Challenges and Opportunities of Cognitive Radio Networks

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Abstract:- The latest trends in spectrum trading allow secondary users (SUs) to employ hybrid access models and exploit bandwidth employing either opportunistic spectrum access or exclusive spectrum access of vacant frequency bands (FBs) leased for exclusive usage. As the field of wireless communication is growing very rapidly in last ten years, the problem of bandwidth scarcity is also increasing and has become more hectic day by day. On the other hand, the studies made by Federal Communications Commission showed that large portion of the spectrum lies vacant most of the time and that portion is the licensed spectrum band; which is utilized by licensed users only. So, to solve this problem of spectrum under-utilization, Federal Communications Commission allowed secondary users to utilize the licensed band when it is not in use and named it as Cognitive Radio.

KEYWORDS :-Cognitive Radio Network, Architecture, wireless communication.

I. INTRODUCTION

A Cognitive Radio having ability to suit multi-dimensionally intelligent wireless communication system that having an importance to fulfill the consumer needs. A Cognitive Radio is capable of: 1) sensing its environment 2) adapting its physical layer functionality. The two basic objectives of cognitive radio are: highly trusted communications whenever and wherever needed and utilization properly the radio spectrum.

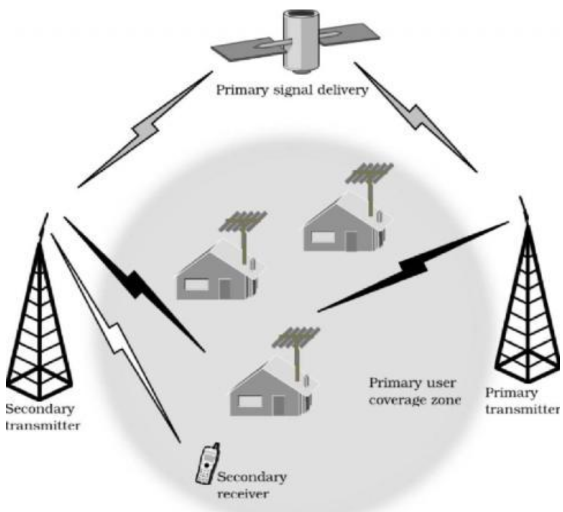

Fig. 1 Cognitive Radio

Spectrum sensing is performed by the SU to sense a spectrum of interested, with the objective of detecting the presence of any PU signals to prevent interference and identify spectrum opportunity for secondary access .

The SU uses spectrum sensing detectors to analyze the signal captured or observed during the sensing period, and based on the detection results, decides whether or not to utilize the spectrum the transmission period. Spectrum sensing results in one of two decisions: false alarm where the SU declares PU is present when the spectrum is empty and detection where the SU correctly declares a PU is using the spectrum. The performance of sensing detection is thus measured through the probability of these two events.

1.1 Cognitive Cycle

There are four main steps in Cognitive cycle

Spectrum Sensing: It refers to detect the unused spectrum and sharing it without harmful interference with other users.

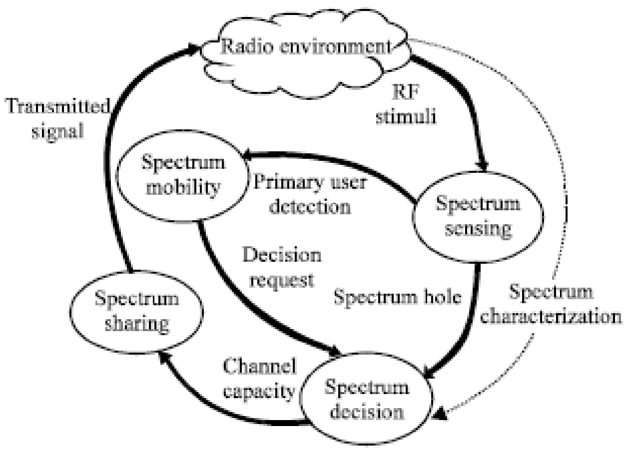

Fig.2 Cognitive Cycle

Spectrum Management: It is the task of capturing the best available spectrum to meet user communication requirements

Spectrum Mobility: It is defined as the process where the cognitive user exchanges its frequency of operation.

Spectrum Sharing: This refers to providing a fair spectrum scheduling method among the users. Sharing is the major challenge in the open spectrum usage.

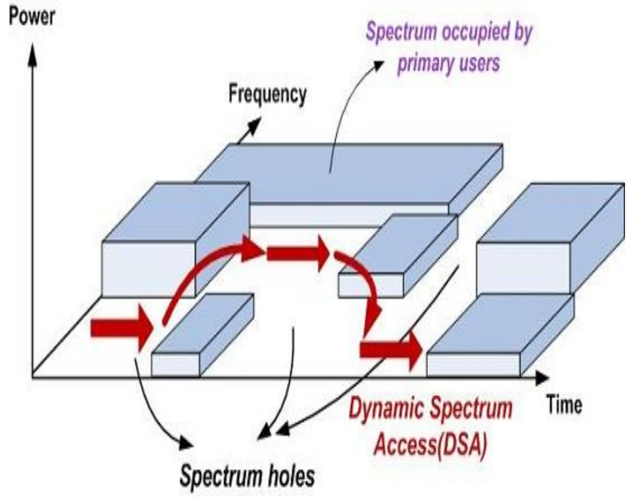

Fig. 3 spectrum holes

II. SPECTRUM MANAGEMENT FUNCTIONALITY AND CHALLENGES

There are several issues faced during spectrum management. CR networks impose unique challenges due to the coexistence with primary networks, as well as diverse quality of service requirements. A CR is designed to be aware of and sensitive to the changes in its surroundings, which makes spectrum sensing an important requirement for the realization of CR networks.

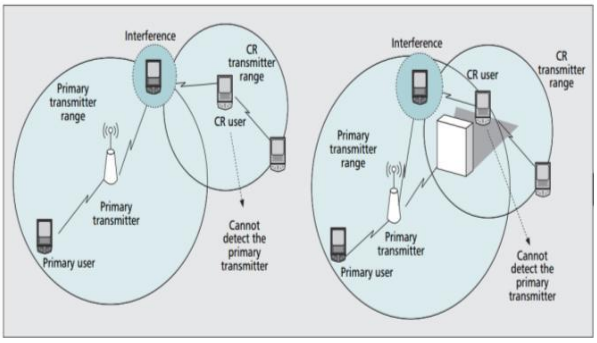

Fig.4 Some issues faced during spectrum management Transmitter detection problem: a) receiver uncertainty; b) shadowing uncertainty

The conventional definition of the spectrum opportunity, which is often defined as "a band of frequencies that are not being used by the primary user of that band at a particular time in a particular geographic area".only exploits three dimensions of the spectrum space: frequency, time, and space. Conventional sensing methods usually relate to sensing the spectrum in these three dimensions. Thus, new spectrum management functions are required for CR networks with the following critical design challenges:

Interference avoidance: CR networks should avoid interference with primary networks.

QoS areness: To decide on an appropriate spectrum band, CR networks should support QoS-aware communication, considering the dynamic and heterogeneous spectrum environment.

Seamless communication: CR networks should provide seamless communication regardless of the appearance of primary users. To address these challenges, we provide a directory for different functionalities required for spectrum management in CR networks.

PUs' activity detection: Due to false alarm and missdetection, the probability that can't detect the existence ofPUs will also exist. It is not only conducive to avoid PUs'interference, but also helpful to enhance the networkthroughput and decrease propagation delay if we exactlyknow the PUs activity. Hence it is a key point that how tocorrectly detect PUs' behavior and how to make reactionimmediately when PUs come back.

Exposed and hidden node problems: Collision and transmission delay will happen due to exposed and hidden node problems, respectively. Especially when large amounts of data need to be sent among large amounts of sensor nodes in CRSNs, these problems will become more serious. Consequently, these problems have to be taken into consideration.

Assignment of sensing time and transmission time: In

CRSNs a time period slot contains the sensing time and transmission time. If increasing the sensing time, accuracy of sensing PUs will be improved, but throughput of CRSNs will be decreased. In contrast, if decreasing the sensing time, the more transmission time will increase the throughput as increasing false alarm and miss detection simultaneously. So how to assign the sensing time and transmission time is also a challenge.

Cross layer design: Channel assignment and routing are interdependent and interaction. So how to jointly cooperate sensor nodes to sense spectrum and select route, how to make a cross layer design in energy fairness and energy efficient way are also the challenges we must face.

Energy efficiency: We must consider energy efficiency first when we design a CRSNs protocol, since it is hard or even impossible to charge the sensor nodes in CRSNs. Network can be considered dead if a certain amount of sensor nodes

III. CONCLUSION

Cognitive radio is the promising technique for utilizing the available spectrum optimally. The important aspect of cognitive radio is spectrum sensing from that identifying the opportunistic spectrum for secondary user communication. At last we summarize the challenges of CRSNs. We provide a better understanding of CRSNs. Nowadays more and more works focus on machine learning and reasoning. In future, we are aiming to apply machine learning and game theory to solve the summarized challenges in CRSNs.

IV. REFERENCES

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