VOL. 10, NO. 9, MAY 2015 ISSN 1819-6608
ARPN Journal of Engineering and Applied Sciences
©2006-2015 Asian Research Publishing Network (ARPN). All rights reserved.
www.arpnjournals.com

A CONFIGURABLE LTE TRANSCEIVER IMPLEMENTATION ON SDR

B. Sainath[1] and K. V. Karthikeyan[2]
[1]Department of Embedded Systems, Sathyabama University, Chennai, India
[2]Department of Electronics and Communication Engineering, Sathyabama University, Chennai, India

ABSTRACT

Over the last decades digital radio systems evolved from GSM with Time Division Multiple Access (TDMA) to UMTS with Code Division Multiple Access (CDMA) to LTE which uses Orthogonal Frequency Division Multiple Access. Goals for Long Term Evolution (LTE) development include higher data rates and lower latencies. The study related to physical layer design is the basic for any mobile system. The Long Term Evolution (LTE) standard defines a multi-mode air interface based on Orthogonal Frequency Division Multiplex (OFDM) within its downlink structure. LTE transceiver is simulated using Simulink. SIMULINK is tool that is being used. OFDM transceiver simulation is to be done that specifies the LTE system each of the individual block are assigned with their specific function where the data is sent and received with low bit loss. . A fast LTE signal processing may be achieved by these measures.

Keywords: TDMA, LTE, OFDM, FDMA.

INTRODUCTION

The physical layer of a communication system handles all the data processing of the bits which should be transmitted/received, such as (de)coding, detection and transmission. The data input to the physical layer will be defined as a transport block and can be of any length. This data is the actual packet which the above layers wants to transmit, whereas a code block is a small slice, with predefined maximum length, of the transport block which is subject to the encoding of the physical layer[1].

A combined layer with both software and hardware programming that include some mechanical device.[2]. The stream of bits is grouped into code words and is then converted to physical signal. With the detailed study of OSI architecture the conversion of data link layer to specify the hardware operations is done in physical layer.

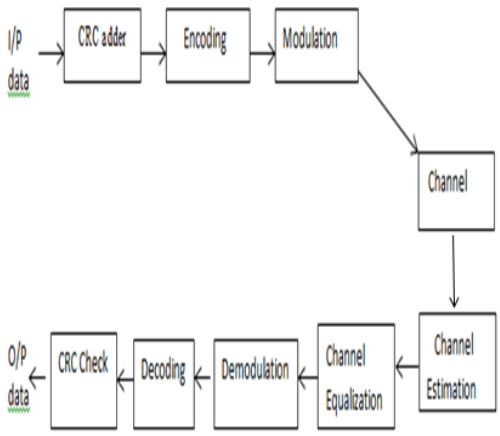

Figure-1. Physical layer of communication system.

OFDM THEORY

Orthogonal frequency-division multiplexing (OFDM) is a method of digital modulation technique with different frequencies a single signal is chop into multi narrow band channels OFDM is very popular in wideband digital communication systems, with both wired and wireless technologies. The basic idea for operation of OFDM is derived to use a large number of parallel narrow-band subcarriers substitute to a single wide-band carrier to transport information.

A large number of closely grouped carrier waveforms are modulated to complex valued data. The OFDM [4] signal multiplexes many low-rate data streams where each data stream is corresponded with a specific subcarrier. Flat fading channel experience is obtained which is the one of its major advantage. The concept of a cyclic prefix is used for slow channels, with a small loss of transmission energy avoiding the inter symbol interference (ISI) and inter carrier interference.

QAM

QAM is a modulation where the two amplitude modulated signals are combined into a single channel, resulting in the increase of bandwidth. QAM has wide range of applications in digital data radio communication. A large variety of QAM are available that include 16QAM, 32QAM, 64QAM etc. The number in the form of QAM refers the constellation points. The possible number of states is referred as constellation point[3]. Radio communication and data delivery are the main applications of QAM. A QAM signal has carriers waves , with same frequency but phase difference of 90 degrees .The term quadrature is obtained from this where 90 degrees is one fourth of a cycle. One signal is referred as the I signal, and the other as Q signal. Mathematically the two different signals can be represented by both sine and cosine waves. The two modulated carriers are combined at the source for transmission. The obtained are then modulated with I or in-phase data stream and Q or quadrature data stream and are generated in band processing area. The QAM demodulator is just the reverse of the QAM modulator.

SOFTWARE-DEFINED RADIO

©2006-2015 Asian Research Publishing Network (ARPN). All rights reserved.

SDR is a radio communication system where the hardware components are being replaced by software without change in functionality. Software radios have notable advantage in the field of military and cell phone services, will be continuously changing in real time. Blade-RF is a Software Defined Radio platform element designed for practical implementation and experimenting with the data related to RF communication. The blade-RF [5] can be tuned from 300MHz to 3.8GHz. The blade-RF is highly integrated and fully reprogrammable.

Figure-2. BLADERF.

The Full-duplex 40MSPS 12bit quadrature sampling is one of the major advantages where it gives the full cycle data transmission supporting high precision FPGA timed RX and TX scheduling is another advantage which the other SDR's can't. Most admirable feature is its upgraded clocking architecture greatly enhances system SNR to 35dB.

SIMULATION

OFDM system is simulated using Simulink in Matlab. The simulation is done in Simulink as it is one of the better tools and it is the one of the easiest way to calculate the bit rate and here bit loss can be verified even. The following shows the simulation model for OFDM transceiver [6] developed based on general structure of OFDM transceiver.

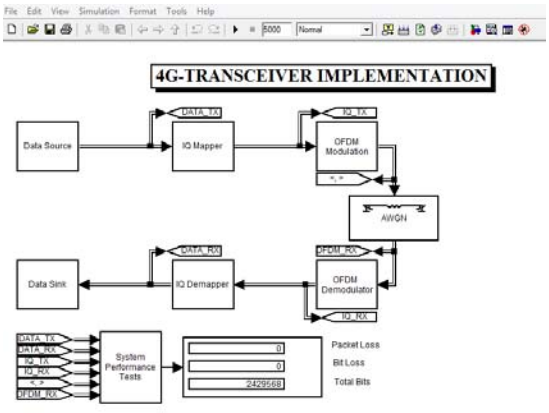

Figure-3. OFDM Transceiver model[6].

The data transmission is being done is observed in the figure 4 and it can be seen no bit loss is being occurred. it has been observed for a while for measuring the data transfer and it is being noted as the total number of bits.

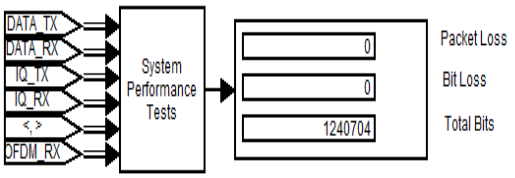

Figure-4. Bit verification.

The spectrum scope a result shown in Figure-5 says that it is clear that channel induced noise affects the received waveform. Where the transmitted signal is "relatively" free from out-of-band harmonics, the out of band harmonics are much more pronounced in the received signal.

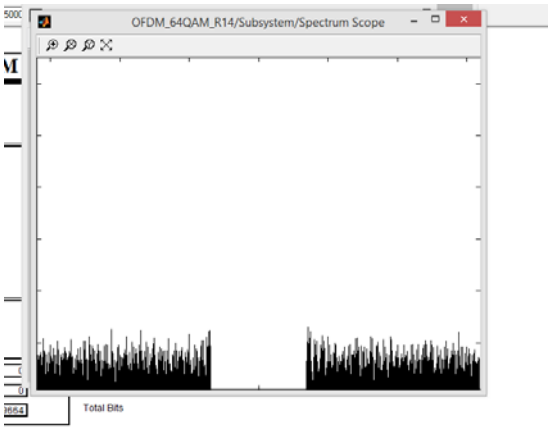

Figure-5. FFT spectrum.

RESULTS

In the process of implementation, the basic for OFDM transmission is used. The Simulink model of OFDM has been simulated and is compiled with SDR i.e. blade RF to obtain the results and to study the practical working of LTE system. The simulated view has been verified. The variable features of blade-RF make it to be configured with upcoming technologies. Advantage in using blade-RF to configure required frequency and to generate required input signal is very efficient.

REFERENCES

[1] Jakob L. Buthler and Michael Buh. 2012. thesis on Implementation of a LTE inspired Transceiver on a USRP Platform.

[2] J. Raja and M. kannan. 2012. "VLSI implementation of high throughput MIMI-OFDM transceivers for 4th generation systems", Indian Journal for engineering and material sciences. Vol. 19, pp 307-319.

©2006-2015 Asian Research Publishing Network (ARPN). All rights reserved.


[3] Tiago Pereira *et al.* 2013. "An FPGA Implementation of OFDM Transceiver for LTE Applications" International Journal on Advances in Systems and Measurements, Vol. 6 no. 1 & 2.

[4] Marco Maso *et al.* 2014. "Reconfigurable cognitive transceiver for opportunistic networks" Maso *et al*. EURASIP Journal on Advances in Signal Processing.

[5] Naund.com/bladeRF X-40 the USB 3.0 Superspeed Software Defined Radio.

[6] Muhammad Nadeem Khan, mathworks.com/Simulink design.