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SPECTRUM MONITORING IN COGNITIVE RADIO NETWORKS: A SURVEY

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Abstract-A cognitive radio is a radio that can be programmed and configured dynamically to use the best wireless channels in its vicinity. A cognitive radio This type of radio automatically detects the available channels in the spectrum and automatically changes the transmission and reception parameters to allow more concurrent wireless communication in a given spectrum band at one location. And it improves the utilization of the radio electromagnetic spectrum. There are different types of spectrum monitoring techniques are available and this paper gives an overview of different spectrum monitoring techniques.

Index Terms— Cognitive radio, dynamic spectrum access, OFDM, spectrum sensing/monitoring

I.INTRODUCTION

The radio spectrum is becoming increasingly congested everyday with the increasing number of wireless devices. But in spectrum usage the wide band is rarely used and the usage of other band is increased. So a wastage of band is occur. Because the unoccupied portions of the licensed spectrum can only be used by the licensed users. The licensed users also called primary users and the unlicensed users are the secondary users. CR autonomously exploit locally unused spectrum to improve spectrum utilization. Depending on the transmission and reception parameters there are two types of cognitive radios are available. One is the full cognitive radio and other is the spectrum sensing cognitive radio. One of the main approaches utilized by the cognitive network is the overlay network model. In overlay network model SUs opportunistically use the spectrum when PUs are idle. Both primary and secondary users cannot operate simultaneously. The secondary users must sense the spectrum whether it is available or not. When the PU is idle the Su is allowed to use the spectrum but it has to monitor the shared band to vacate the band as soon as primary user reappearance is detected. During this process the CR system spend a long time interval during which the secondary transmitters are silent while the frequency band is sensed. Since the CR users do not utilize the spectrum during the detection time, these periods are called quiet periods. The energy detection is followed by feature detection to distinguish whether the source of energy is a primary user or noise. This mechanism is repeated periodically to monitor the spectrum. Once the PU is detected, the SU abandons the spectrum for a finite period and choose another valid spectrum band in the spectrum pool for communication. This process is repeated periodically to monitor the spectrum. If a PU is detected then the SU vacates the spectrum for a finite period of time and selects another valid spectrum band in spectrum pool for communication. Here, SU stops communicating periodically to detect the reappearance of PU.

The cognitive radio network uses another type of monitoring approach in that case the CR receiver is monitored during reception and without any quiet periods. In this case the primary user is active only when the number of error is above the threshold value. The error count is obtained by the LDPC code. But this method is impossible in many cases so it is rarely used. So it is device to use algorithms to monitor the spectrum.

II. TYPES OF SPECTRUM SENSING

A. Cooperative spectrum sensing

Within a cooperative cognitive radio spectrum sensing system, sensing will be undertaken by a number of different radios within a cognitive radio network[2]. Typically a central station will receive reports of signals from a variety of radios in the network and adjust the overall CR. Cognitive radio cooperation reduces problems of interference where a single cognitive radio cannot hear a primary user because of issues such as shading from the primary user, but a second primary user acting as a receiver may be able to hear both the primary user and the signal from the cognitive radio system.

A1.Types of cooperative spectrum sensing

The cooperative spectrum sensing is again classified into two. They are centralised and distributed approach. In the former case there is a master node within the network that collects the sensing information from all the radios within the network. It then analyses the information and determines the frequencies that can and cannot be used. Also it have the ability to undertake a number of different sense actions at the same time. But in the case of distributed approach, no one node takes control. Instead communication exists between the different nodes and they are able to share sense information. The cooperative spectrum sensing has many advantages. It reduces the false alarm and it gives high accurate signal detection.

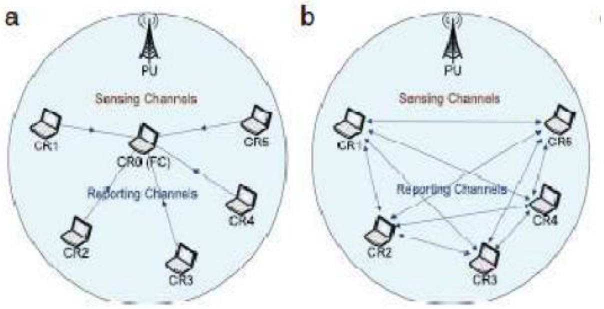

Fig1 a:centralised cooperative spectrum sensing, b:Distributed cooperative spectrum sensing[2]

B. Non cooperative spectrum sensing

This form of spectrum sensing, occurs when a cognitive radio acts on its own. The cognitive radio will configure itself according to the signals it can detect and the information with which it is pre-loaded.

III. SPECTRUM MONITORING TECHNIQUES

In conventional systems, before the SU communication traditional spectrum sensing is applied .And if the algorithm indicates the presence of PU in the band spectrum sensing is not repeated. When the monitoring correctly determines that there is no primary signal in the band then the spectrum sensing is performed and it can be used to deliver packets in the secondary network. Thus the spectrum efficiency of the secondary network is improved. The SU receiver must follow two consecutive phases, which are sensing phase and monitoring phase. Among both the phases sensing phase is applied over a predefined period.

A. Receiver Statistics

Receiver statistics is a physical-layer statistics that permit a cognitive radio to monitor the band in which it is receiving a packet[1]. The statistics for each cognitive radio of the secondary network is derived in its demodulator and decoder. In this the secondary user perform a session based communication. And each session requires the delivery of packets. The radio which sends the packet is called source and the radio which receives the packet is called destination. The receiver statistic known as the *iteration count* (IC) can be employed to detect the emergence of a primary signal, when the secondary receivers employ iterative decoding. The total number of iterations required to decode all received words in the packet divided by the number of code words that were sent in the packet is the IC for a packet. When the IC is large for a packet, then it is likely that the received signal representing the packet was corrupted, and the corruption might be due to the presence of a primary signal in the frequency band. During the packet reception there is a chances of occurring an error. The error count (EC) for the packet is the number of positions in which the two data sequences different that is the transmitted one and the received one. The receiver's error count (REC) is defined only for correctly decoded packets In EC-based monitoring, detection occurs when the emergence of the primary signal causes an increase in the value of the EC. But the receiver statistics cannot be used in all situation because the characteristics which change from one receiver to the another. So it is difficult to realize it.

B. Energy ratio algorithm

To verify the algorithm the secondary user physical layer model must be considered. For this the data coming from the source is segmented into blocks[1]. In CR networks there are k secondary users and one primary user. The primary user occupies a spectrum and it also share the same spectrum with the secondary users. The spectrum shared by the secondary user is called master node and it gives information to all others The timing of each slave is controlled by the master node by allowing time delay in advance.

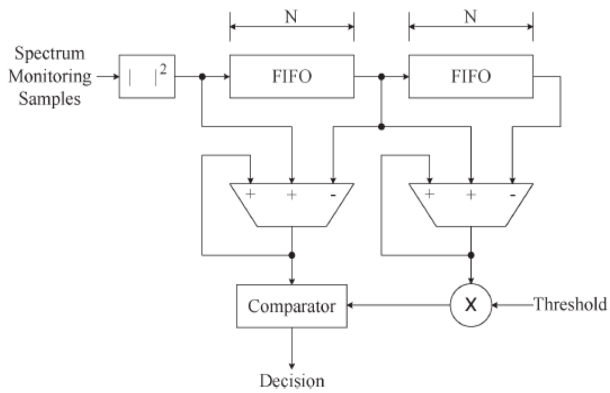

Fig2:Architecture of the energy ratio algorithm

The master node have the capacity to convert the signal back to the frequency domain and the control the information from the slaves. The slaves are able to send the decisions over the channel. In this algorithm number of tones are reserve for the spectrum monitoring purpose. The secondary user can monitor the band and test the primary user appearance, based on the signal on the reserved tones at the receiver. Over the reserved tone sequence two windows are passed. The energy of the samples that fall in one window is calculated and the ratio of the two energies is taken as the decision making variable and therefore it's named as energy ratio algorithm. The energy ratio algorithm is mainly used in OFDM based cognitive radio networks.

The fig 2 shows the architecture of the algorithm and in this the reserved tone sequence is injected to be squared.

Then two FIFO memories are used to store the squared outputs to manage the energy evaluation for the two windows. The idea depends on the sliding concept for the windows where the total energy enclosed by one window can be evaluated by only adding the absolute squared of the new sample and subtracting the absolute squared of the last sample in the previous window. The ratio may not be evaluated directly, instead we can multiply the energy of the first window by the threshold and the multiplication output is then compared to the energy of the second window.

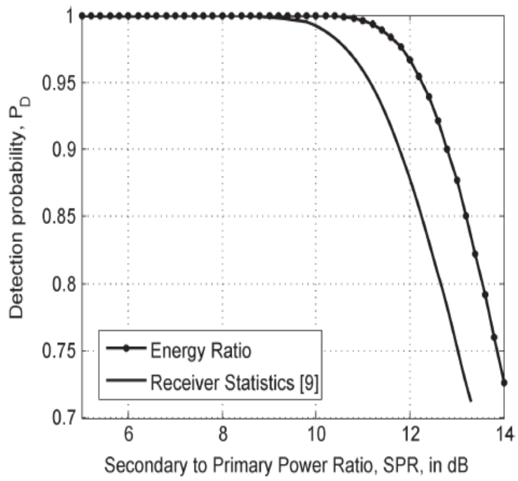

Fig3:comparison of receiver statistics and energy ratio algorithm[1]

From this graph it is clear that the energy ratio algorithm works better than receiver statistics.

IV. CONCLUSION

In this survey we have seen different spectrum monitoring techniques for Cognitive radio networks. In the receiver statistics method the cognitive radios of the secondary network to perform spectrum monitoring during the reception of packets. By this method greater spectral efficiency is obtained by the secondary network.

Another spectrum monitoring algorithm that can sense the reappearance of the primary user during the secondary user transmission is the energy ratio algorithm. This is designed for OFDM systems such as Ecma-392 and IEEE802.11af systems. The detection performance is superior than the receiver statistics method. For computational complexity, the energy ratio architecture is investigated where it was shown that it requires only about double the complexity of the conventional energy detector. This spectrum monitoring algorithm can greatly improve the performance of OFDM-based cognitive networks by improving the detection performance with a very limited reduction in the secondary network throughput.

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REFERENCES.

[1] Abdelmohsen Ali and Walaa Hamouda,"Spectrum Monitoring Using Energy Ratio Algorithm for OFDM-Based Cognitive Radio Networks", IEEE Trans. Wireless communications vol. 14, no. 4,April 2015.

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

[3] W. S. Jeon, D. G. Jeong, J. A. Han, G. Ko, and M. S. Song, "An efficient quiet period management scheme for cognitive radio systems", IEEE Trans. Wireless Commun., vol.7, no. 2, pp. 505–509, Feb. 2008.

[4] R. Saifan, A. Kamal, and Y. Guan, "Efficient spectrum searching and monitoring in cognitive radio network", in Proc. IEEE 8th Int. Conf. MASS, 2011, pp. 520–529.

[5] A. Ghosh and W. Hamouda, "Cross-layer antenna selection and channel allocation for MIMO cognitive radios," *IEEE Trans. Wireless Commun.*, vol. 10, no. 11, pp. 3666–3674, Nov. 2011.

[6] S. H. Hwang and M. J. Rim, "Adaptive operation scheme for quiet period in IEEE 802.22 system," in *Proc. ICTC*, Sep. 2011, pp. 482–484.

[7] D. Chen, J. Li, and J. Ma, ―In-band sensing without quiet period in cognitive radio,‖ in *Proc. IEEE WCNC*, 2008, pp. 723–728.

[8] W. Hu *et al.*, ―Cognitive radios for dynamic spectrum access Dynamic frequency hopping communities for efficient ieee 802.22 operation,‖ *IEEE CommunMag.*,voln45, no. 5, pp. 80–87, May 2007.

[9] X . Gong, S. Vorobyov, and C. Tellambura, ―Optimal bandwidth and power allocation for sum ergodic capacity under fading channels in cognitive radio networks,‖ *IEEE Trans. Signal Process.*, vol. 59, no. 4, pp. 1814–1826, 2011.

[10]]. S. Brandes, I. Cosovic, and M. Schnell, ―Reduction of out-of-band radiation in ofdm systems by insertion of cancellation carriers,‖*IEEE Commun. Lett.*, vol. 10, no. 6, pp. 420–422, Jun. 2006.