes increase

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and that we observe that the projected approach is strictly superior to the overlay-based approach in terms of power consumption, and coincides with SFRA for the genus SU`s that are sufficiently removed from the worst-case element PU.

Fig. 4 shows the energy potency of genus SU`s versus user ID with completely different resource allocation methods once $R_k^{min} = 0.2$ Mb/s. we tend to outline energy potency for user k as

$$E^{(k)} = \frac{R^{(k)}_{act}}{\sum_{i \in A^{(k)} \cup N^{(k)}} P_{i,k}},$$

wherever $R^{(k)}_{act}$ is that the actual rate supported a possible power allocation answer.

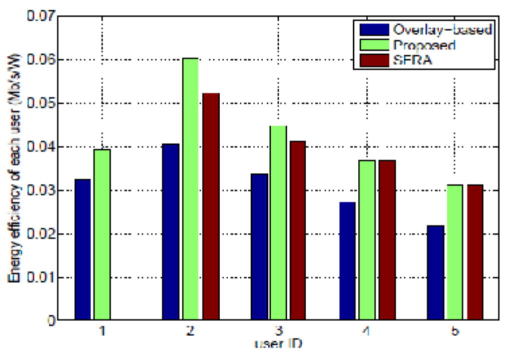

Fig. 4: The energy efficiency of SUs versus user ID with different resource allocation strategies.

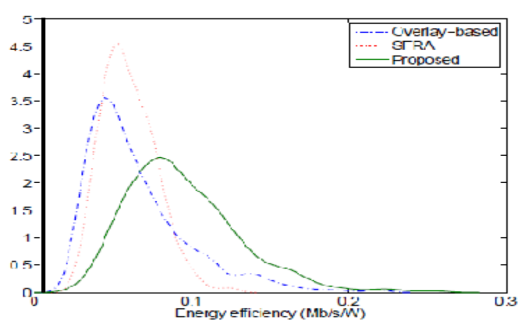

Fig. 5: The probability density functions of energy efficiency with different resource allocation strategies.

The equivalent metric for energy potency will be found in some publications, e.g., [14], [22], [23]. From this figure, we can see that the projected theme outperforms the overlay-based theme since additional channel resources are utilized. Once the SU is near to the CBS ($d^{(k)}_{SP}$ = 513 m), the energy potency of the projected theme is best than SFPA since the interference constraints of some channels are relaxed in line with potential spectrum sensing results.

To demonstrate the impact of geographical locations on energy potency, all the simulation results on top of area unit obtained by employing a same set of random channel realizations for various users. We tend to currently take into account fast random channels for every SU to produce some elaborated applied math insight into the simulations. Fig. 5 shows the chance density functions of energy potency for SU4 in Fig. 3 obtained by simulation of 1000 sets of channel realizations with completely different resource allocation schemes. The used simulation parameters are constant as those mentioned at the start of this section except the channel data. Here we tend to solely offer the results of SU4 since the entire genus SU`s have similar chance density functions associate degreed therefore we tend to take SU4 as an example. From this figure, we will see that the norm of energy potency with projected them is around 0.07 Mbps/W whereas it's solely regarding 0.03 for overlay and 0.05 for SFRA, severally. Therefore, we will conclude that the genus SU`s win the most effective performance by applying the projected theme. In summary, the projected theme is in a position to adapt to completely different resource allocation methods for genus SU`s settled at different locations and achieves the highest energy potency or smallest power consumptions all told situations.

VI. CONCLUSIONS

This paper has careful the role of adaptive resource allocation in CR networks in terms of energy potency since energy-efficiency familiarized style is a lot of and a lot of necessary for wireless communications. Supported the prevailing analysis on resource allocation for OFDM-based CR networks, this paper proposes associate degree adaptive hybrid resource allocation strategy to boost the energy potency by utilizing spectrum and spatial opportunities. A completely unique adaptive power and channel allocation algorithmic program has been projected to satisfy the projected resource allocation strategy supported the interference violation take a look at. As compared between the prevailing themes that don't think about SUs' locations and also the projected resource allocation scheme, we've found that resource allocation by considering spatial info enhances the energy potency and avoids uncalled-for spectrum sensing.

VII.REFERENCES

[1] J. Mitola, "Cognitive radio: an integrated agent architecture for software defined radio," Ph.D. dissertation, 2000

[2] S. Haykin, "Cognitive radio: brain-empowered wireless communications," IEEE J. Sel. Areas Commun., vol. 23, no. 2, pp. 201–220, 2005.

[3] Q. Zhao and M. Sadler, B, "A survey of dynamic spectrum access," IEEE Signal Process. Mag., vol. 24, no. 3, pp. 79–89, 2007.

[4] A. Ghasemi and E. S. Sousa, "Fundamental limits of spectrum-sharing in fading environments," IEEE Trans. Wireless Commun., vol. 6, no. 2, pp. 649–658, Feb. 2007.

[5] L. B. Le and E. Hossain, "Resource allocation for spectrum underlay in cognitive radio networks," IEEE Trans. Wireless Commun., vol. 7, no. 12, pp. 5306–5315, Dec. 2008.

[6] X. Zhou, G. Li, D. Li, D. Wang, and A. Soong, "Probabilistic resource allocation for opportunistic spectrum access," IEEE Trans. Wireless Commun., vol. 9, no. 9, pp. 2870–2879, 2010.

[7] X. Kang, H. Garg, Y.-C. Liang, and R. Zhang, "Optimal power allocation for ofdm-based cognitive radio with new primary transmission protection criteria," IEEE Trans. Wireless Commun., vol. 9, no. 6, pp. 2066–2075, 2010.

[8] G. Bansal, M. J. Hossain, V. K. Bhargava, and T. Le-Ngoc, "Subcarrier and power allocation for OFDMA-based cognitive radio systems with joint overlay and underlay spectrum access mechanism," IEEE Trans. Veh. Technol., vol. 62, no. 3, pp. 1111–1122, Mar. 2013.

[9] S. Wang, Z.-H. Zhou, M. Ge, and W. Chonggang, "Resource allocation for heterogeneous cognitive radio networks with imperfect spectrum sensing," IEEE J. Sel. Areas Commun., vol. 31, no. 3, pp. 464–475, Mar. 2013.

[10] Y. Tachwali, B. F. Lo, I. F. Akyildiz, and R. Agusti, "Multiuser resource allocation optimization using bandwidth-power product in cognitive radio networks," IEEE J. Sel. Areas Commun., vol. 31, no. 3, pp. 451– 463, 2013.

[11] D. Shiung, Y.-Y. Yang, and C.-S. Yang, "Transmit power allocation for cognitive radios under rate protection constraints: a signal coverage approach," IEEE Trans. Veh. Technol., vol. 59, no. 8, pp. 3956–3965, Oct. 2013

[12] J. Zou, H. Xiong, D. Wang, and C. Chen, "Optimal power allocation for hybrid overlay/underlay spectrum sharing in multiband cognitive radio networks," IEEE Trans. Veh. Technol., vol. 59, no. 8, pp. 3956–3965, Oct. 2013.

[13] J. Mao, G. Xie, J. Gao, and Y. Liu, "Energy efficiency optimization for OFDM-based cognitive radio systems: a water-filling factor aided search method," IEEE Trans. Wireless Commun., vol. 99, no. 99, pp. 534–539, Oct. 2013.

[14] T. Xue, Y. Shi, and X. Dong, "A framework for location-aware strategies in cognitive radio systems," IEEE Wireless Commun. Letters, vol. 1, no. 1, pp. 30–33, Feb. 2012.

[15] A. G. Marques, L. M. Lopez-Ramos, G. B. Giannakis, and J. Ramos, "Resource allocation for interweave and underlay crs under probabilityof-interference constraints," IEEE J. Sel. Areas Commun., vol. 30, no. 10, pp. 1922–1933, Nov. 2012.

[16] Y. Song and J. Xie, "Optimal power control for concurrent transmissions of location-aware mobile cognitive radio ad hoc networks," in Proc. IEEE Global Telecommun. Conf. (Globecom), 2009, pp. 1–6.

[17] H. Celebi and H. Arslan, "Cognitive positioning systems," IEEE Trans. Wireless Commun., vol. 6, no. 12, pp. 4475–4483, 2007.

[18] W. Chee, S. Friedland, and S. H. Low, "Spectrum management in multiuser cognitive wireless networks: optimality and algorithm," IEEE J. Sel. Areas Commun., pp. 421–430, Feb. 2011.

[19] J. Wang and D. P. Palomar, "Worst-case robust MIMO transmission with imperfect channel knowledge," IEEE Trans. Signal Process., no. 8, pp. 3086–3100.

[20] S. Boyd and L. Vandenberghe, Convex Optimization. Cambridge University Press, 2004.

[21] W. Yu and R. Lui, "Dual methods for nonconvex spectrum optimization of multicarrier systems," IEEE Trans. Commun., vol. 54, no. 7, pp. 1310– 1322, 2006.

[22] F. Meshkati, M. Chiang, H. V. Poor, and S. C. Schwartz, "A gametheoretic approach to energy-efficient power control in multicarrier CDMA systems," IEEE J. Sel. Areas Commun., pp. 1115–1129, Jun. 2006.

[23] C. U. Saraydar, N. B. Mandayam, and D. J. Goodman, "Efficient power control via pricing in wireless data networks," IEEE Trans. Commun., vol. 50, no. 2, pp. 291–303, Feb. 2002