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Cognitive radio communication system based on hardware platform and relevant quiet period research thereof

Min Li[1,2], Fengming Bai[1]

[1]Changchun University of Science and Technology, 130022, (CHINA)

[2]College of Humanities and Information, Changchun University of Technology, 130122, (CHINA)

ABSTRACT

when a cognitive radio system is designed, one of the key technologies for establishing the radio system is that cognitive nodes cognize other surrounding ones. For this reason, a thorough research for perception and detection methods is regarded as one core part of the cognitive radio quiet period research. The text focuses on the design and research of the system without the quiet period, and analyzes performance simulation processes and results during the radio quiet period, thus the text has strong scientific nature and reasonability.

KEYWORDS

Cognitive nodes; Radio communication, Quiet period; Research and analysis.

INTRODUCTION

It is very simple to detect the quiet period of the cognitive radio communication system, thus users can effectively detect the quiet period and the detection method can be widely applied, as actual advantages of the radio quiet period. The traditional cognitive radio cannot reach excellent effects on user's monitoring and interference, so that omission or wrong judgment appears during the detection process. However, the effective research process is executed by designing the system without the quiet period and combining three parameters to reach better detection effects, meanwhile the users of cognitive nodes are continuously promoted [1] in effective interference ability. In the text, perform the relative discussion and research on design of the systems with the quiet period or not, and execute the effective research on the relation curve among parameters of the radio quiet period system for regular selection, thereby improving operation efficiency of the system and service quality of the radio communication system. Through the detection method, resource consumption during system design is constantly reduced such that the radio quiet system can be better updated.

QUIET PERIOD OF COGNITIVE RADIO

In the text, the scheme for cognitive radio design adopts the synchronous quiet period, during perception, in order to prevent communication of the other nodes from being judged as external interference by a certain node, thus the radio quiet period must be adopted to ensure clean spectrum perception environment of the cognitive nodes so as to acquire accurate occupancy conditions of master user channels. In design of the centralized system, the entire system is controlled by central nodes to roughly synchronize the whole period, before perception, guard interval for the period is formed by waiting. On this basis, all cognitive nodes form the specific period of "perception- report-communication", and form the quiet period through synchronization of communication and perception processes. In design of the distributed system, maintain rough synchronization of the entire system network through phase timers of all nodes, before perception, still remain the guard interval to form the synchronous quiet period.

Quiet period design impact on cognitive radio system design

From design of the cognitive radio system, the quiet radio design based on the former can synchronously arrange all phases, however, during the radio communication quiet period, system resources occur some consumption such that relative hindrance is generated during establishment of the cognitive radio system. However, to the independent setup process of the radio communication system during the quiet period, the time period on establishment of the cognitive radio system will be constantly increased so as to generate some negative impacts[2] on operation efficiency of the cognitive radio system. To the cognitive radio system during the quiet period, relatively interrupt communication, relatively affect t service capability of the cognitive radio system, and reduce its service quality.

DESIGN OF SYSTEM WITHOUT QUIET PERIOD

Distinguishing method of master users during perception without quiet period

During establishment of the cognitive radio communication system, if some node is in the perception phase, other surrounding nodes can perform relative communication in the perception range. The cognitive nodes cannot check the master users in advance, thus they cannot hinder other nodes. Channels of the master users have been occupied by other node users, the node is greatly reduced in communication quality, relatively speaking, the cognitive nodes are greatly increased in error rate. The cognitive nodes can directly judge whether the users have accessed into the intervening channels because they acquire enough communication quality information.

Detection method of system without quiet period based on transmission error rate

In research, take the center as the basis during system establishment and design the system without the quiet period. In previous designs, the spectrums are effectively perceived by the cognitive nodes such that other nodes can become relative quiet to achieve clean surrounding environments where the spectrums exist. In report of the management center, only relative information is transmitted to perceived spectrum environments, so that the manager center can effectively analyze whether the users intervene. In the process, because the cognitive nodes are interfered by other nodes and interference cannot be totally eliminated during the radio quiet period, scientific judgment[3] on whether the users intervene cannot be timely and effectively executed only by relevant information acquired from relative energy perception. In report, effectively check other surrounding spectrums on the site, report relevant communication quality information to the management center, and take the error rate during the proving period as the important measurement index of the communication quality. Thus the management center effectively processes and analyze communication quality after receiving the relevant reported information on the site, judgment on whether the users intervene will be systematic and reasonable.

The management center judges whether the users intervene based on two aspects. Firstly, effectively analyze other existent surrounding communication spectrums and execute energy detection to unfound spectrums, because the unfound spectrums are idle on energy display, if other surrounding spectrums are existent, they are being used by the users or relative noise interference is present. Secondly, during analysis of the spectrums, if the Moy spectrums on the previous period are distributed into the communication ones, their energy can be detected, at the moment, the communication quality of

spectrums reported by nodes can be ensured, the error rate is less than the basic judgment standard l_{imQ}, thus it is thought that the users have no access. On the contrary, if the communication quality of the reported spectrums is weak, the error rate is more than the basic judgment standard l_{imQ}, it is thought that the users have accessed[4]. See Figure 1 for specific judgment processes from management center.

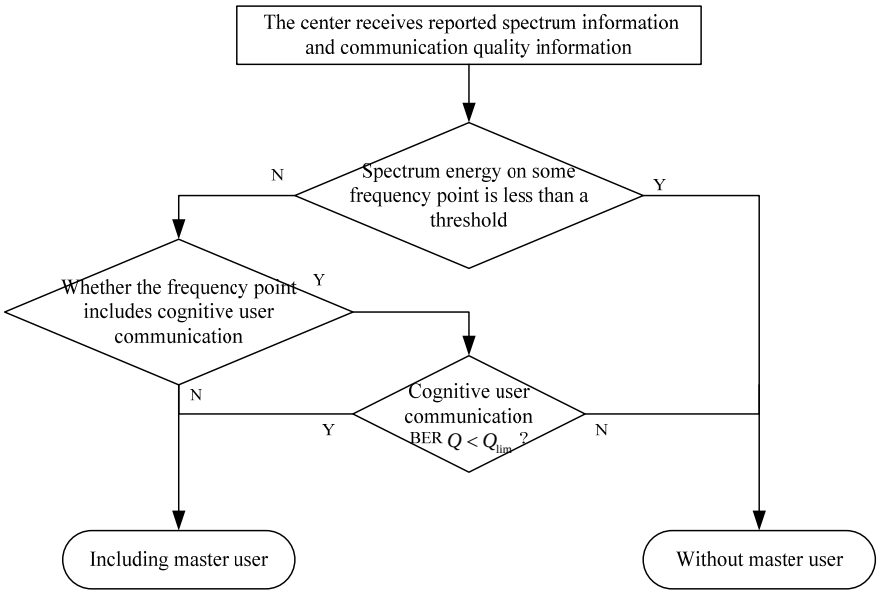

Figure 1 : Detection process of master user without quiet period

Performance simulation and test result

When the master users during the radio quiet period are detected, energy detection and error rate judgment are regarded as main complying methods. In said two judgment, the user access condition is regarded as omission without effective judgment from the management center, without access, the management center judges the user has accessed, as wrong judgment. During research on accurate judgment from the management center, effectively judge by combining several parameters which mainly include test time, comparison threshold and master user noise ratio. Select relevant parameters through performance simulation. Firstly, comparison threshold, from the discussion of the previous section, we can see that the error rate of each communication node has one relative measuring standard from each reported node, relative judgment on whether the users intervene is executed, then the reported error rate of the communication node is Q during testing time and scientifically compared with the threshold $Q_{\lim}$ to effectively judge whether the users have intervened[5]. In the process, carefully consider the threshold $Q_{\lim}$, ensure the scientific and reasonable setup process, set $Q_{\lim}$ as $Q_{\lim} = \alpha Q_{usual}$, and ensure alphas above one. The average error rate from the phase without the master user during Q_{usual} communication process is initially set as the user without access during T_{test}, and the specific calculation method is as follows:

$$Q_{usualnew} = \beta Q_{usualold} + (1-\beta) Q_{last}$$

At this point, take Q_{last} as the reported error rate (represented by letter Beta) of some node during previous communication, and regard 0.618 as the general value. Pay special attention to Beta scope below one. When some node reports the error rate to the management center (Q is less than $Q_{\lim}$), we think that the user has accessed. In the next step, simulate the system to set the special Alpha value, and establish laying models based on Figure 2.

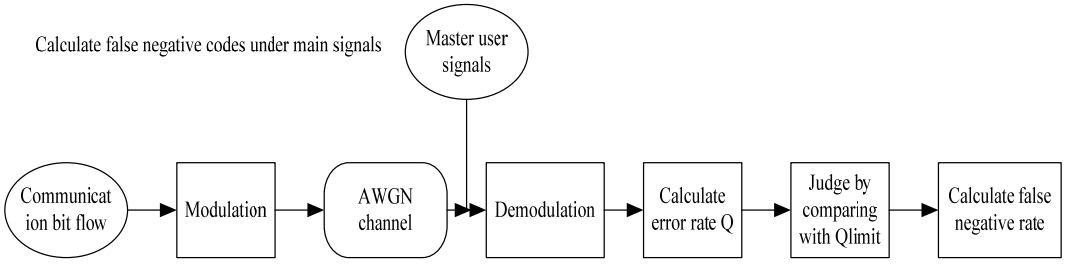

Figure 2 : Simulation detection model

During establishment of the simulation monitoring model, select other parameters according to their relative principles. Firstly, represent Ttest by the communication bit flow length, and take 1000 characters to eliminate random influence factors. Select -4db as the user noise ratio, confirm the internal relation among the misjudgment rate, the false-negative judgment rate and the threshold during establishment of the policy detection model, and take results according to Figure 3.

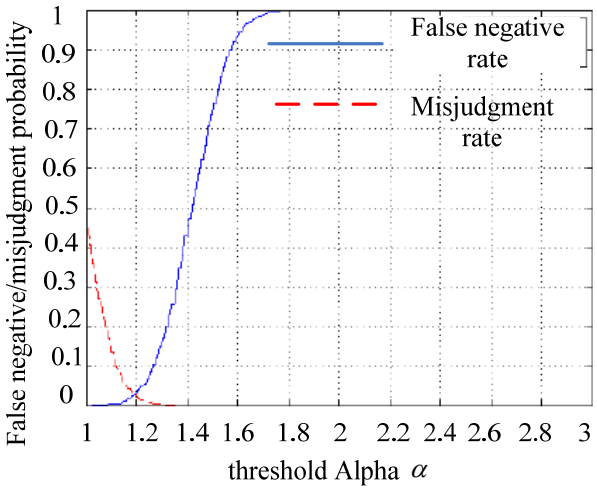

Figure 3 : Relation curve among false negative/misjudgment rate and threshold alpha

During implementation of radio quiet simulation, we can clearly see that the misjudgment rate is constantly reduced along with increasing of the threshold, both which are mutually restrained, but there is the negative effect on the false negative value instead of the positive one. In order to balance said three parameters, generally select 1.2 as the threshold.

Secondly, test time. During establishment of the simulation model, through Figure 2, we can see that the test time is represented by letter bit. Through Figure 3, select 1.2 as the threshold, and select SNRpn=-4db as the permanent signal to noise ratio. At the moment, draw one relation curve among the false negative rate, the misjudgment rate and the test time from the management center and see Figure 4 for details.

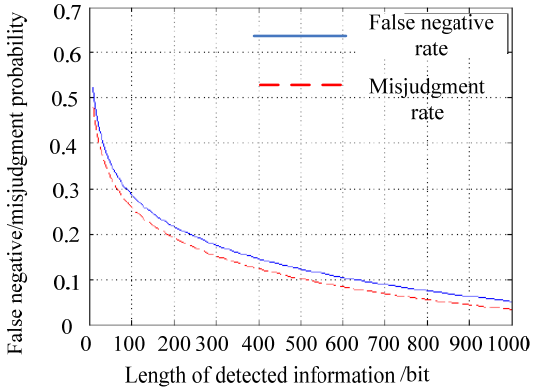

Figure 4 : Relation curve among test time and false negative/misjudgment probability

During establishment of the simulation model, see Figure 4 for simulation results. Along with constantly prolonged test time (with increasing of detected information length), it is inevitable to constantly reduce the misjudgment rate and the false negative rate. From this aspect, we can fully see the longer test time and the better effect, thus the greater value[6] is selected as the Ttest one. However, there is a certain disadvantage, along with prolonging of the test time, resulting in the negative effect on the operation efficiency and constantly increasing analysis quantity of the system data from the management center. Thus we should balance the test time and the detection efficiency and finally select 800bit as the detected information length.

Finally, selection of master user noise ratio. During establishment of the policy model, generally select 1000bit s1 as the test time and 1.2 as the threshold. However, due to the misjudgment rate, obtain them during detection without user access, and don't e relate to the parameter. At the moment, we only relatively analyze influence between the signal to noise ratio and the false negative rate from the user. Through establishment of the simulation model, draw the relation curve between them and see Figure 5 for details.

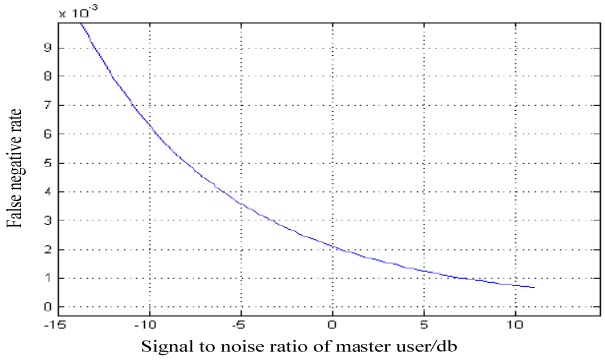

Figure 5 : Relation curve between signal to noise ratio and false negative rate from master user

Through analysis of the simulation model result, we can summarize one discipline. Along with continuous increasing of the signal to noise ratio, the false negative rate from the management center is continuously reduced. Namely, with continuous increasing of the signal to noise ratio, the cognitive nodes capture signals from the master user at higher success rate, thus it is inevitable to reduce the false negative rate to the minimum, meanwhile expectation [7] in the prevision discussion of the text can be achieved.

Protocol amendment of primary system after usage of detection method without quiet period

During establishment of the simulation model, we can summarize one discipline. Through reasonable arrangement of said three parameters, during radio quiet period, detection pertinence will be continuously enhanced such that the management center will further promote the practical effect of data processing and analysis. Through the previous discussion, we can further update the system, and effectively design the cognitive radio communication protocols based on the centralized model.

After use of the radio quiet period, the system doesn't relatively set the timer with time protection. However, to communication of the cognitive nodes, effectively utilize the timer during detection, scientifically calculate the error rate during communication within measurement time and effectively store it. After the cognitive nodes receive the commands, the other spectrum data around the spectrum information will be reported when the management center reports the data, meanwhile frequency points and error rates detected during the previous communication are simultaneously transmitted to the management center. The management center detects the master user without the quiet period upon receipt of the reported data.

In the above process, the cognitive nodes can timely avoid the master user during communication and relatively judge it through the error rate, then perform relative communication. Subsequently, the cognitive nodes will open the timer with time protection during communication, and specifically calculate the error rate within specific regular time. At the moment, compare the thresholds and the detection methods during discussion, if the main users are present, please timely terminate communication and see Figure 6 for special flow charts:

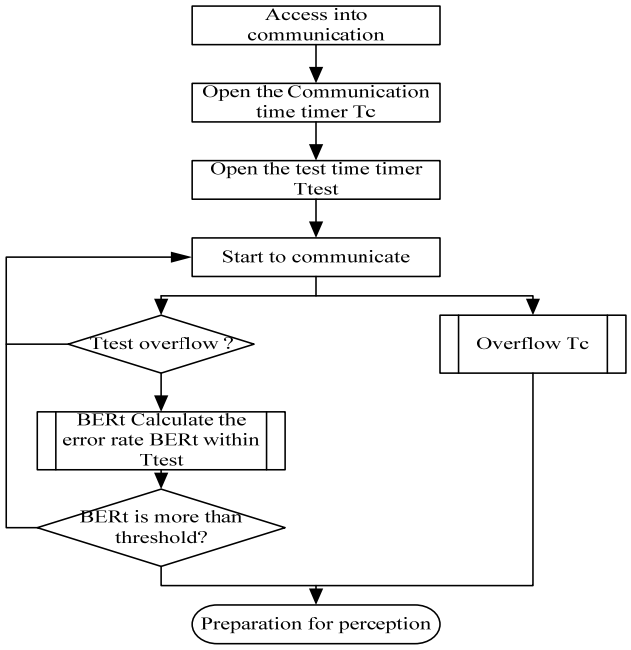

Figure 6 : Communication flow chart of cognitive nodes detected by PN without quiet period

CONCLUSION

The specific research on the cognitive radio communication system and its quiet period is as mentioned above, in the process, relative discoveries are executed based on designs of the systems with quiet period or not in cognitive radio, and relationship among said three parameters correctly judged by the management center is researched, thereby establishing a substantial theoretical basis to further update the radio quiet period.

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