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# A Smart Grid System Based On Cloud Cognitive Radio Using Beamforming Approach In Wireless Sensor Network

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***Abstract:*** *In this paper at wireless network we use the cognitive radio (CR) channels for communication. The performance of the process is limited by the self-interference which occur in the CR system. To overcome that problem beam forming method is used effectively which reduces the self-interference of smart meter channels. MMSE method is the main concept in the beam forming method utilized in the smart meter system. MMSE will provide accurate channel estimation and noise plus interference to reduce the self-interference in the CR system. The method of channel estimation and noise plus interference was carried out in IEEE 802.22 WRAN (wireless regional area network). This process gets fulfil over the utilization of the cloud computing smart grid infrastructure that hosts IEEE 802.22 WRAN CR standard. The output from the stimulation will show the improvement in the system capacity and BER.*

***Index term:*** *Cognitive radio, Beam forming, Self-inference.*

## 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.

These heterogeneities must be captured and handled dynamically as mobile terminals roam between wireless architectures and along the available spectrum pool. The key enabling technology of 4G networks is the cognitive radio. Cognitive radio techniques provide the capability to use or share the spectrum in an opportunistic manner. Dynamic spectrum access techniques allow the cognitive radio to operate in the best available channel. More specifically, the cognitive radio technology will enable the users to (1) determine which portions of the spectrum is available and detect the presence of licensed users when a user operates in a licensed band (spectrum sensing), (2) select the best available channel (spectrum management), (3) coordinate access to this channel with other users (spectrum sharing), and (4) vacate the channel when a licensed user is detected (spectrum mobility).

Once a cognitive radio supports the capability to select the best available channel, the next challenge is to make the network protocols adaptive to the available spectrum. Hence, new functionalities are required in an 4G network to support this adaptively. In summary, the main functions for cognitive radios in 4G networks can be summarized as follows:

- **Spectrum sensing**: Detecting unused spectrum and sharing the spectrum without harmful interference with other users.
- **Spectrum management:** Capturing the best available spectrum to meet user communication requirements.
- **Spectrum mobility:** Maintaining seamless communication requirements during the transition to better spectrum.
- **Spectrum sharing:** Providing the fair spectrum scheduling method among coexisting 4G users.

## II. 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

***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.

## III. PARAMETER SETTINGS

The transmission scheme is OFDMA in a DFT-spread OFDM form. The table shows that different transmission bandwidths have different parameter settings. The transmission is frame based with radio frame duration of 10 ms and consists of 20 sub frames of 0.5 ms.In technical specification TR 25.814 V7.1.0 [6], a sub frame is equivalent to a TTI. An example of sub frame structure for uplink transmission. Based on technical specification TR 25.814 V7.1.0 [6], a sub frame consists of two short blocks and six long blocks.

The short block is a reference symbol and transmitted in a time-multiplex format with the long block. It has the following purposes: uplink channel estimation for uplink coherent demodulation/detection; and possible uplink channel quality estimation for uplink frequency or time domain channel- dependent scheduling. The short block duration is half the long block duration. The long block is primarily used to transmit data.

In the work item phase, the 3rd Generation Partnership Project (3GPP) has modified certain physical layer parameters and hence has changed the assumptions

Were initially applied for the evaluations in this chapter. In particular, the sub frame or TTI duration has changed to 1 ms to include two 0.5-ms slots, each with a structure. As it can be seen, the modified short-block duration is equal to the long block and placed in the middle of the slot (as of 2007, the final position within the slot had not been decided).

Initially, the supported modulation schemes have been *p*/2 BPSK (binary phase key shifting), QPSK (quadrature phase shift keying), 8 PSK (phase shift keying), and 16 QAM (quadrature amplitude modulation). In the work item phase, the supported modulation scheme for data transmission was changed to QPSK, 16 QAM, and 64 QAM (optional).

## IV. OFDMA TRANSMISSION

The basic uplink transmission technique is single-carrier transmission with cyclic prefix to achieve uplink inter user orthogonally and to enable efficient frequency domain equalization at the receiver side. The transmitter and receiver structure for OFDMA transmission is shown in Figure 1.An OFDMA structure is identified by the insertion of DFT spreading and inverse discrete Fourier transform (IDFT) dispreading at the transmitter and receiver, respectively. From this implementation structure, OFDMA is also known as DFT-spread (DFT-S) OFDM, which is a form of the single-carrier transmission technique where the signal is generated in the frequency domain. The DFT spreading combines parallel M-PSK/M-QAM symbols to form an OFDMA symbol. To formulate the DFT-S system, we can start by defining *sm*as the *m*th transmitted symbol at the output of an equivalent OFDM system.

The modulator converts the random bit stream input to the M-QAM/M-PSK symbols represented by the vector **xm**of length *Nd.* The OFDM system then constructs *sm*as

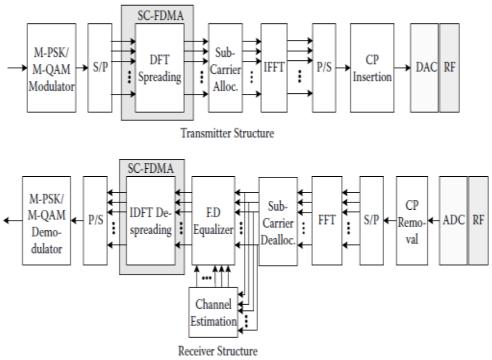


**Fig 1** OFDMA and SC FDMA basic transmitter and receiver structures.

## V. CHANNEL ESTIMATION

Some OFDM systems (as, for instance, the DAB standard modulate the subcarriers differentiallythe information symbols may be encoded differentially from one OFDM symbol to the next within one subcarrier, or differentially between adjacent subcarriers within one OFDM symbol. In a fading channel environment, such a modulation does not need to track the subcarrier attenuations (tracking of the carrier frequencies has still to be done).

The performance sacrifice associated with this modulation scheme compared with coherent modulation schemes is often motivated by its simple receiver structure and its avoidance of pilot symbols. However, if the subcarriers are coherently modulated as in the DVB standard [*ETSI*, *1997b*], estimation of the channel's attenuations of each subcarrier is necessary.

These estimates are used in the channel equalizer, which, in an OFDM receiver, may consist of one complex multiplication for each subcarrier in an OFDM symbol.

Channel estimation in OFDM is usually performed with the aid of pilot symbols. Since each subcarrier is flat fading, techniques from single-carrier flat fading systems are directly applicable to OFDM. For such systems pilot-symbol assisted modulation (PSAM) on flat fading channels [*Moher and Lodge*, *1989*; *Cavers*, *1991*] involves the sparse insertion of known pilot symbols in a stream of data symbols. The attenuation of the pilot symbols is measured and the attenuations of the data symbols in between these pilot symbols are typically estimated/interpolated using time-correlation properties of the fading channel.

The concept of PSAM in OFDM systems also allows the use of the frequency correlation properties of the channel. The first pilot pattern inserts entirely known OFDM symbols in the OFDM signal. The second modulates pilot symbols on a particular set of subcarriers. The third pattern uses scattered pilot symbols, as in the DVB standard. In OFDM systems where Doppler effects are kept small (that is, the OFDM symbol is short compared with the coherence time of the channel) the time correlation between the channel attenuations of consecutive OFDM symbols is high. Furthermore, in a properly designed OFDM system the subcarrier spacing is small compared with the coherence bandwidth of the channel.

Therefore, there is also a substantial frequency correlation between the channel attenuations of adjacent subcarriers. Both the time and frequency correlation can be exploited by a channel estimator. The choice of pilot pattern determines the form of the channel estimator.

Most documented channel estimation concepts consist of two steps, one or both of which use the correlation of the channel. First, the attenuations at the pilot positions are measured and possibly smoothed using the channel correlation.

## VI. RESULTS AND DISCUSSIONS

**Explanation**

In the below graph it shows the OFDMA BER analyses with shorter distance in QAM, PSK and ideal cases to determine the throughput of the signal strength when compared with the BER. There will be not much difference in the waveform in case of the shorter distance between the QAM and the PSK.

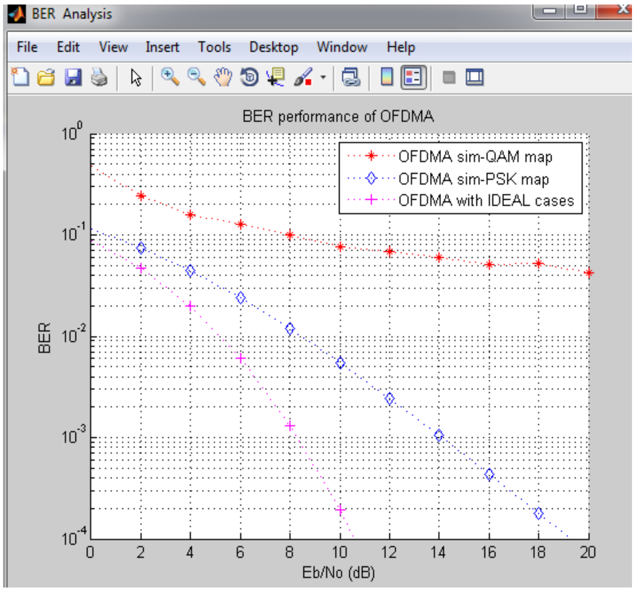


**Fig 2**OFDMA BER analyses with shorter distance

**B. OFDMA over distance metrics**

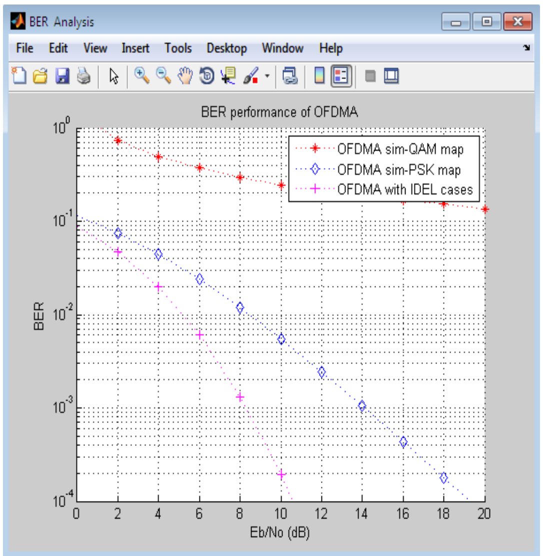


**Fig 3** OFDMA BER analyses over longer distance

**Explanation**

In the above graph it shows the OFDMA BER analyses with longer distance in QAM, PSK and ideal cases to determine the throughput of the signal. There will large amount of variation between the waveform of the OFDM in QPSK and PSK since the signal travels very large distance.

**C. Channel estimation**

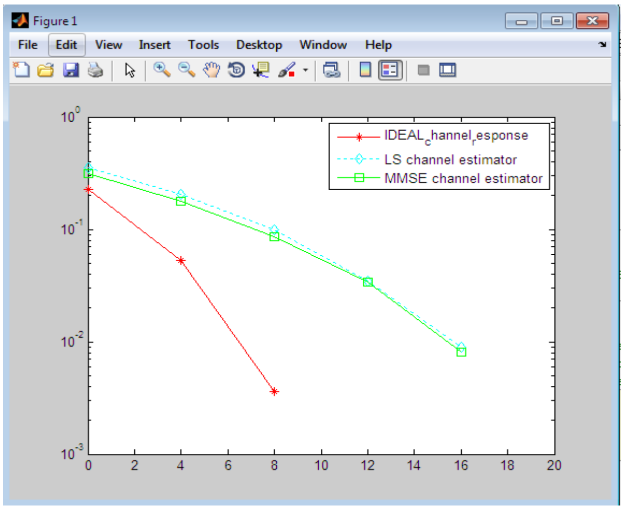


**Fig 4**BER performance of LS vs MMSE channel estimation

**Explanation**

In the above graph its shows the difference between the MMSE channel estimator and LS channel estimator. Where the LS channel estimator has the drawback of the high iteration rate due to which the throughput of the signal gets decreased and because of that the MMSE channel estimator is preferred in large process.

**D. Channel attenuation**

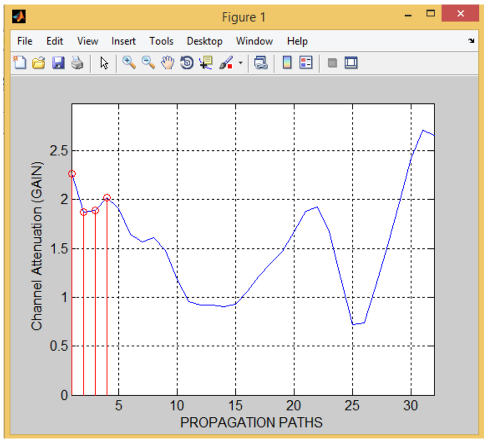


**Fig 5** frequency selective fading

**Explanation**

Here channel attenuation level caused in different delay propagation is proved to be nonlinear. The gain will be time varying one leads channel estimation process to be done for every time iterations. The channel attenuation will vary according to the changes in the propagation path.

**E. BER performance over beam forming effect**

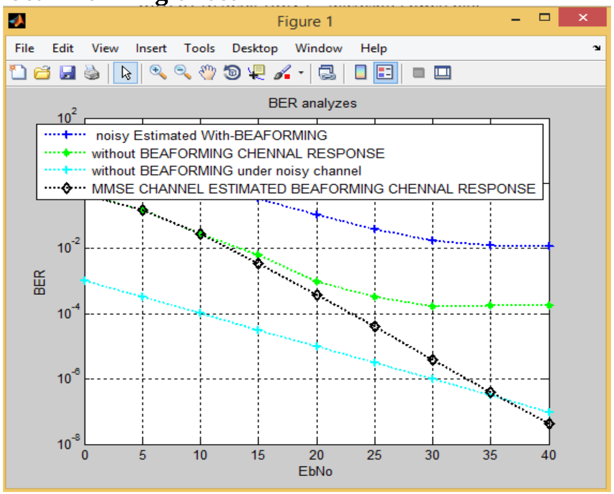


**Fig 6**BER analyses of BEAMFORMING over noisy & noiseless channel

**Explanation**

Here with noiseless channel there is no significant QOS difference for beam forming effect when SNR range is low. But with noisy channel there is considerable BER reduction in beam forming process over multipath propagations.

## VII. CONCLUSION

In this paper, we analyze the performance of different equalization algorithm for OFDMA system. Initially we analyzes the cognitive radio sytems and OFDMA multiple access scheme with various ,modulation schemes over distance metrics .The proposed algorithm is based on channel estimation that exploits the sparsity of the estimated error signal. We also perform multiple beamforming symbol selection in each iteration to prove the fast convergence. We illustrated the performance of our algorithm in numerical simulations, and our algorithm shows a significant performance improvement compared to linear equalizers, while the BER rate is much lower compared to feeding back one symbol at a time for channel estimation.

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