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Classics of Cognitive radio: A comparative study

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Abstract: One of the forms of wireless communications is cognitive radio. It contains transmitter and receiver. It automatically sense the channels to send the data. It has two users' primary users and secondary users. Licensed spectrum are used by primary user and unlicensed spectrum are used by secondary user. Secondaryuser has to leave the channel when primary user becomes active. This leads to the problems on congestion, energy, channel bonding, channel switching and channel prediction. In this survey paper different methodologies are studied. Second order kalman filtering channel estimation methods, optimal pilot-Based channel estimation method, effects of unfit channel sensing and evaluation methods, machine learning techniques, based on remaining idle time channel bonding projects, sense and struck problem.

INTRODUCTION

Cognitive radio is a form of wireless communication. Here transmitter intelligently detects the channels which are in used and which are not in used to transmit the data [1]. Cognitive radio has two user: primary user and secondary users. Primary user uses licensed spectrum while secondary user uses unlicensed portion of the spectrum by using cognitive radio technology.

The ability of the cognitive radio is to sense and collect the information with in the environment such as frequency, modulation, bandwidth, energy etc. fromthe secondary user can identify the unused available spectrum to transmit the data secondary users performs the following functions: sense the unused available spectrum and select the stable channel

Secondary users leaves the channel when the primary users starts to access the spectrum. It leads to harmful interference to primary user. Channel selection [2] plays a vital role to reduce the harmful interference of primary user.

If secondary user transmit data when primary user is not using the licensed spectrum then it must take care of reappearance of primary user. This can be identified by different detection techniques, like energy recognition, feature extraction, filtering matched and coherent detection. Above mentioned technique have limitations because of unpredictability noise, shadowing and multiple path effect. By using cooperative sensing it improves detection accuracy by considering spatial and multiuser diversity

Channel prediction [3] methods in channel allocation reduces interference to primary users. For prediction of channels. It contains different methodologies like spectrum hole prediction based channel allocation, Distance factor recursive least square(DF-RFS), MLP predictor and HMM predictor, Remaining idle time aware intelligent channel bonding, channel switching simulator, Traffic pattern prediction

STATE-OF-THE-ART

In the paper Olusegun Peter awe et.al. [4] States that the channel gain between the primary user and secondary user can be evaluated using pilot based second order kalman filtering tracker classifier. K-Means algorithm implemented to measure the energy at secondary user terminals with two centroids as active and inactive status of primary user. In the secondary user the centroid as activestatus of primary user are adapted based on the channel estimated from kalman filter and also K-means clustering algorithm used to classify and to make the decisions on the primary user. Quadratic polynomial regression algorithm used to find the possibility of secondary user receiver depending on the location of co-channel interference and also noise and interference for adapting the centroid at inactive primary user status. This methodology improves spectrum recognition in cognitive radio and channel gain for fading channels between the primary user and secondary user.

Optimal pilot-based channel estimation [5] method established for estimating of the channels based on the least square estimation. This method uses orthogonal frequency division multiplexing channels for allocating bands to unlicensed users. This avoids inferences the channel estimation in OFDM channels through various input and various output systems. Rider grey wolf optimization algorithm is used to transmit the signal between the fading OFDM channels. The estimation is calculated using least square of the original channel state and evaluated symbols. Here progress work done on existing optimization algorithm. Future work can be done on other hybrid optimization algorithms

Zahraa Abd El-Hamid et.al. [6] Energy detection methods are used which leads to decreases in performance. Another

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challenge is the wireless channelling medium has the variations along with time and changing environment. Commonly multipath fading channels are used it gives randomness in received signals channel state information (CSI) maintained in both the sides of receiver and transmitter. Depending on the transmitter scheme larger bit rates are achieved. After that based on the CSI information needs at the receiver for logical detection. The sensing uncertainty because of wrong alarms and overlook detection effects the design of channel evaluation algorithms. Solution for this is to use OFDM channels. OFDM has the ability to keep away from interference using the methods cyclic prefix (CP), high spectral effects because of orthogonally, implementation of simple equalizer and frequency selective fading robustness. Simulation results shows that among the LS, LMMSE, EM and BER algorithms, EM algorithm reaches a significant improvement but it fails when the system becomes complex.

In this paper Syed Hashim Raza Bukhari et.al. Proposes two new approaches are introduced called as remaining idle time aware intelligent channel bonding (RITCB) and remaining idle time aware intelligent channel bonding with interference prevention (RITCB-IP) [7]. It identifies the suitable channels for channel bonding where the channels are in the idle time, remaining amount of idle time is calculated to select channels. These two approaches decreases harmful interference this leads to increase the life time of sensor nodes. It also takes care of the primary radio nodes traffic which decreases the service quality and data rate requirements when frequent channel switching for channel bonding. The result of this approach shows that suitable channels are given by intelligent channel selection for channel bonding depending on the idle time. This is implemented for single hop scenario. Multi-hop scenario implementationto be considered for future work.

Some protocols are used to find the availability of a channel. One of theprotocol use hidden markov model (HMM) [8] but it does not works for all the cases. In the paper Dina Tarek et.al [9] states that uses two new protocol along with the HMM model in an advanced way. In this techniques the data is divided into two sets. First set works with Bayes theorem and the second set works with two models of support vector machine (SVM) gives the improved results. Two limitations are identified from this channel prediction technique. First is the waiting time for sensing data i.e. Channel state is more. Second is more number of time taken to train the model. This limitations can be achieved using CRIOT, which means integrated IOT with cognitive radio network.

A new challenge occurred in conventional approach called as sense and stuck. To solve this the system introduces a latest frame structure by Prabhat Thakur et.al. [10]. A new frame structure contains prediction of spectrum and sensing times for continuous data transmission through the primary spectrum access technique. This improves to maximize through put and sensing reliability. When transmitter starts sensing the channels, the chances of a sensed channel as active is more in number, which leads to high data loss. To solve this problem a new frame structure is designed by solving sense and stuck problem. Secondary user starts sensing the channels which are idle. Suppose if the channel is active then once again it starts sensing the channels one by one. In this situation it maysense same channels more than one time and got shucked repeatedly in the same channel called as sense and stuck problem. A novel approach is introduced to select the channel to sense based on prediction probabilities. Here prediction probabilities depends on the previous sensed information i.e. Information about the state of the channel. Results shows that improved throughput. Another challenge task for future work is classic selection of number of challenges by increases the throughput.

CONCLUSION

In this survey paper, discussed different methodologies for channel estimation, channel switching and channel bonding. Some of the failures spot are when the system becomes complex, it fails when implementing multi-hop scenario. Some problems can be solved by integrating with IOT. The system fails when implementing optimal selection of number of channels to increase the throughput and when implementing hybrid optimization algorithms.

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