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Spectrum - Sharing Multihop Cooperative Relaying Performance Analysis Using Cognitive Radio Networks

S.Ananthi[1], S.Tamilelakkiya[2], K.Pushpa[3], M.Sangeetha[4], Sivaroopini[5].

Assistant Professor, Department of ECE, New Prince Shri Bhavani College of Engg. & Tech., Chennai, India [1&2]

Department of ECE, New Prince Shri Bhavani College of Engg. & Tech., Chennai, India [3,4&5]

ABSTRACT*:* Spectrum sharing networks with distributed AF relaying is used to improve the secondary rate and reduce the interference on the primary. In the asymptote of large number of relays optimal power strategy for the secondary source and relays was found, achieving a secondary rate proportionally to log n. The half-duplex rate loss was reduced and the scaling of secondary rate was enhanced by the introduction of the Alternating Relay Protocol. The trade-off between the secondary rate and the interference on the primary was characterized. The combined relaying technique of multi-hop amplify-and-forward (AF) and decode-and-forward (DF) techniques is employed to have a enhanced communication among the users .The proposed relaying technique improves the data rate by 20% under frequency selective fading channel compared to the AF & DF relaying under Rayleigh fading channel.

KEYWORDS: Multiuser Detection, Cognitive Radio, Amplify and forward, Decode and forward.

I. INTRODUCTION

Cognitive radio is an intelligent radio that can be programmed and configured dynamically. Its transceiver designed to use the best wireless channel in its vicinity. This process is a form of dynamic spectrum management. The main consideration is, it will select the immediate available channel for better communication so that the bit rate increases for N number of relays with equal distribution of data among the users.

The source signal is selected and the available spectrum is shared among the user to establish a licensed communication by Frequency selective fading channel [3]. Equalizers are often deployed in such channels to interface with each other. Cognitive radio selects the immediate available channel for primary and secondary user access. ARP protocol is employed for relaying techniques. Additional relaying path for selection of best signal is done with Co-operative relaying [1].Clustering modifies data preprocessing and model parameters until the result achieves desired properties.

With the frequency selective fading channel the available frequency is shared among the users to have a licensed communication. Spectrum sharing [4] allows the unlicensed secondary users to share the spectrum of licensed primary users as long as the interference caused on the primary user is tolerable. Primary user allocates the spectrum to the secondary users by itself without degrading its own performance using spectrum sharing techniques.

II. SYSTEM MODEL

The Fig 1 shows the system model , In which for a single primary user multiple secondary users can be selected by using Multi user detection (MUD) .The selection is for the relaying techniques to select the best signal for transmission.

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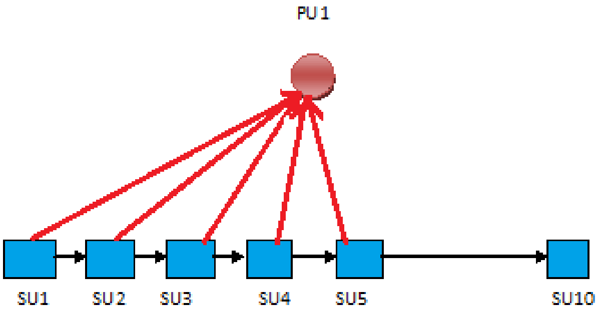

Fig1: System model

Multiuser detection encompasses both receiver technologies devoted to joint detection of all the interfering signals or to single-user receivers which are interested in recovering only one user but are robustified against multiuser interference and not just background noise [2].Spectrum allocation for multiuser (Rayleigh fading) is not up to the level of distribution and due to fading, high loss in data at receiver. In order to overcome this problem Frequency selective fading channel is used. Equalizers are often deployed in such channels to compensate for the effects of Inter symbol interference. By the use of frequency selective fading the available spectrum is shared among the users to have a licensed communication.

The data rate of secondary user by Amplitude and Forwarding technique is calculated by the channel capacity equation

$$C = \log 2 \det (I + AR_xA^\dagger)(BR_nB)^{-1}$$

In this equation, $R_x = E\ xx^\dagger$ is the covariance matrix of the transmitted signal vector, and $R_n = E\ nn^\dagger$ is the noise covariance matrix. For our systems, we have $R_x = (P/mTx) \cdot I_{mTx}$, and $R_n = N \cdot I_n$, where $n = 2mRx + M \cdot mrel$. In this the water filling algorithm is employed for channel power allocation in MIMO systems.

2.1 Co - operative Relaying:

Co-operative relaying is a technique for wireless communications promising gains in throughput and energy efficiency [5]. In this technique a device transmits a data signal to destination; a third device overhears this transmission and relays the signal to the destination as well. Finally the destination combines the two received signals to improve decoding. Devices located between source and potential destination must agree in a distributed manner which of them will act as relay and thus promote wireless communication.

2.2 Alternating Relaying Protocol(ARP):

The ARP is used to reduce the interference in the primary interference and to increase the secondary data rate. ARP is the combination of both AF& DF. AF relay acts as an analog repeater resulting in noise enhancement in the relay path. DF relay fully decodes, again encodes and retransmits the received message, propagating decodes errors that may lead to wrong decision at the destination.

2.2.1: Amplify & Forward Relaying:

The Amplify and Forward relaying technique simply amplify the signal received by the relay and forward it to the destination. The signal received by the relay node must be attenuated and needs to be amplified before it can be sent again towards destination. The main drawback of this technique is while amplifying the received signal the noise in the signal is also amplified and it is not able to store any information in a buffer as the processing involved is analogue

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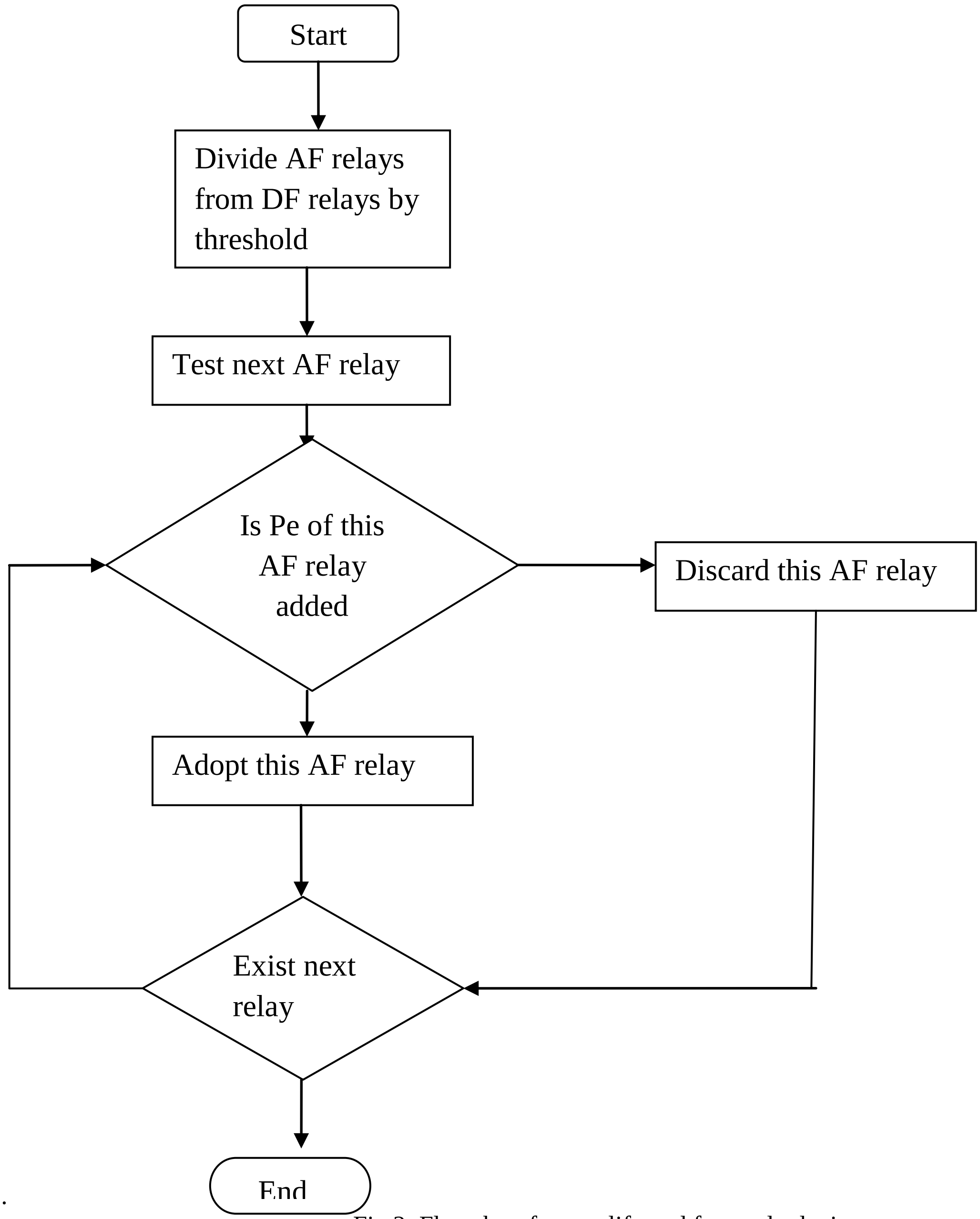

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Fig 2: Flowchart for amplify and forward relaying.

2.2.2: Decode & Forward Relaying:

In decode and forward relaying the received data in the relay node is decoded first and then it is transmitted to the destination after re-encoding. If an error correcting code is placed with source message, bit errors in received data could be corrected at the relay node. To avoid such effects the Alternative relaying protocol which is the combination of Amplify and forward, decode and forward relaying is employed [6].

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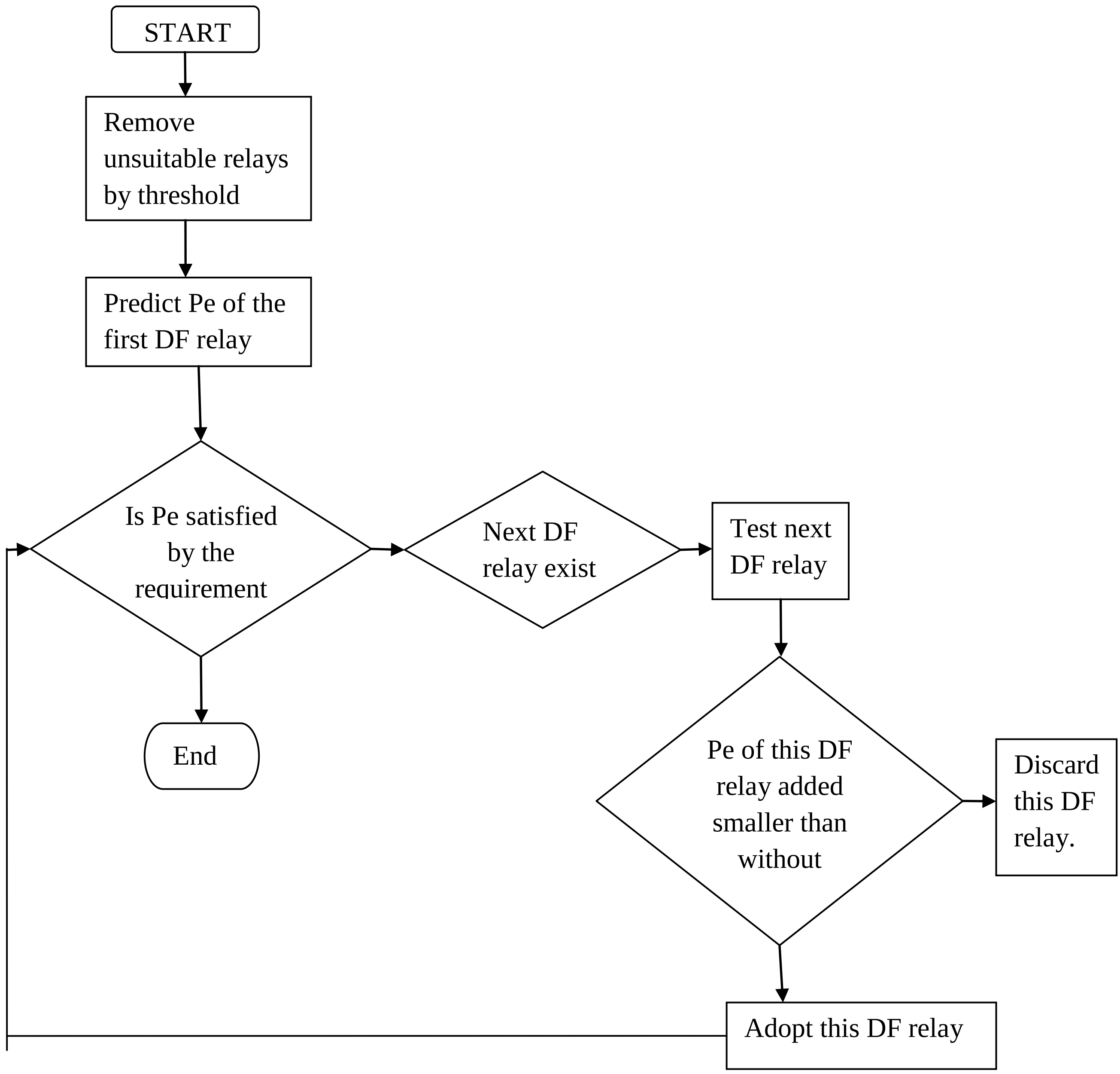

Fig 3: Flowchart for decode and forward relaying.

III. SIMULATIONS & RESULTS

In our system single primary user and ten secondary users are assumed and ten relay launches are considered. Frequency selective fading channel is used.

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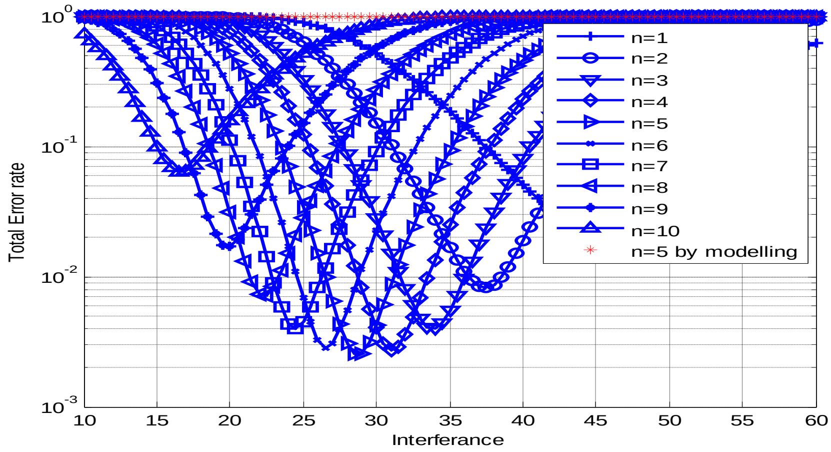
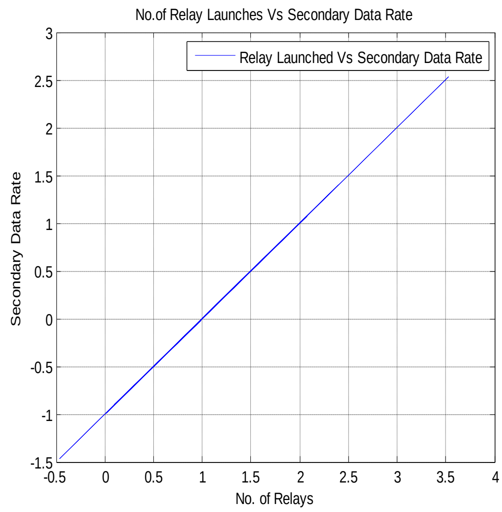


Fig 4: Total error rate Vs Interference.

The figure 4 gives the relation between the total error rate to the primary user interference. The 'n' denotes to the number of secondary users to corresponding relay launches. It shows that fifth user (n=5) provides better error rate performance compared the other secondary users.



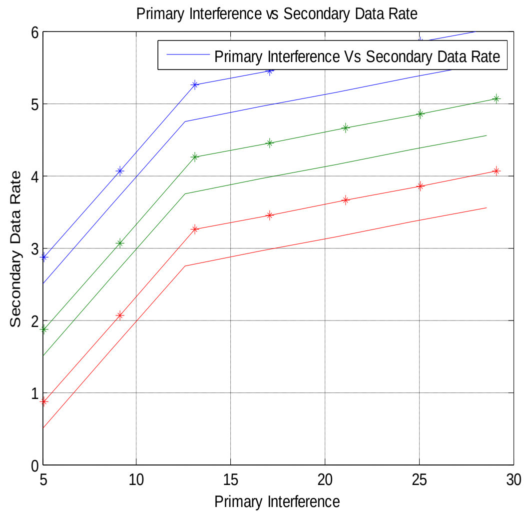


Fig 5: No of relays Vs secondary data rate. Fig 6: Primary interference Vs secondary data rate.

The simulation graph in fig. 5 shows the Secondary data rate for the number of relay launches for the secondary user. The date rate is high if the relay launch is further increased. For a simultaneous relay launching achievable data rate of secondary user can be obtained.

In fig 6, it gives the characteristic performance in the secondary data rate by reducing the primary user interference where the comparison is between existing and proposed for three hops, here the straight line indicates the existing system and start symbol denotes the proposed system. It is observed that if the interference of the primary user is reduced then the secondary user data rate will be increased.

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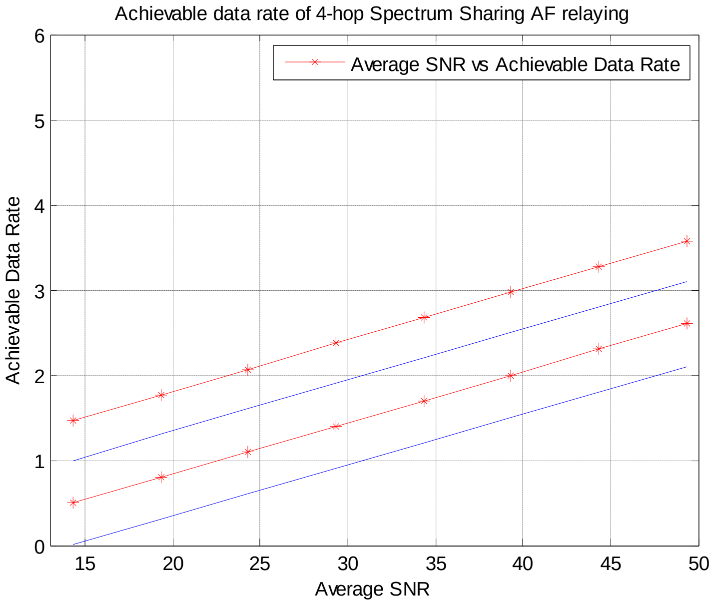

Fig 7: Average SNR Vs achievable data rate.

Figure 7 relates the achievable data rate of the secondary user with average SNR for two hops where the straight line indicates the existing system(Rayleigh fading) and the star symbol denotes the proposed system(Frequency selective fading) . The achievable data rate for both Rayleigh and Frequency selective fading channel is inferred from the graph shown for each hopping. The data rate of the secondary user can also be increased with hop rate .

IV. CONCLUSION

The maximum data rate in secondary user is achieved by reducing the interference of primary user by the selection of relay models. Frequency selective fading channel is used to increase the secondary data rate and hence the data loss is comparatively reduced and the available spectrum is shared among the users. It shows the secondary user data rate is increased by 20 % through frequency selective fading channel and ARP relaying compared to AF/DF relaying under Rayleigh fading channel.

REFERENCES

[1] Chao zhai,ching,p.c and wei zhag,"Cooperative spectrum sharing based on two-path successive relaying",IEEE transaction on communication, volume 61,2013.

[2] Minghua xia, Sonia assay, "Spectrum - sharing Multi-hop cooperative Relaying performance Analysis using extreme Value Theory", IEEE transactions on wireless communication, volume 13,2014.

[3] Xiamen gong,voro byov and s.a telambura "Optimal Bandwidth and power allocation for suergodic capacity radio networks" IEEE transaction on signal processing ,volume 42 ,2013.

[4] Varaka Uday Kanth, Kolli Ravi Chandra, Rayala Ravi Kumar "Spectrum Sharing In Cognitive Radio Networks" International Journal of Engineering Trends and Technology(IJETT)- Volume4Issue4- April 2013.

[5] Rania Mokhtar ,B.M.Ali, NK noordin, Rashid saeed "Distributed co-operative spectrum sensing in cognitive radio networks with adaptive detection threshold "proceedings of the Asia –pacific advanced network 2010.

[6] HimalA.Suraweera,Peter J.Smith, Chau yuen "Full duplex relay selection for Amplify-and forward cooperative networks" IEEE transactions on wireless communication, VOL 11,NO.12,december 2012.