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VLSI Implementation of Variable Length Radix-2^5 for Cognitive Radio System

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Abstract-
Cognitive Radio System (CRS) is a radio system which is aware of its operational and geographical environment, established policies, and its internal state. It is able to dynamically and autonomously adapt its operational parameters (sub carrier mapping) and to increase the system throughput for 4G requirements. Fast Fourier Transform (FFT) has already been widely applied to area of signal analysis, frequency spectrum estimate and OFDM-based communication systems. In OFDM systems, the required FFT sizes vary according to different operation standards or system parameters. Hence, it's desirable to design a domain specific, power-scalable, high speed and area-efficient variable-length FFT processor. In this project propose a radix-2^5 FFT which will give similar performance with radix-32 but it is radix actually radix-2. This can use it for any 2^N mapping requirements. Finally it is carried out VLSI implementation of proposed system and its performance was analyzed

Keywords - CRS, FFT, OFDM, subcarrier mapping

I. INTRODUCTION

Next Generation (4G) communication networks, also known as Dynamic Spectrum Access Networks (DSANs) as well as cognitive radio networks will provide high bandwidth to mobile users via heterogeneous wireless architectures and dynamic spectrum access techniques. The inefficient usage of the existing spectrum can be improved through opportunistic access to the licensed bands without interfering with the existing users. 4G networks, however, impose several research challenges due to the broad range of available spectrum as well as diverse Quality-of-Service (QoS) requirements of applications.

Primary user (or licensed user) has a license to operate in a certain spectrum band. This access can only be controlled by the primary base-station and should not be affected by the operations of any other unlicensed users. Primary users do not need any modification or additional functions for coexistence with 4G base-stations and 4G users.

In this work, mathematical priority queue model was built, classical queue parameters were discussed and CR improvement was computed on a real system implementation. Different CUs differ from each other in arriving process, serving process, QoS requirement, etc. Hence, classifying all of them into just one kind is not precise enough. To achieve a more precise model, [31] proposed further priority level partition among CUs. Moreover, suppose CUs have been further partitioned already, not only PU can preempt, but also higher priority CU can preempt lower ones.

I. COGNITIVE RADIO

Cognitive radio technology is the key technology that enables an 4G network to use spectrum in a dynamic manner. The term, cognitive radio, can formally be defined as follows.

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A. Cognitive capability

Cognitive capability refers to the ability of the radio technology to capture or sense the information from its radio environment. This capability cannot simply be realized by monitoring the power in some frequency band of interest but more sophisticated techniques are required in order to capture the temporal and spatial variations in the radio environment and avoid interference to other users. Through this capability, the portions of the spectrum that are unused at a specific time or location can be identified. Consequently, the best spectrum and appropriate operating parameters can be selected.

B. Spectrum sensing:

A cognitive radio monitors the available spectrum bands, captures their information, and then detects the spectrum holes.

C. Spectrum analysis:

The characteristics of the spectrum holes that are detected through spectrum sensing are estimated.

D. Spectrum decision:

A cognitive radio determines the data rate, the transmission mode, and the bandwidth of the transmission. Then, the appropriate spectrum band is chosen according to the spectrum characteristics and user requirements. Once the operating spectrum band is determined, the communication can be performed over this spectrum band.
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II. SPECTRUM SCHEDULING

Spectrum scheduling should consider user priority in claiming the spectrum. Traditional priority queue model divides CR system users into PU and CU. The PU seizes the spectrum according to their stochastic characteristic, whereas the CU leases the spectrum vacancy at the absence of PU. Such leasing policy is aimed to make best efficient utilization of the precious spectrum resources.

A. Cooperative communications:

In traditional wireless technologies, point-to-point or point-to-multipoint communications have been widely used. In contrast to point-to-point communication. Thanks to cooperative communication techniques, limitations in underlay CRNs such as low transmission rate and short range communication can be overcome.

In a CCRN, the SU-Tx communicates with the SU-Rx through the help of one or several SRs in which both the SU-Tx and SRs have to adapt their transmit power to satisfy the constraint of the PUs communication in their vicinity. Here, a simple CCRN is presented where the SU-Tx communicates with the SU-Rx through the help of a single SR. The SR and SU-Rx are subject to the interference from the PU-Tx, while the SU-Tx and SR must control their transmit power to keep the interference at the PU-Rx at an acceptable level.

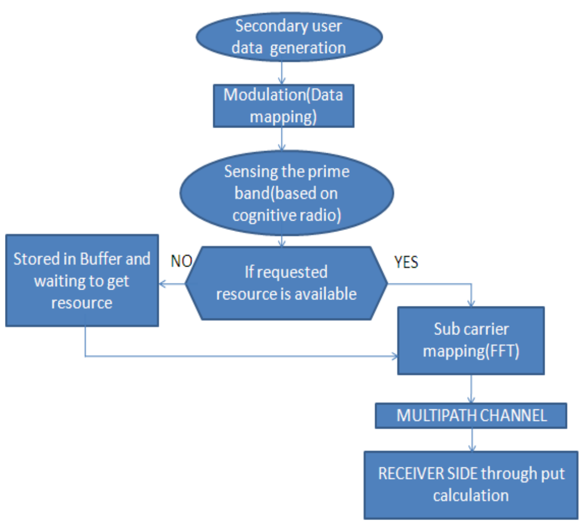

Fig 1 Receiver architecture

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B. SPECTRUM HOLES

A spectrum hole is originally defined as a band of frequencies which are readily assigned to a PU, however, it may not be always used by the PU at a specific time or a geographic area [5]. Depending on the communication environment, the spectrum holes can be identified following frequency and time(see Figure 1), or space. Frequency spectrum hole is a contiguous frequency band in which activities of the SU do not cause any harmful interference to the PUs.

Temporal spectrum hole is a frequency band that is not occupied by a PU for a period of time. By using advanced spectrum sensing techniques, an SU can detect spectrum holes and opportunistically access it without degrading any quality of service (QoS) of the PU.

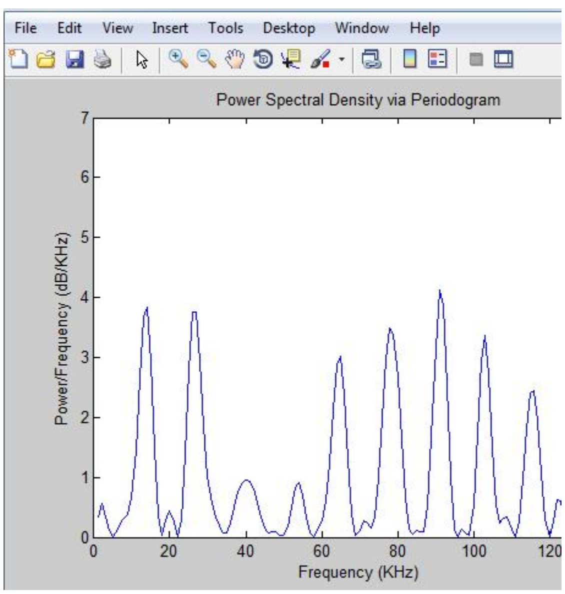

Fig 2 Holes in 3rd and 4th band

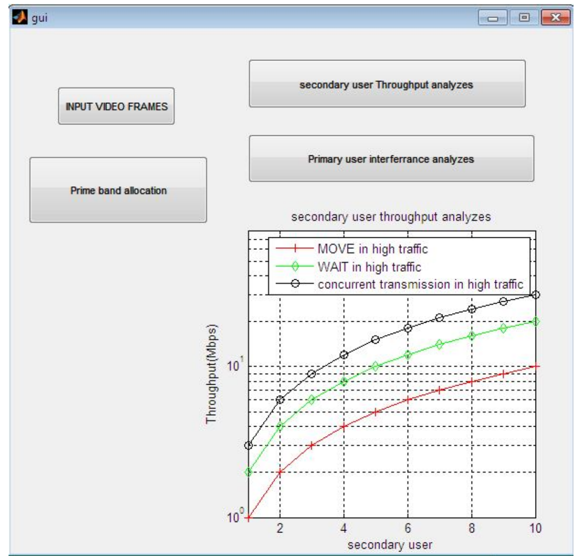

Fig 3 Throughput analysis

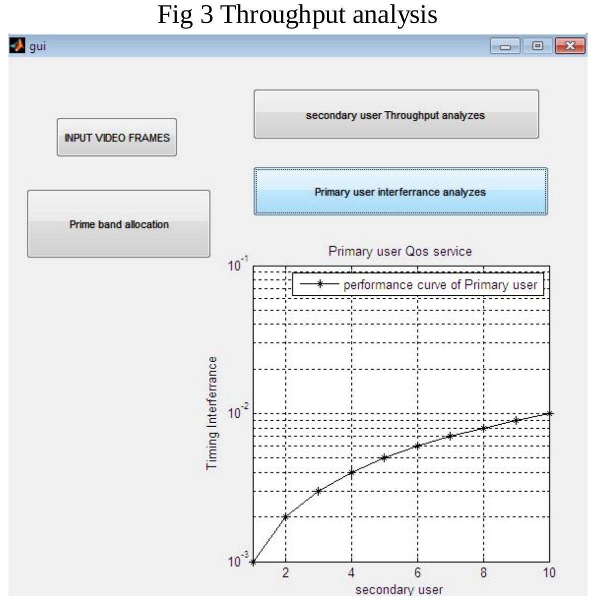

Fig 4 Primary user interference analyzes

III. PERFORMANCE RESULTS

Interference rate in prime bands will be increased when we increase the number of secondary users. It will be linear interferences caused by concurrent transmission. In

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case of MOVE secondary users will move from one prime band to another based on holes availability. But in WAIT secondary users has to wait to get holes in their unique prime bands. Compare with these two methods concurrent transmission will give better throughput rate.

IV. CONCLUSION

In this paper we describe spectrum wastages as a hole and it was originally defined as a band of frequencies which are readily assigned to a Primary Users; Here we successfully sensed those unused bands it was used by the secondary users at a specific time. Depending on the communication environment, we analyzes two methodologies in which spectrum holes are allocated to secondary user and finally robustness of proposed system was analyzes by measuring BER of PU's and throughput of SU's.

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