

Cognitive Radio Spectrum Sharing Techniques : A Review

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Abstract: Cognitive Radios are promising solutions to the problem of overcrowded spectrum. Using channel selection techniques the access can be opportunistic by using frequency hopping, frequency tracking and frequency coding. Spectrum sharing cognitive radio networks allows cognitive radio users to share the spectrum bands of the licensed users. This paper explores various cognitive radio spectrum sharing techniques.

Keywords: Cognitive Radio , Spectrum Sharing

I.INTRODUCTION

Cognitive radio (CR) is a form of wireless communication which a transceiver can intelligently detect which communication channels are in use and which are not, and its avoid occupied ones when they are instantly move into unoccupied channels . For minimizing the interference to other users optimizes the use of available radio frequency spectrum. Cognitive Radio is a promising technology to alleviate the increasing stress on the fixed and limited radio spectrum. With the new paradigm shift in the FCC's spectrum management policy [1]. To increase the network performance creates opportunists for new more aggressive spectrum reuse CR technology lays the foundation for the deployment of smart flexible network that co-operativity enhance the network to increase the network performance.[8] The cognitive radio terminology was coined by Mitola, and refers to a smart radio which has the ability to sense the , learn from the history, and make intelligent decisions to adjust its transmission parameters according to the current state of the environment. The potential contributions of cognitive radios to spectrum sharing and an initial framework for formal radio etiquette have been discussed in [2].

(A) FEATURES OF COGNITIVE RADIO

1. Cognitive capability: Using this feature the cognitive radio dynamically scans the whole spectrum and finds portion for its transmission. Spectrum sensing, spectrum management and spectrum sharing are the components of the cognitive capability.
2. Reconfigurability: It is the parameter adjustment capability without any modification in the hardware components. The parameters are Operating frequency, Modulation and Transmission power etc.

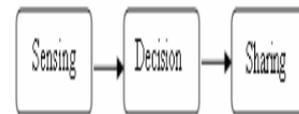


Fig 1. Block Diagram of Cognitive Capability

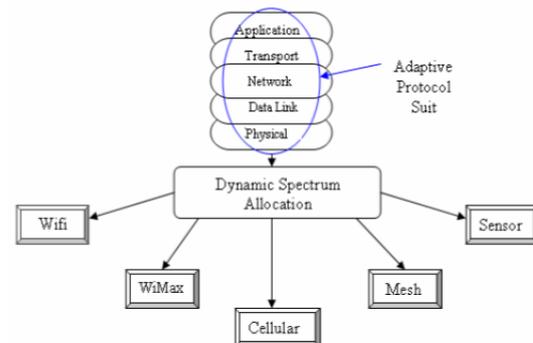


Fig 2. Block Diagram Of Reconfigurability

(B) FUNCTIONS OF COGNITIVE RADIO

Cognitive Radio has main four function blocks:

1. *Spectrum sensing* aims to detect the unused spectrum and sharing it without harmful interference with other users.
2. *Spectrum management* capture the best channel to establish communication
3. *Spectrum mobility* maintain the channel in case the PU is detected.
4. *Spectrum Sharing* distribute the spectrum among the secondary users according to the usage cost.[3,4]

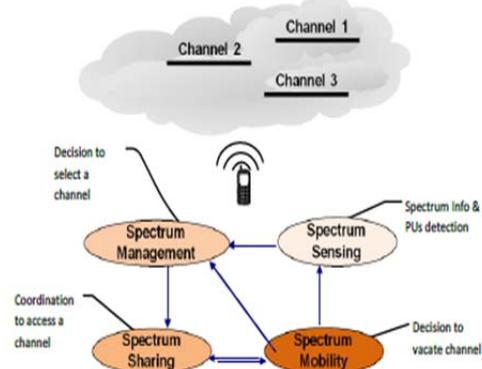


Fig 3. cognitive radio main function

II. Spectrum Sharing Aspects and Techiques:

It refers to providing the fair spectrum scheduling method, one of the major challenges in open spectrum usage is the spectrum sharing. The main challenge after detecting the available spectrum is to access or share the spectrum among the secondary users of the cognitive radio. The solutions for spectrum sharing in cognitive radio networks can be mainly classified in three aspects:[6]

- a. Network Architecture
- b. Spectrum Access
- c. Spectrum Allocation

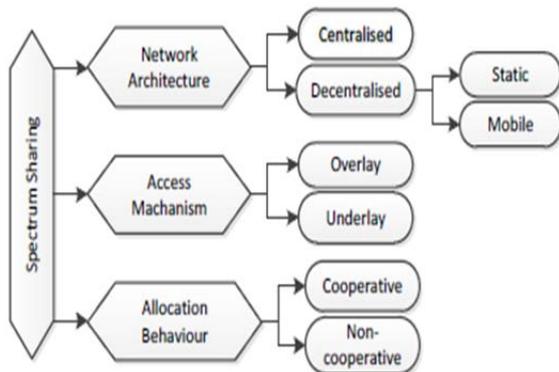


Fig 4. spectrum sharing Techniques

The first spectrum sharing techniques in the cognitive radio network based on network architecture. It has two types :

1. *Centralized spectrum sharing*: In this, a centralized entity controls the spectrum allocation and access system. Each entity in the cognitive radio network forwards the range of the spectrum allocation to the centralized entity. Using this range, the centralized entity constructs the spectrum allocation map.
2. *Distributed spectrum sharing*: In this, spectrum sharing is used where the development of the framework is not necessary. In it no need of the centralized entity, each and every node is responsible for the spectrum allocation and access is based on local policies.

The second spectrum sharing techniques in cognitive radio networks based on access behavior, which is of two types:

1. *Cooperative spectrum sharing*: In the cooperative method, CR users are responsible for coordinating the functionalities of the cognitive network in order to ensure the optimisation of the spectrum utilisation and improving network efficiency through the exchange of information..
2. *Non-cooperative spectrum sharing*: This is also called as the non collaborative spectrum sharing (selfish) solution. Non-cooperative systems, CR users are not responsible for coordinating the cognitive functionalities with other cognitive devices. The main difference between these two methods is relatively clear: the first approach essentially requires the exchange of information; hence a common control channel (CCC) is required to facilitate the information exchange. However, in the second approach, the cognitive nodes do the network functions tasks on their own without the need for any collaboration from other cognitive users. This would make the task more

challenging and difficult for a cognitive user. In addition, this can affect the performance due to reasons like lower efficiency, slower sharing of spectrum resources allocation, and less reliability than the cooperative technique[7]

The third spectrum sharing techniques of the cognitive radio is based on the access technique; these are two types:

1. *Overlay spectrum sharing*: In this, the node accesses the network using a spectrum hole which is not used by the primary user (licensed user), so that the interference to the primary user is reduced.
2. *Underlay spectrum sharing*: In this the node accesses the networks by observing the spread spectrum techniques developed for the cellular networks. When the spectrum allocation map is ready, the cognitive radio begins transmission. Due to this, at certain position, it will interfere with the primary user and causes interference. This solution needs increased bandwidth compared to the overlay technique.

III. LITERATURE REVIEW

Mitola et al.[1] discuss the non-cooperative power allocation matching problem in cognitive wireless mesh networks formed by a number of clusters with the consideration of energy efficiency. Due to the secondary users' selfish and spontaneous features, the problem is modeled as a stochastic learning process. Q learning processes, a learning SU performs Q-function updates based on the conjecture about the other SUs' behaviors. This learning algorithm provably converges given certain restrictions that arise during learning procedure.

Saleem et al[2] discuss the techniquetry to maximize different parameters with the objective maximizing the utility of spectra. According to Federal Communication Commission (FCC) more than 70% of the available channel is not utilized optimally.

Baldini et al.[3] discuss the overview of Cognitive radio. This paper summarize the challenges in the context of the future evolution of CR techniques. This is provide the survey of security aspects and techniques which is required in the CR process.

Domenico et al.[4] discuss the future design challenges of cognitive MAC protocols. In this paper Available resource are schedule(dynamic spectrum allocation) improving coexisting between users that belong to heterogenous system (dynamic spectrum sharing). Various functions of Cognitive radio are discussed in this paper.

IV. CONCLUSION

In this paper we have reviewed different spectrum sharing technique available in literature. Cognitive radio is one of the methods to utilized the spectrum efficiently and key element of cognitive radio is spectrum sharing .

These techniques when implemented in real world, will prove as a boon to everyone. The spectrum will be efficiently used and available for a person in need. Spectrum sharing is used for share the spectrums. If any channel(licensed channel) is free then another channel (unlicensed channel) can access the free channels.

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