

CHANNEL ALLOCATION METHODS FOR DIFFERENT FREQUENCY RANGE IN MOBILE COMMUNICATION

AASHIF

spectrum holes available for employment by secondary users. to

Radio Environment to detect the spectrum holes, The primary objectives of cognitive radio are

ABSTRACT

I. INTRODUCTION

There is a growing demand for spectrum to accommodate future wireless services and applications. The present fixed allocation schemes have indicated a low utilization of the spectrum over both space and time. Hence, to satisfy the demands of applications it can be inferred that dynamic spectrum usage is a required necessity. According to the IEEE 802.22 standard the unlicensed secondary devices can operate in the licensed TV band, because this is the high underutilized licensed band, so long they do not interfere the licensed primary users. Therefore, the secondary users having cognitive radio features will automatically switch to another channel or mode upon detecting the primary user in its operating band. This paper is mainly concentrating on cognitive radio. Cognitive Radio is the fastest growing topic of research today. Undertaking the communication, what is the most important and precious natural resource? Radio Electromagnetic Spectrum. Various wireless applications require some bandwidth. Even with the most advanced technologies, radio spectrum allotted is limited. And even, the large portion of the assigned spectrum is used such that the geographical variations in the utilization of the allotted spectrum, ranges from 15% to 85% with high variance in time. That's why we need some method for utilization of that wasted part. Cognitive Radio is just an approach of research to improve the utilization of this precious natural resource. What does it do to solve this problem? Sense the provide highly reliable communication for all users of the network and to facilitate efficient utilization of the radio spectrum in fair- minded way.

Electromagnetic spectrum is a natural resource, the use of which is licensed by the government agencies and is assigned to license holders or services on long-term basis for large geographical regions. It is due to this regulation that spectrum access is the bigger problem than physical scarcity of spectrum. In this way, it limits the ability of potential spectrum users to obtain such access. The underutilization of spectrum leads to think about spectrum holes. Spectrum holes are nothing but basically, a band of frequencies assigned to primary user, but at a particular time and geographic location, the band is not utilized by that user. Beside this, the need for high rate of data transfer is increasing because of change of voice – only communication to multimedia type. The current static frequency allocation by the government agencies cannot tolerate the requirements of higher data rate devices. So the better utilization of spectrum can be achieved by making it possible for secondary users, who are not being serviced, to access a spectrum hole occupied by the primary user at right location and time. Cognitive Radio merges as the most tempting solution for these problems FCC (Federal Communication Commission) definition of Cognitive Radio is:

Keywords— Cognitive Radio, Next Generation, Electromagnetic Spectrum.

“Cognitive Radio: A radio or system that senses its operational electromagnetic environment and can dynamically and autonomously adjust its radio operating parameters to modify system operation, such as maximize throughput, mitigate interference, facilitate interoperability, access secondary markets” Specifically, the cognitive radio technology will enable the user to (1) determine which portions of the spectrum are available and detect the presence of licensed users when a user operates in a licensed band (spectrum sensing), (2) select the best available channel (spectrum management), (3) coordinate access to this channel with other users

(spectrum sharing), and (4) vacate the channel when a licensed user is detected (spectrum mobility).

These functionalities enable spectrum-aware communication protocols. However, the dynamic use of the spectrum causes adverse effects on the performance of conventional communication protocols, which were developed considering a fixed frequency band for communication.

II. COGNITIVE RADIO

Recalling the definition of cognitive radio, the two characteristics of the cognitive radio can be defined:

- **Cognitive capability:** Cognitive capability refers to the ability of the radio technology to capture or sense the information from its radio environment. This capability cannot simply be realized by monitoring the power in some frequency band of interest but sophisticated techniques are required in order to capture the temporal and spatial variations in the radio environment and avoid interference to other users. Through this, portions of the spectrum that are unused at specific time or location can be identified.
- **Reconfigurability:** Cognitive capability provides spectrum awareness whereas reconfigurability enables the radio to be dynamically programmed according to the radio environment.

is further used by a licensed user, the cognitive radio moves to another spectrum hole or stays in the same band, altering its transmission power level or modulation scheme to avoid interference as shown in Fig. 1.

Cognitive Capability

The cognitive capability of a cognitive radio enables real time interaction with its environment to determine appropriate communication parameters and adapt to the dynamic radio environment. In this section, we provide an overview of three main steps of the cognition cycle: spectrum sensing, spectrum analysis, and spectrum decision. The steps of the cognitive cycle as shown in Fig. are as follows:

- **Spectrum sensing:** A cognitive radio monitors the available spectrum bands, captures their information, and then detects the spectrum holes.
- **Spectrum analysis:** The characteristics of the spectrum holes that are detected through spectrum sensing are estimated.
- **Spectrum decision:** A cognitive radio determines the data rate, the transmission mode, and the bandwidth of the transmission. Then, the appropriate spectrum band is chosen according to the spectrum characteristics and user requirements.

Once the operating spectrum band is estimated, the communication can be performed over this spectrum band. However, since the radio environment changes over time and space, the cognitive radio must keep track of changes of the radio environment. If the current spectrum band in use becomes unavailable, the spectrum mobility is performed.

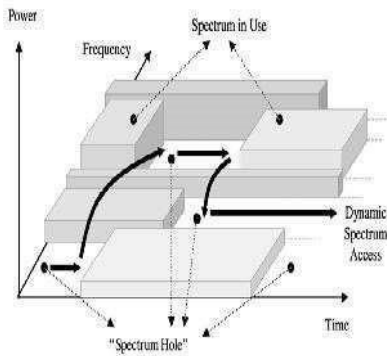
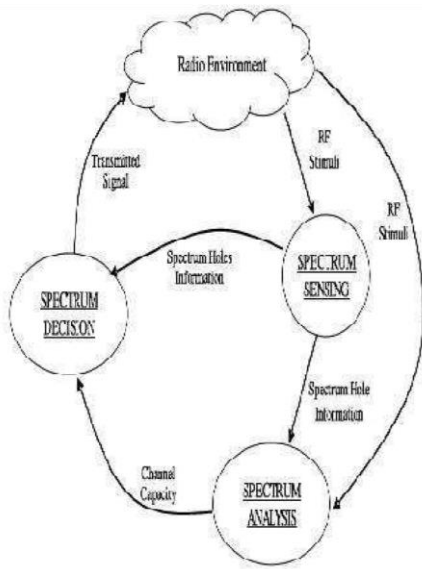


Fig. 1. Spectrum Hole Concept

The main objective of the cognitive radio is to obtain the best available spectrum through cognitive capability and reconfigurability as described before. Since most of the spectrum is already assigned, the most important challenge is to share the licensed spectrum without interfering with the transmission of other licensed user as illustrated in Fig 1. The cognitive radio enables the usage of temporally unused spectrum, which is referred to as spectrum hole. If this band



Reconfigurability

Reconfigurability is the capability of adjusting operating parameters for the transmission on the fly without any modifications on the hardware components. This capability enables the cognitive radio to adapt easily to the dynamic radio environment. There are following reconfigurable parameters as explained below:

- **Operating frequency:** A cognitive radio is capable of changing the operating frequency. Based on the information about the radio environment, the most suitable operating frequency can be determined and the communication can be dynamically performed on this appropriate operating frequency.
- **Modulation:** A cognitive radio should reconfigure the modulation scheme adaptive to the user requirements and channel conditions. For example, in the case of delay sensitive application, the data rate is more important than the error rate. So, the modulating scheme that enables the higher spectral efficiency should be selected.
- **Transmission power:** Transmission power can be reconfigured within the power constraints. Power control enables dynamic transmission power configuration within the permissible power limit. If higher power operation is not necessary, the cognitive radio reduces the transmitter power to a lower level to allow more users to share the spectrum and to decrease the interference.
- **Communication technology:** A cognitive radio can also be used to provide interoperability among different communication systems.

Transmission parameters of a cognitive radio can be reconfigured at any time, not only at the beginning of transmission but also during the transmission. According to spectrum characteristics, these parameters can be reconfigured such that the cognitive radio is switched to a different spectrum band, transmitter and receiver parameters are configured and the appropriate communication protocol parameters and modulation schemes are used.

III. SPECTRUM SENSING

The most important requirement of the next generation network is to sense the spectrum holes. A cognitive radio is designed to be aware of and sensitive to the changes in its surrounding. The spectrum sensing function enables cognitive radio to adapt to its environment by detecting spectrum holes.

Most efficient way to detect the spectrum holes is to detect the primary users that receiving data within communication range of a next generation user. In reality, however, it is difficult for a cognitive radio to have direct measurement of a channel between a primary receiver and a transmitter. This is topic of further work to solve it.

IV. SPECTRUM MANAGEMENT

In next generation networks, the unused spectrum bands will be spread over wide frequency range including both unlicensed and licensed bands. These unused spectrum bands detected through spectrum sensing show characteristics according to not only time but also operating frequency and bandwidth. Since next generation networks should decide on the best spectrum band, spectrum management functions are required for next generation networks, considering the dynamic spectrum characteristics. We classify these functions as spectrum sensing, spectrum analysis and spectrum decision.

V. SPECTRUM MOBILITY

The next generation networks target to use the spectrum in a dynamic manner by allowing cognitive radio to operate in the best available frequency band. In order to get the "Get the Best Available Channel" concept, a next generation radio has to capture the best available spectrum. Spectrum Mobility is the process when an user changes its frequency operation.

Spectrum Handoff

When current channel conditions become worse or primary (or licensed) user appears, the need for spectrum mobility arises. Spectrum mobility gives rise to spectrum handoff. The protocols for different layers of the network stack must adapt to the channel parameters of the operating frequency. Moreover, they should be transparent to the spectrum handoff and associated latency.

A cognitive radio can adapt to the frequency of operation. Each time when a next generation user changes its frequency of operation, the network protocols will shift from one node of operation to another. The purpose of spectrum mobility management is to make sure that such transitions are made smoothly and in shortest possible time such that the applications running on a user experience minimum performance degradation during a spectrum handoff. For this, mobility management protocols must learn about the duration of a spectrum handoff. This information should be provided by the sensing algorithm.

Spectrum Mobility Challenges

The following are the main challenges for efficient spectrum mobility in next generation networks.

- At a given time, several frequency bands may be available. So, algorithms are required to decide the best available spectrum based channel characteristics of the available spectrum and the requirements of the applications that are being used by a user.
- After the best available spectrum is selected, the next challenge is to design new mobility and connection management approaches to reduce delay and spectrum handoff.

When the current operational frequency becomes busy in the middle of communication by user, then the applications running on this node have to be transferred to another available frequency band.

VI. CONCLUSION

Next Generation Networks are being developed to solve current wireless network problems resulting from the limited available spectrum and the inefficiency in the spectrum usage by exploiting the existing wireless spectrum opportunistically. Next generation networks, equipped with the intrinsic capabilities of the cognitive radio. In this paper, intrinsic properties and current research challenges of the next generation networks. But I mainly focus on Spectrum Mobility, one of the characteristics of cognitive radio.

REFERENCES

- [1] S. Haykin, Cognitive radio: brain empowered wireless communications, IEEE journal on Selected Areas in Communications 23(2) (2005) 201-220.
- [2] R.W. Thomas, L.A. DaSilva, A.B. MacKenzie, Cognitive networks, in: Proc. IEEE DySPAN 2005, November 2003, pp. 352-360.
- [3] FCC, ET Docket No 03-222 Notice of proposed rulemaking and order, December 2003.
- [4] F.K. Jondral, Software-defined radio-basic and evolution to cognitive radio, EURASIP Journal on Wireless Communication and Networking 2005. [5] R Ahuja, High performance LTE technology: The future of mobile communication 2014