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Spectrum Sensing Cognitive Radio Network based Massive 5G System : A Review

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ABSTRACT: - In recent years, the rapid growth in wireless service increases the demand for the frequency spectrum. The available spectrum is underutilized due to the static allocation of the spectrum on the conventional spectrum management method. An efficient solution to overcome the underutilization of the spectrum band is cognitive radio technology which is defined by software defined radio. The aim of cognitive radio is to obtain the best available spectrum through cognitive capability and configurability which involves spectrum sensing, analysis, decision and adaptation. The challenging factor is to combine the Non-cooperative communication in cognitive radio to improve the spectral efficiency and to reduce the BER factor of unlicensed user's communication. In this paper, a comparative study of different communication techniques are done by considering Rayleigh fading channel environment and the advantages of non-cooperative communication is analyzed.

KEYWORDS: OFDM System, MIMO-OFDM, Cognitive Radio, Non-Cooperative Communication

I. INTRODUCTION

In recent years, the rapid growth in wireless service increases the demand for the frequency spectrum. As a precious resource, the radio spectrum must be perfectly managed to maximize the utilization and minimize the interference. To meet the growing demand, new broadband communication technologies have been introduced to utilize the radio spectrum effectively. The spectrum use is intense on certain portions while a significant amount of spectrum remains underutilized. High utilization is common in the cellular and FM radio bands, while other bands indicate low usage levels. Most of the licensed users do not transmit all the time in all geographic locations where the license covers. Records from the FCC indicate that spectrum allocated in the bands below 3GHz have a utilization range of 15% to 85% .The available spectrum is underutilized due to the static allocation of the spectrum. In the conventional spectrum management method, each operator is allocated with a certain frequency band and the licensed user operates in that particular band.

Hence it is tedious to find the vacant bands to deploy new services. Consequently, techniques that provide new ways of exploiting the available spectrum are required. As a result, Dynamic Spectrum Access (DSA) was proposed to solve the inefficiency caused by the static allocation of spectrum. With this concept, use of existing radio spectrum is enhanced by opportunistic spectrum access (OSA) of the frequency bands that are not occupied by the licensed or primary user.

II. LITERATURE REVIEW

Arun Kumar et al. [1], in Orthogonal Frequency Division Multiplexing OFDM, a cyclic prefix (CP) are connected to decrease the mediation between symbols. The CP results in bandwidth wastage, and the solution to this issue prompts to the cognitive radio. In the initial segment of the work, OFDM with CP is given and coordinated with cyclostationary spectrum sensing. Subsequently, OFDM with cyclostationary spectrum sensing without CP is proposed with the function of the filter at the transmitter and receiver being to utilize the bandwidth that is squandered in the CP stage. The Bit Error Rate BER, like hood detection, false alarm, and error probability are obtained and analyzed.

Abdullah Yaqot et al. [2], cognitive radio (CR) in conjunction with multiple-input multiple-output orthogonal frequency-division multiple access (MIMO-OFDMA) is a candidate technology for future mobile radio networks. The short communication range of underlay CR systems is commonly a major limiting factor. In this paper, had propose a computationally and spectrally efficient resource allocation scheme for multiuser MIMO-OFDM based underlay CR networks to provide good spectral efficiency gain, and therefore increased communication range. The scheme is optimal for the downlink but, however, near-optimal for the uplink. Simulation results demonstrate the bandwidth and

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computational efficiencies of the proposed scheme compared to the state-of-the-art.

Danda B. Rawat et al. [3],have proposed the performance of cognitive radio (CR) in MIMO-OFDM system with the help of cyclostationary spectrum sensing. CR devices continuously sense the channel to check whether it is idle or not using spectrum sensing detection. There are two types of channel assign in cyclostationary spectrum sensing i.e. primary and secondary spectrum sensing. Primary spectrum sensing is a sensing to sense the licensed users and secondary spectrum sensing is a sensing to sense the not licensed users. It is calculate the mean square error (MSE), successful reconstruction rate (SRR) and probability.

Shan Jin et al. [4], the WiMAX (worldwide Interoperability for Microwaves get entry to) is a promising generation that can provide excessive velocity voice, video and facts provider as much as the patron cease. The improvement of 802.sixteen requirements for BWA (Broadband wireless access) technologies turned into prompted through the rapidly growing need for excessive-speed, ubiquitous and price powerful get right of entry to. The WiMAX also can be taken into consideration to be the principle era within the implementation of other networks like wireless sensor networks. Growing an expertise of the WiMAX device can be first-class performed via looking at a model of the WiMAX device. This paper discusses the version building of the WiMAX bodily layer using Simulink in MATLAB R2009a model. This model is a beneficial device for BER (Bit mistakes fee) overall performance assessment for the actual time audio facts communiqué by using the WiMAX physical layer, below exclusive channel encoding price, and virtual modulation schemes and channel situations, except serving as a helpful resource for the scholars and the researchers who need to base their studies and research in the subject of WiMAX. On this paper, transmitter and receiver version are simulated consistent with the parameters set up by using the standards, to assess the overall performance. Additionally convolution coding is used to enhance the system overall performance. The performance analysis is being completed via reading the bit loss and packet losses happened all through transmission over the channel.

Maan Singh et al. [5], the real and imaginary parts of complex factor corresponding to in-phase components and quadrature components of OFDM symbols, respectively. It is to be noted that in ideal cases, the demodulation is performed based on the assumption of perfect symbol timing, carrier frequency, and phase synchronization. This is usually not practically possible to achieve; therefore, the demodulated signal will not be the exact replica of input signal; resulting in bit error rate (BER). The term BER can be mathematically expressed as the difference of the received demodulated data and the input data.

Muhammet Nuri Seyman et al. [6], some of signal to noise ratio (SNR) discount techniques were proposed for multiple-input multiple-output (MIMO) orthogonal frequency division multiplexing (OFDM) structures; but, maximum of them contain very high computational complexity and are not applicable to MIMO-OFDM systems with area frequency block coding (SFBC). on this paper, we suggest a low-complexity PAPR reduction scheme for SFBC MIMO-OFDM systems, in which the enter series is accelerated by a hard and fast of segment rotation vectors respectively after which each resulting sequence is decomposed into numerous sub-sequences based totally at the linear belongings of SFBC. After computing the inverse fast Fourier transform (IFFT) to convert each frequency-domain sub-collection into a time-domain signal, we carry out equal SFBC encoding operations in the time area for producing candidate signal units, wherein the only with the bottom maximum SNR is chosen for transmission. With the proposed scheme, we can generate a huge wide variety of candidate signal sets by means of computing only some IFFTs. In comparison to preceding related schemes, the proposed one achieves comparable PAPR reduction overall performance with much decrease computational complexity.

III. SPECTRUM SENSING

A noteworthy test in psychological radio is that the auxiliary clients need to identify the nearness of essential clients in an authorized range and quit the recurrence band as fast as could be expected under the circumstances if the relating essential radio rises so as to stay away from impedance to essential clients. This procedure is called range detecting. Range detecting and estimation is the initial step to execute Cognitive Radio framework [5]. We can sort range detecting systems into direct technique, which is considered as recurrence space approach, where the estimation is done straightforwardly from flag and backhanded strategy, which is known as time area approach, where the estimation is performed utilizing autocorrelation of the flag. Another method for ordering the range detecting and estimation techniques is by making bunch into model based parametric strategy and period gram based nonparametric technique.

a. Essential transmitter discovery: For this situation, the identification of essential clients is performed dependent on the

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got flag at CR clients. This methodology incorporates coordinated channel (MF) based location, vitality based recognition, covariance based discovery, waveform based location, cyclostationary based recognition, radio recognizable proof based identification and irregular Hough Transform based location.

b. Agreeable and synergistic location: In this methodology, the essential signs for range openings are recognized dependably by communicating or participating with different clients, and the technique can be executed as either brought together access to range facilitated by a range server or conveyed approach inferred by the range stack smoothing calculation or outside identification.

Figure 1 shows the detailed classification of spectrum Sensing techniques. They are broadly classified into three main types, transmitter detection or non-cooperative sensing, cooperative sensing and interference based sensing. Transmitter detection technique is further classified into energy detection, matched filter detection and cyclostationary feature detection [12].

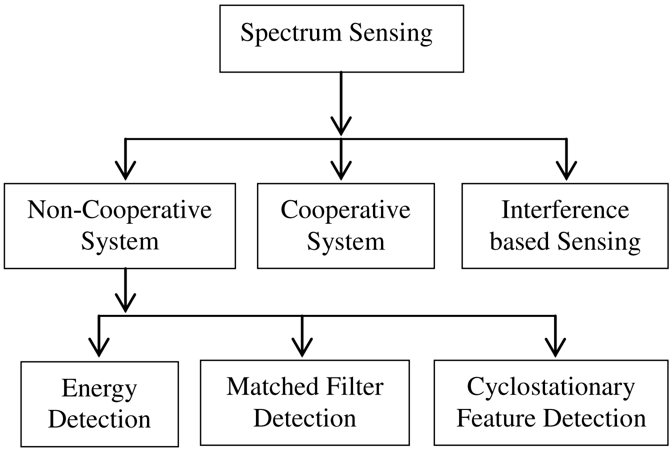

Fig. 1: Classification of spectrum sensing techniques

Non-cooperative Spectrum Sensing
Since it is difficult to sense the status of the primary receiver, so to detect the primary user transmission it is necessary to detect the signals sent by the primary transmitter. This kind of spectrum sensing is also called primary transmitter detection.

Energy Detection
If CR users have no information about the primary signals then energy detection can be used for spectrum sensing. ED is optimal detector if noise power is known to the CR user [2]. Energy detection is very simple and easy to implement. It is the most popular spectrum sensing technique. In energy detection, the presence of the signal is detected by measuring the signal over an observation time.
Advantages: Simple and fewer complexes than other techniques No prior knowledge of the primary signal required Easy to implement
Disadvantages: High sensing time required to achieve the desired probability of detection Using ED, it is not easy to distinguish Primary Signal from noise signal Detection performance is limited by noise uncertainty Spread spectrum signals cannot be detected by ED.

Matched Filter
Detection In matched filter detection SNR of the received signal is maximized. The CR user needs to have the prior knowledge of the primary signal transmitted by the primary user. This is the basic requirement for the matched filter detection. Matched filter operation defines a correlation in which unknown signal is convolved with the filter whose impulse response is the mirror and time shifted versions of a reference signal [6].

Advantages: It needs less detection time. When information of the primary user signal is known to the CR user then Matched Filter Detector is optimal detector in stationary Gaussian noise [3].

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Disadvantages: It needs priori knowledge of the received signal. High Complexity.

Cyclostationary Feature Detection

The modulated signals are generally cyclostationary in nature and this kind of feature of these signals can be used in this technique to detect the signal. A cyclostationary signals have the statistical properties that vary periodically with time [7]. This periodicity is used to identify the presence or absence of primary users. Due to the periodicity, these cyclostationary signals exhibit the features of periodic statistics and spectral correlation, which is not found in stationary noise [8].

Advantages: Robust to noise uncertainties and better performance in low SNR regions. Capable of distinguishing the CR transmissions from various types of PU signals. No synchronization required Improves the overall CR throughput
Disadvantages: Highly complex method long sensing time

IV. PROPOSED METHODOLOGY

The circuit will be implementations in MATLAB 2013b software, with the main parameters described below. We generated a random binary signal generate in a serial manner. To analyze a signal in the time domain, we apply IFFT (Inverse Fast Fourier Transform) and convert it from parallel to serial OFDM signal to add a cyclic prefix (CP), which helps avoids interference between OFDM symbols.
This signal is then feed through an Additive White Gaussian Noise (AWGN) channel. At the receiver end, the CP is removed and the signal converted from serial to parallel to get the original, with FFT applied to each symbol for analysis in the frequency domain. After demodulation, the signal is cross correlated with that of a time-shifted local oscillator.
Finally, the received signal is compared to a threshold value (ʎ) following the SNR or determines whether the signal is absent or present; if the received signal is greater than the threshold value, there will be detection, otherwise not:

$$S(t) = n(t) \qquad H0$$

$$S(t) = \{h*P(t) + n(t)\} \qquad H1$$

Where S(t) is the secondary user, P(t) the primary user's transmitted signal, n(t) is AWGN, h the amplitude gain of the channel, H0 = there's no primary user, and H1 = primary user is present.

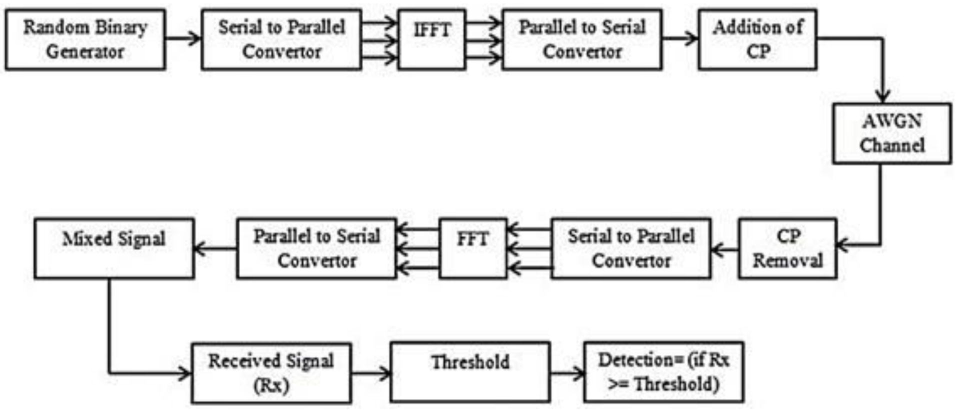

Fig. 2: Proposed MIMO-OFDM System using Matched Filter Detection Technique

V. CONCLUSION

A matched filter, also known as optimal linear filter, is a spectrum-sensing method that detects the free portion of the primary user's spectrum and allocates it to secondary users. It derives from cross-correlating an unknown signal with known ones to detect the unknown signal's presence based on its SNR. In matched-filter detection, the dynamic threshold is used to improve the spectrum-sensing efficiency and provide better performance in cases of lower SNR.

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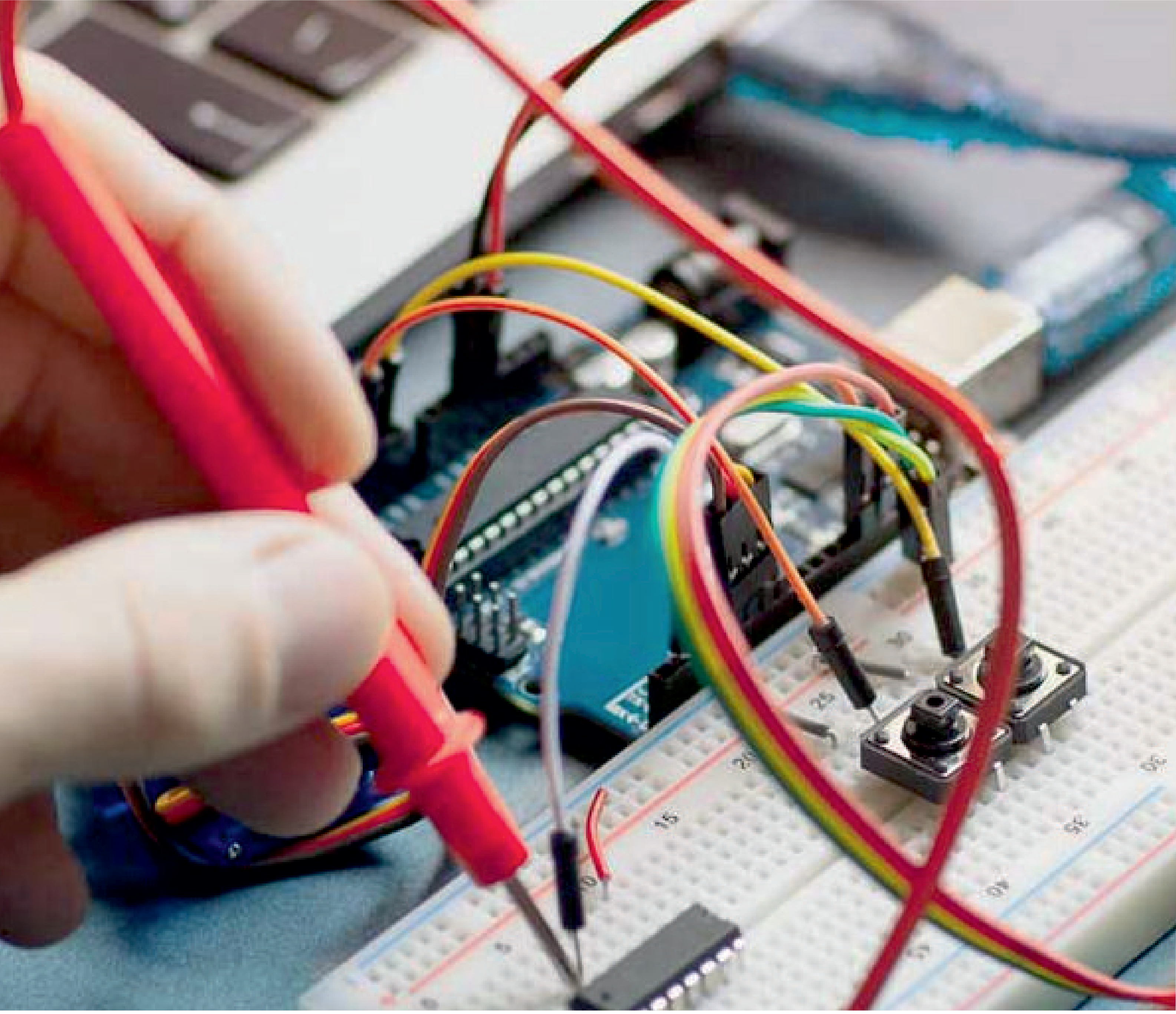

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