Adapting Software Defined Radio and OFDM for medium range communication

Jaya T*

[1]Department of Electronics and Communication Engineering, Vels Institute of Science, Technology & Advanced Studies (VISTAS), Pallavaram, Chennai, Tamil Nadu,India.
Email: jaya.se@velsuniv.ac.in

ABSTRACT

Recently the problem in wireless Communication is transmission channel suffers due to multipath propagation and channel dispersion due to Inter Symbol Interference (ISI), thereby degrading the system performance greatly. Future Communication requires high data rate and effective utilization of bandwidth. Hence there is a need to enhance the Bit Error Rate (BER).The recent advancement in technology has lead to Internet of things (IOT), big data and many more advanced applications in MANET. The bridging gap between these two applications is connected by Cognitive radio which is approached by the Software Defined Radio (SDR). So there is a need for development of software defined radio system for real time applications. This design detects the unused radio spectrum band using efficient spectrum sensing technique at the time of overloading and reduces the issues of data delay and link failures. The proposed work is to develop and implement a adaptive SDR algorithm using OFDM technique for medium range communication in a real world applications.

KEYWORDS: Adaptive Modulation, Multi path propagation, Software Defined Radio (SDR), Internet of things (IOT), Inter Symbol Interference(ISI), Bit Error Rate(BER)

***Corresponding author**

Dr. T.Jaya

Department of Electronics and Engineering,

Vels Institute of Science, Technology & Advanced Studies (VISTAS), Pallavaram,

Chennai-600 017,Tamil Nadu, India.

Email : jaya.se@velsuniv.ac.in,

Mob No – 9941156806

INTRODUCTION

The requirement of the future generation is networked communication systems with a larger coverage range. The office environment or in an entertainment circumstances, people expect transparent internetworking which provides exchanging information, entertainment, and file transferring. The internetworking should be on-demand requirement with whatever they feel like, in spite of time or location. Signal to Noise Ratio varies every time due to multipath fading and interference from other customers, in the wireless communication channel. The modulation method of Orthogonal Frequency Division Multiplexing is a very attractive multi carrier transmission technique for wireless, high speed transmission. The advantages are allows multiple access, strength against multipath loss, Inter Symbol Interferences (ISI), narrowband interfering, high bandwidth efficiency, and less receiver complication due to the simple frequency domain equalization, as well as, simpler realization using IFFT/FFT. Apart from this OFDM provides inherent flexibility in the system further allows adaptive bit and power consignment[1]. However bandwidth limitation is an existing issue and researchers are still working on the layer 1,2 and 3 parameters to improve the data throughput and bit error rate. Nowadays most of the available radio spectrum is allocated to different services, applications and users. There is a need to find suitable spectrum bands to meet the demand of future services [2,3].

The promising technology to overcome this problem is Software Defined Radio (SDR) which senses and understands the environment and transmits adaptively in the vacant spectrum. The policy engine in SDR is the intelligent machine for making intelligent decisions and configures the radio and physical parameters. The transmission needs are identified by this decision unit based on the channel information from policy engine as well as neighbouring and network spectrum sensing data. Since the physical layer function is concerned, SDR will be able to communicate with different radio access technologies or improve the characteristics of communication by altering the configuration factors of OFDM. It is proposed to develop and implement an adaptive SDR algorithm using OFDM technique for medium range communication in real world applications[4].

LITERATURE REVIEW

A fundamental SDR system consists of a computer attached to a RF front end capable of receiver and transmitter radio signals. However the RF front end require an antenna appropriate for required Radio Frequency bands and transceiver chip that is consist of one

local oscillator, analog-to-digital converter(ADC), digital/analog converter (DAC),and an interface card (e.g. Ethernet cable) that join the front end to the programmable computer. The system may have a general purpose processing unit to process the digital output signals and programs to comprehend tasks such as noise removing, amplification and modulation which is applied in hardware. The design idea of the SDR is beneficial for the reason that it decreases the need for special function hardware and permit the developer to insert novel functionality to the radio by changing the software[5]. The flexibility nature in the SDR agree to for the probable to support several wireless standards, where as a particular hardware transceiver antenna can simply support a few or one standard. Hence, the SDR device can be seen as an progressively more reasonable option and generated [6]. A practical downlink Non-Orthogonal Multiple Access (NOMA) system based on an open-source Software Defined Radio (SDR) platform named as Open Air Interface (OAI) has been developed and efficiency of the baseband signal processing improved by an Successive Interference Cancellation (SIC) receiver, a multi-thread processing method is also introduced [7,8]. The future 5G networking is a innovatory technology which can change users' Internet use practice in daily life, as it make a actually wireless environment. The communication is faster, with improved quality, in addition to is more safe. Most prominently, users can really utilize network services anytime, everywhere. By means of increasing demand, the bandwidth utilization and frequency band resources is further than expectations [9]. Frequency spectrum and network details have substantial significance; thus, spectrum sensing, spectrum utilization and channel should be concurrently considered [10]. Software Defined radio (SDR) and Software Defined networks (SDNs) are the most excellent solution used for communication networks [11]. In general medium range communication systems in a presence scenario in India varies from Courier service, Banking services, Vehicle Rental services to some other applications. Originally all these application was not online and it was totally on a telephonic control systems. Today it is now become a simple services with handheld apps in cell phone linked with goggle mapping, tracking and becoming very user friendly. However such kind of a user friendly applications give rise to certain errors like delay, data loss and spectral mismanagement and in availability [12]. Since the users at a time becomes many it is bound to happen. So an adaptive either software Defined or Controller algorithm understands the above problem areas and make characteristic study to make a good SDR policy engine if it is made and trained in the field with the user and made it as a hardware as one of the very important root for those who are working in the marketing line. In addition to the above the security also has been built in the algorithm[13].

PROPOSED SYSTEM DESIGN

Methodology

Software defined radio is an essential part in cognitive radio where it change all analog component into digital part and execute all the necessary work on software. In software defined radio every radio hardware are previously present no need of additional tedious events those are similar to mixer, filter, modulator in addition to demodulator. As we be expecting the software defined radio to be reconfigurable, the information after the test be able to reprogrammable. Therefore the individuals be capable of do their experiments exclusive of the expensive hardware and obtain the same result later than a number of simulations. SDR works in three steps first the input real time signal is approved through the RF section after that it goes to the signal processing element and after that to the user interface structure in Figure 1.

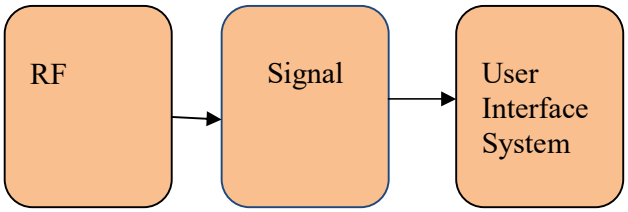

Figure 1.Processing Steps Involved in SDR

Spectrum Sensing

Spectrum bandwidth sensing and alertness is one of the a large amount of important elements of SDR idea. Spectrum sensing techniques are the procedure to know the presence of primary users (PU). With the growth of technology and a variety of applications move toward to employ hence spectrum scarceness occurs where the requirement of well-organized utilization is compulsory. The aim is to get the primary user and at the exacting time & frequency if one channel is available or there is a bandwidth hole then secondary user can make use of those available channels hence spectrum can be proficiently utilized as well as effectiveness of the communication network will increase. The focus is on the energy detection technique with its features and drawbacks are eliminated by cyclostationary detection. Since cyclostationary detector acts well to the low Signal to Noise Ratio (SNR) principles whereas it does not carry out energy detection. This is a feature based detection hence also has enhanced processing gain. The demand for bandwidth utilization in wireless

communication field owing to the development of applications are the major reason at the back the improved utilization of bandwidth. Band width sensing can in addition to boost the efficiency of the bandwidth available and the techniques utilized for this are energy finding, matched filter, cyclostationary recognition. For this reason the use of cyclostationary recognition technique is additional well-liked as per the requirement of bandwidth and it is not exaggerated by low SNR.

Proposed Algorithm

The proposed method of adaptive SDR algorithm based OFDM system is shown in Figure 2. The modulation technique OFDM is an attractive scheme because of its high resistance to multi-path signal fading and its ability of contribution is high transmission throughput data rate. However, the connection quality of the proposed system could be dishonoured when the sub-channel intrusion signal power from neighbouring cells are increased.

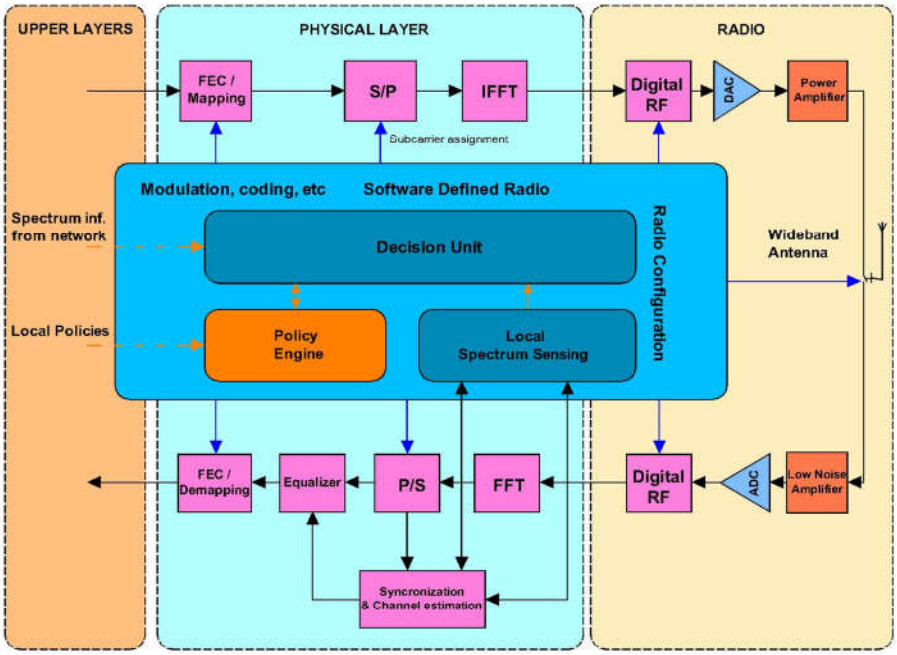

Figure 2: Proposed Adaptive SDR based OFDM system

The goal of OFDM is to separate the large amount of wide frequency band of fading channels into number of flat fading frequency channels. However the Orthogonality property permit many information signals to be transmitted in parallel above a same channel and is identified without any nosiness. The proposed system performance be able to be enhanced by channel

coding. As shown in the schematic diagram of adaptive SDR algorithm based OFDM system ,whole layers be capable of work together through the policy engine. The system parameters and radio components are configured by the cognitive engine. This policy engine is answerable for building clever decisions and configuring the radio components and physical layer parameters. The transmission opportunities are identified by the choice unit based on the channel information from policy engine with local and network bandwidth sensing data. As far as physical layer is concerned, cognitive radio be able to communicate with a variety of radio access technologies in the environment, or it be able to get better the communication network quality based on the environmental properties, by just changing the configuration parameters of the proposed system and the radio interface. It should be noted that corresponding coding type, coding rate, type of interleaver pattern, and other parameters in medium access control (MAC) and upper layer functions necessitate to also be altered consequently.

SIMULATION RESULT

First we set the center frequency for SDR input port which determines the peak frequency in Fourier transform of the wavelet. The wavelet purpose is in consequence a band pass filter. In order to face the whole spectrum band unlimited levels would be necessary. Signal source that collects data from an Resistor Transistor Logic-Software Defined Radio and the output signal of set length mentioned by the samples for each frame parameters as shown in figure 3.

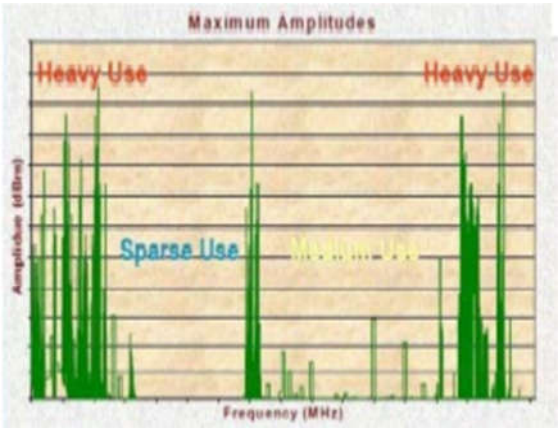

Figure 3: Spectrum Utilization

At this time the center frequency also shows the center frequency of the input signal used for the RTL-SDR radio. The misplaced samples output to train RTL-SDR receiver blocks to

output the number of lost samples through the host data transfer. Where zero indicates the no data loss, positive number indicates above run occur. The default rate is not particular which means that the port is not enabled and no information about dropped small package is not displayed. The obtained peak frequency set utilize an FFT to obtain the frequency with the greatest power from the received information signal which is equal to the frequency offset. Fig.3 shows spectrum allocation output specified in different levels for various usage.

The periodogram of frequency set proceeds the power spectrum estimation of the received signals. Probe frequency block obtain the index of the maximum level amplitude function across the set of frequency band signals and change the index to the value of frequency according to Frequency offset = Index of Max Amplitude x Frame Size/(FFT length*frame sample time) The spectrum sensing levels are indicated in figure 4. The MATLAB function find peak frequency performs this conversion. The frequency and magnitude of the detected signal is compared with a threshold value according to energy detection spectrum analyzing technique. If the detected frequency is less than a threshold value and also the magnitude is greater than another threshold value set by using trial and error method, we can assume that the spectrum is free which is available for secondary user. The occupied block has value 0.Otherwise we can assume that the spectrum is not free which is used by primary user. Then the occupied block will be 1. The Minimum Energy Consumption is shown in figure.5.

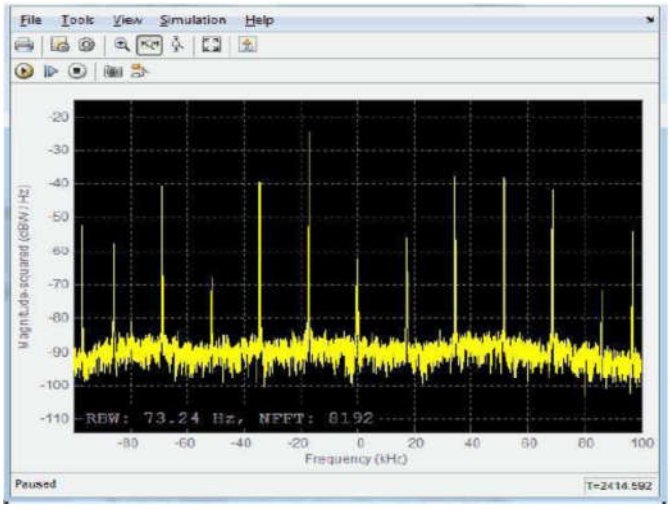

Figure 4: Spectrum sensing- Frequency Vs Magnitude Squared

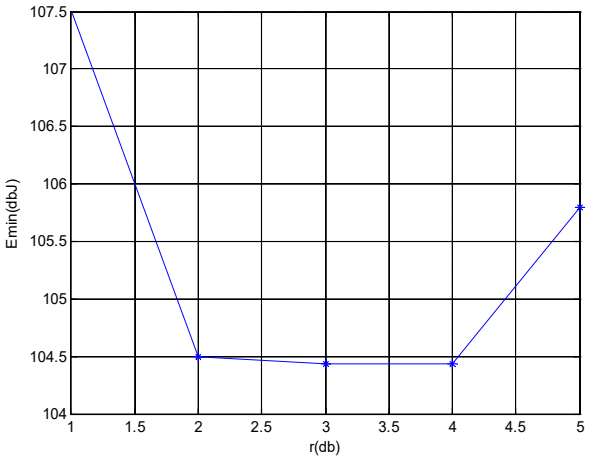

Figure 5: Effect of Fusion Rule in Minimum Energy Consumption

CONCLUSION

Cognitive radio is an new technology proposed to boost the bandwidth usage by allowing dynamic allocation of the unused spectrum in altering environments. Cognitive users monitor the spectrum and are allowed to use it as long as it does not get in the way with primary users to whom it has been licensed. SDR will have a key role to play, in the cognitive systems. We implemented an SDR based spectrum lookup device which be able to be used by a proposed system. The SDR interfacing program detects unused frequency bandwidth ranges. We employed energy detection method to perform spectrum sensing.

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