

An Effectual Hybrid Relay Selection Approach for Improving Security and Reliability Trade Off in Cognitive Radio Network

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Abstract – The cognitive network is the main research area for the forthcoming wireless technology and is most effectual solution to stable the spectrum insufficiency and recover the utilization of the spectrum. However, there are various open challenges and random atmosphere of CRNs, where unlicensed users which are secondary users can feel free to use the channels that are not occupied by the licensed users which are primary users. So this paper shows that the enhancement of the security using signal and multiple relay selections to increase the security and reliability in cognitive radio networks. In this paper the hybrid Decode amplify and forward (DAF) approach is used by using Huffman coding. The whole arrangement is done in MATLAB environment. It is noticed from the result and discussions that our proposed approach is able to achieve less bit error rate and high capacity to reduce the vulnerabilities in cognitive radio networks (CRN).

Keywords: Cognitive Networks Amplify and Forward, Bit Error Rates, Relay Selections

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1. INTRODUCTION

Growing demands of the technologies and business have determined wireless technology regeneration and progressed in a speedy way. In future, the inadequate resources of the spectrum opposes with the increasing demands of the business (Jiang, et. al., 2016). The Federal Communications Commission reports and records discussed that presently spectrum shortage is basically due to the unproductive and inflexible regulations moderately than the corporeal deficiency of the availability of the spectrum (Zhong & Zhang, 2016). Newly, the CRN (Cognitive radio networks) has brought to the front position to resolve the battle among limited supply of the spectrum and demand from wireless applications enhancements and facilities. The CRN networks are defined as efficient wireless network retaining expertises to attain the data of its working (Ng & Lo, 2016).

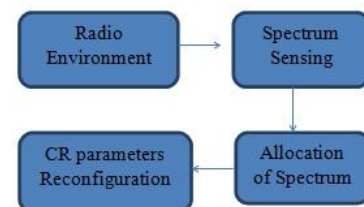


Fig 1: Generalized block diagram

However, CRNs work in an open and random access networks environment. Spectrum sensing technologies are used for sensing channel (unoccupied channel) that cannot be used by primary users. Cognitive users (the terms “secondary users” and “cognitive users” are used mutually unless explicitly mentioned) have flexible and convenient channel access mode, which greatly improves the efficiency of spectrum utilization, and effectively solves the lack of spectrum problem (Zhao, et. al., 2016). The security of cognitive radio network has been uniting growing attentions. Because various unidentified wireless devices are allowed to hopefully access the licensed spectrum in the architecture of cognitive radio, cognitive radio systems are vulnerable to spiteful attacks. Besides, CRNs not only look all the

security threats in popular wireless networks, such as eavesdropping, tampering, imitation, forgery, and noncooperation etc., but also new security hazard related to unique cognitive characteristics, such as primary user repeat attack, falsifying data, denial of service attack etc. (Alageli, et. al., 2016) (Zou, et. al., 2015) At present, the research on network security has gradually become one of the warm topics of cognitive radio networks. Therefore, it is necessary to survey the research status of security techniques for cognitive radio network.

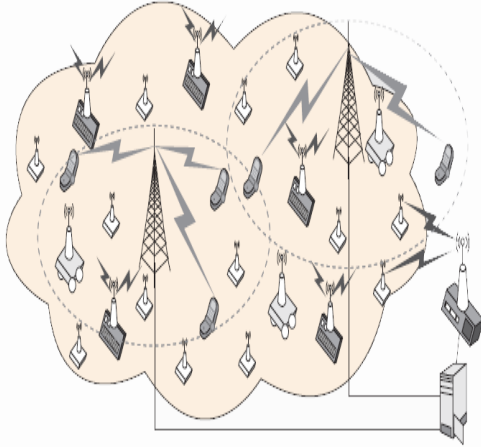


Fig 2: Cognitive Radio Scenario

2. SECURITY ISSUES AND CHALLENGES IN COGNITIVE NETWORK

The existence of malicious nodes is a great menace for improving the capacity, which can be classified into two basictypes (Chen & Baram, 2016) passive attacks and active attacks.

- An active attack corresponds to the situation in which a malicious user intentionally disrupts the system.
- A passive attack corresponds to the situation in which a malicious user attempts to interpret source information without injecting any information or trying to modify the information; i.e., passive attackers listen to the transmission without modifying it (Rombouts, et. al., 2016).

The overall goal is to ensure the network security and enhance the network capacity with less bit error rate (Akyildi, et. al., 2016). The rest sections discussed the significant literature review, proposed system methodology with various result simulations for increasing the capacity, reliability and security of the cognitive networks.

3. PROPOSED WORK

The proposed work deals with hybrid relay selection scheme in cognitive radio network based on single and

multiple relay approach over fading channel for improving the SRT (security and reliability tradeoff). In this research work signal to noise ratio value (dB) are used for the relay selection. As the signal receive strength and signal to noise ratio is high for the particular cognitive node then the multiple relay is selected as the routing node for sending packets from the single user to the destination. The route also consists of the less path delays for the increasing the security and reliability issues.

Path loss deals with the decrease in power density or we can say the attenuation of the electromagnetic tendency as it broadcasts over space. Path loss is very big concern in the study and strategy of the link stability of a cognitive system.

We have considered two distorted environment where the scenario is taken place for the result evaluations. The very first is the AWGN (additive white Gaussian noise) and the second one is the Rician fading channel which is having a big concern in the producing the distortion and reducing these distortions is the main task for the high security and reliabilities.

Path loss is expressed in decibels. The path loss can be evaluated as

$$PL = 10t \times \log_{10}(d) + C$$

Where PL is the path loss, t is the exponent for path loss, d is the distance among the source and destination, regularly measured in meters, and C is system losses (Kohn, et. al., 2014) (Saleem & Rehmani, 2016)

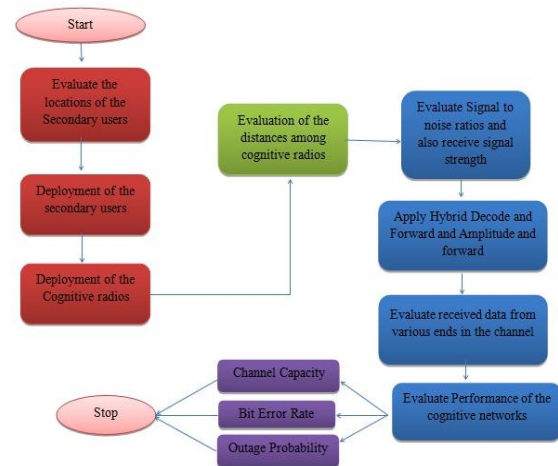


Fig 3: Proposed Methodology Flow diagram

Algorithmic Flow Steps:

Step 1: Initially the user locations are evaluated and then the deployment the secondary users is taken place.

Step 2: The process of deployment of cognitive radios is initialized

Step 3: Distances among the cognitive radios are evaluated to achieve the high signal strength to achieve routing in the cognitive radios

Step 4: The hybrid approach for decode forward and amplitude and forward approach is achieved to obtain high security and reliability tradeoffs

Step 5: The evaluations from each end of the channel such as from relay to the base station, from mobile station to the base station is taken place

Step 6: The performance is evaluated in terms bit error rate, channel capacity and outage probability.

4. RESULT AND DISCUSSIONS

The whole scenario is done in MATLAB 2016a. We have used MATLAB because this is efficient computing tools to achieve high end analysis in an effectual manner.

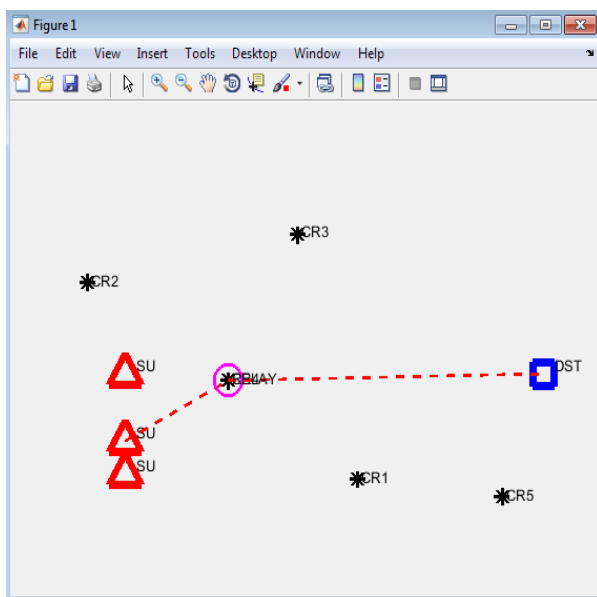


Fig 4 (a): Single relay selection Network

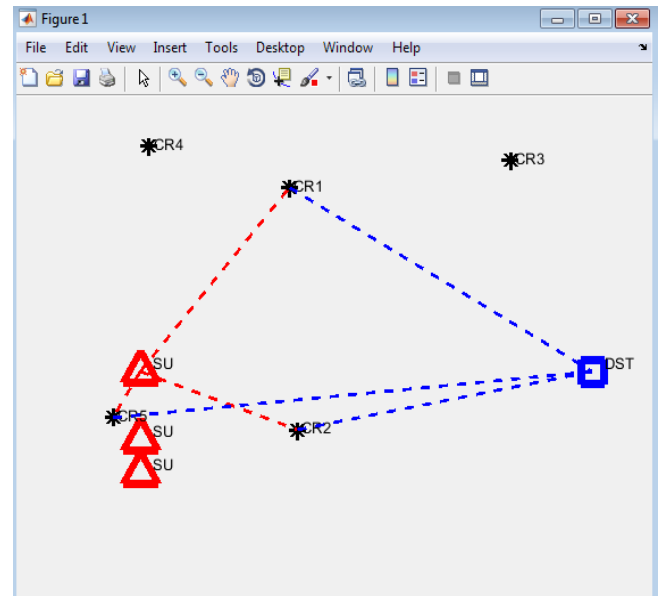


Fig 4(b): Multiple Relay Selection Network

The Fig 4(a) shows the single relay cognitive radio network and 4(b) shows the multiple relay selected network in which secondary users is deployed with cognitive radios. These cognitive radios are mobile in nature which deals with the dynamic topology which is one of the significant tasks in terms of the stability of the network and also high signal strength.

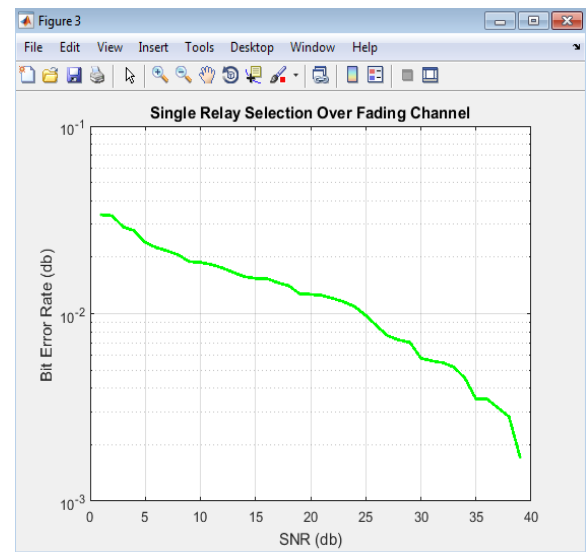


Fig 5: Bit Error Rate (Single relay)

The fig 5 shows the bit error rate in additive white Gaussian noise fading channel which shows that the network is able to achieve less bit error rates as the signal to noise ratio increases.

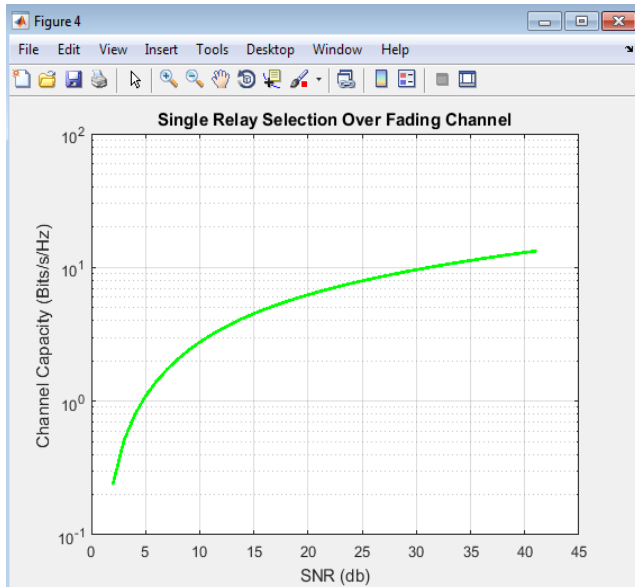


Fig 6: Channel capacity (Single relay)

The fig. 6 shows the channel capacity over fading channel in case of signal relay selection and shows that the information is reliably broadcasted over a fading communication channel.

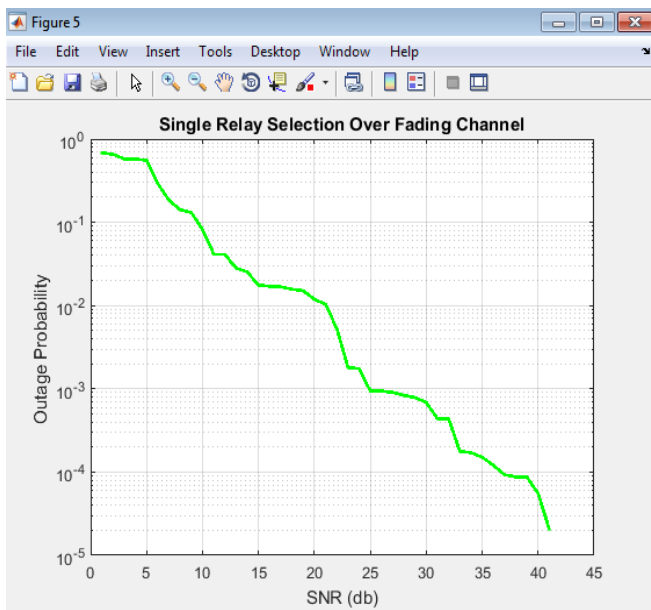


Fig 7: Outage Probability (Single relay)

The fig. 7 shows the outage probability in case of single relay selection which deals with the probability distribution that the rate of the information is not supported which shows the network reliability. It is one of the main concerns in the cognitive radio. This parameter must be long lasting for the stabilization of the working of the network. It deals with the probability that the channel rate information is not long lasting. Outage probability is well known with the capability that the stability rate will become less than the threshold rate.

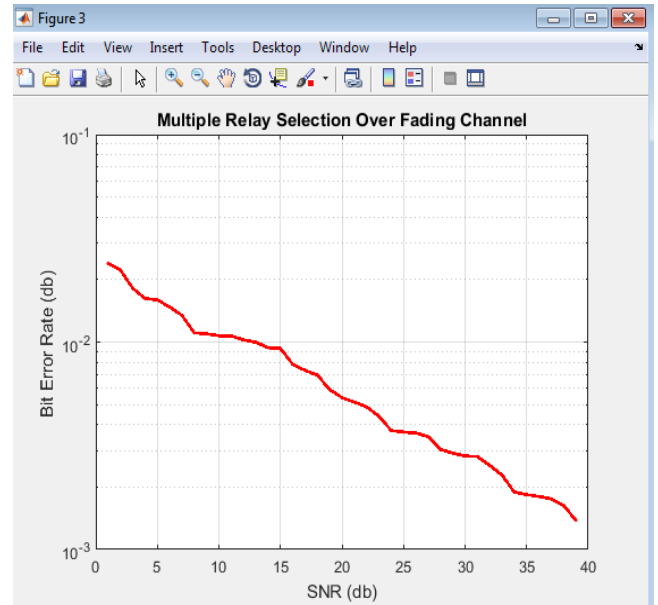


Fig 8: Bit Error Rate (Multiple relay)

The fig. 8 shows the bit error rate for multiple relay selections and shows that our proposed approach is able to achieve less bit errors which must be low for high reliabilities

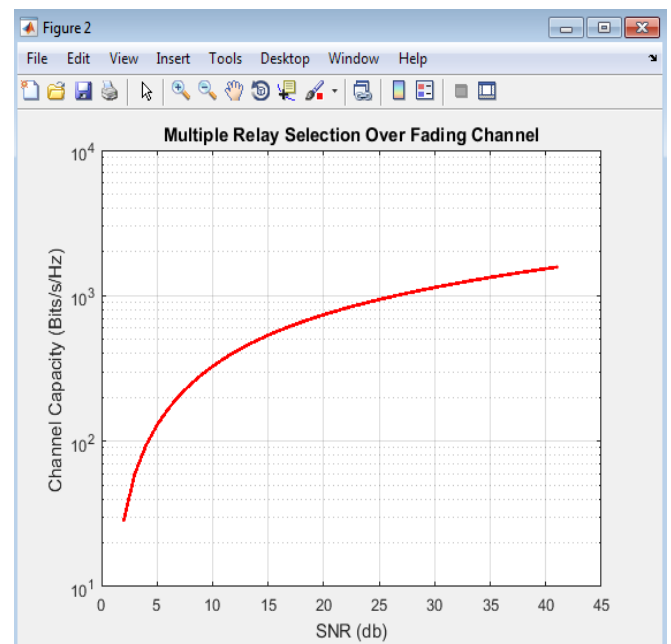


Fig 9: Channel Capacity (Multiple Relay)

The fig. 9 shows the channel capacity over fading channel for multiple relay selections and shows that the proposed system is able to achieve high channel capacity than the single relay scenario and is able to achieve high capacity of information to transmit from source to the destination.

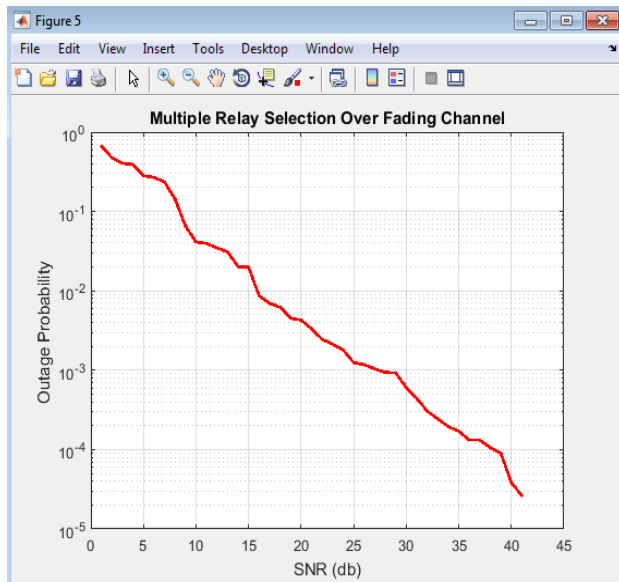


Fig 10: Outage Probability (Multiple Relay)

The fig. 10 shows the outage probability in case of multiple relay selection which shows that our system is able to achieve less outage probability in case of multiple relays and is able to handle the information transmissions in longer times with less error rate probabilities.

Table 1: Performance Evaluations over fading channel

Parameters	Single Relay	Multiple Relays
Capacity (bits/s/Hz)	130	1120
Bit Error Rates (db)	0.0013	0.0029
Outage Probability (db)	0.00025	0.00049

Table 2: Bit error rate comparison

Parameters	Decode and Forward [18]	Hybrid (DF + AF)
Bit Error Rates (db)	0.0019	0.0011

Table 3: Outage Probability comparison

Parameters	Decode and Forward [19]	Hybrid (DF + AF)
Bit Error Rates (db)	0.0036	0.00049

From table 1, 2, 3 shows that the performance evaluation between the single and multiple relay selection approaches and also the performance comparison among the various approaches that the

proposed approach is able to achieve effectual results for both the selection schemes and they are also nearly matched with the performance in terms of the capacity, bit error rates and outage probabilities. Also the multiple relay selection is performing better as the communication traffic is able to manage by multiple relays in efficient manner.

5. CONCLUSION

This paper deals with the hybrid decoding and amplification approach for the single and multiple relay selection approached to increase the SRT of the communication system. From the above result and discussions we can notice that the proposed developed scheme is able to meet all the factors and is well efficient to increase the system efficiency with less error rate probabilities and high capacity to carry information at large distances.

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