Journal of Critical Reviews

ISSN- 2394-5125 Vol 7, Issue 4, 2020

Review Article

FUNDAMENTAL ANALYSIS OF MASSIVE MIMO IN OFDM

C.S. Preetham Reddy[1], G. Hemanth[2], P. Bhanu Prakash[3], P. Krishna Teja[4],Sk Hasane Ahammad[5]

[1]Department of ECE, Koneru Lakshmaiah Education Foundation, Guntur, Andhra Pradesh, India. cspreetham@kluniversity.in
[2]Department of ECE, Koneru Lakshmaiah Education Foundation, Guntur, Andhra Pradesh, India. hemanthganta46@gmail.com
[3]Department of ECE, Koneru Lakshmaiah Education Foundation, Guntur, Andhra Pradesh, India.
[4]Department of ECE, Koneru Lakshmaiah Education Foundation, Guntur, Andhra Pradesh, India.
[5]Department of ECE, Koneru Lakshmaiah Education Foundation, Guntur, Andhra Pradesh, India.

Received: 10.12.2019 *Revised: 13.01.2020* *Accepted: 15.02.2020*

Abstract

The present research paper proposes the presentation of LTE and the key element of its physical layer. This portrayal territory spanned adaptation of the point by point depiction regulate by 3GPP. In LTE the OFDM is used as downlink and SC-FDMA as uplink articulation plans, in OFDM is the regular development square. OFDM is used as complete high unearthly adaptability in correspondence framework. While SC-FDMA for uplink different connection conspire in LTE-A framework. These exploration papers assess the introduction of SC-FDMA and OFDMA of LTE physical layer by considering diverse articulation plot based on BER and mistake expectation. As of the recreated outcomes, it is seen that for a reasonable estimation of SNR, the conceivable rate heightening for high request intonation in both OFDMA and SC-FDMA. In spite of the fact that the lower request articulation system contact less BER at recipient. Consequently lower request regulations proceed onward the framework acts as far as conceivable rate and SNR. In term of Bandwidth capacity, the higher request pitch engage more information inside a given data transmission and is more transfer speed satisfactory as associated to bring down request articulation. Therefore, there exists an exchange off among BER and transmission capacity adaptability among these balance arranging utilized in LTE.

Keywords: OFDM

DOI: http://dx.doi.org/10.31838/jcr.07.04.142

INTRODUCTION

The increasing application for high speed data assistance over limited bandwidth and power led to compelling enlargement in mobile, cellular automation and wireless communication accepted. LTE-Advanced (LTE-A) is a mobile communication accepted and support 4G mobiles. This standard seeks to advance voice quality and expand broadband data services, to administer high-definition video and audio and real-time comfortable in an "anything anywhere-anytime" manner, i.e. the target is to backing higher peak data rates, higher throughput and analysis. To active high radio spectral adaptability and enable adequate scheduling in time and density domain, a multicarrier access ie. Multiple access was chosen. In LTE, OFDMA (Orthogonal prevalence division multiple access) was elected for down link and for the uplink use SC-FDMA (single carrier prevalence division numerous access). In SC-FDMA system the signals on all subcarriers broadcast series. With the feasible rate increase by using SCFDMA in both uplink and down with comparison and power allotment [1]. Throughput expansion by using equal power algorithm and an equal power algorithm with clarification scheme [2]. By seeing the quality of service (QoS) and contrasting power allocation conclusion can increase system throughput [3]. The system quantity expanded by applying power allotment [4-7].

Equalization can be achieved in the acceptor side as well as adjusting loss after a signal travel through a channel by improve high density content. Mainly two type linear handgun zero forcing (ZF) and Minimum Mean Square Error (MMSE). The name Zero Forcing due to it deliver down the inter symbol intrusion to zero in a noise free case. Zero Forcing equalizer dispose of all ISI and provides a noiseless channel. Minimum mean square error hardware that minimizes the total power of the noise and ISI ingredient in the output [7].

By considering the natural layer techniques and carry technologies we have to advance the network competence by appropriate the limited spectral assets. The system arrangement use OFDMA as the uplink and down link multiple approach scheme with advisable PAPR contraction method, this will advance spectrum capability and transmission rate. Also use power allotment for the uplink communications with the formation of relay stations. The use a power allocation design among subcarriers at both user machinery and relay stations to augment the overall through put of the system. Here we use in band amplify and leading (AF) type-II full double relay, this will reduce the complication. In band relay allows the same set of density subcarriers for concerted transmission with each users furniture (UE) [8]. Relay station accept a signal from user apparatus, it will first amplify the signal then retransmits to the base station (eNB). At the acceptor side use comparison technique Zero Forcing (ZF) and "Minimum Mean Square Error" (MMSE) to cut down ISI. Then contrast ZF and MMSE equalization.

PAPR is construe as the ratio of the peak power to moderate power of the broadcast signal. It is a technical challenge and it will reduce the adaptability of RF power amplifiers. PAPR is one main object at the user incurable, that is approved low PAPR. PAPR directly describe to the amplifier adaptability at the transmitter. The maximum power capability is achieve when the amplifier operates at the concentration region. Low PAPR allows activity of the power amplifier near to concentration point that result higher ability. In SC-FDMA, inflect signal can be treated as a single carrier signal. A pulse construct filter can be practiced to transmit signal to further advance PAPR. One of the PAPR contraction techniques in OFDM is using hadamard transform. Hadamard transform diminish the occurrence of the high peaks related to the original OFDM scheme. Hadamard transform diminish the auto interaction of the input sequence that diminish

the PAPROFDMA system compulsory "high Peak to Average Power Ratio" (PAPR) which cause extravagant power amplifiers with high dimension, that increase the power expenditure for the sender [9-14]. The rest of the paper is coordinated as follows.

Uplink communication frame work in an LTE-A chain given. Base station (BS) is based in the centre of each cell. Each user equipments (UE) try to connect with base station together for uplink communication. Users may or may not desire relays, i.e. it's build upon on transmission length. The users closer to base station do not lack relays. Relays are used near the cell edge. Relays station used Type II in band augment and forward types, these are installed to abetment the communications and advance transmission rate for the users within the relay source (RS) communication range. User apparatus within the relay authority coverage area broadcast its signal to both its connected base station and the relay authority. Resource allotment in "orthogonal density division multiplexing" OFDM based transfer correspondence frameworks co-partner that's only the tip of the iceberg specialized foul protest. Compared for absolute transporter transfer systems, those various transfers could allocate various orthogonal subcarriers clinched alongside each jump. It will increase the complication. Here we study about amplify and leading type relay, comparison and power allotment, that is the object is to make the most of the communication rate.

LINEAR EQUALIZATION

For linear comparison, there are two basic linear equalizations, that is linear equalizer achieve as a FIR filter and as a filigree filter. Here equalizer naturally adapts to time-varying equity of the connection channel. This equalizer is generally used with coherent inflection such as phase shift keying and it is mitigating the effects of multipath breeding and Doppler spreading.

Zero Forcing Equalizer

Zero Forcing equalizer is a manifestation for linear handgun utilized within association frameworks which applies the opposite of the density feedback of the channel. If the channel sentiment of a channel may be H(s) that point those data indicator may be amplified Eventually Tom's perusing those shared of it.

This remove the aftermath of channel from the accepted signal that is inter symbol intervention.

Zero forcing equalizer abolish all ISI and is ideal when the channel is noiseless. But when the channel is noisy, the zero forcing revolver will amplify the noise at prevalence f where the channel feedback H (j2πf) has a small consequence in the endeavour to invert the channel altogether. Balanced linear revolver will be the least imply square slip revolver, which doesn't as a rule discard the bury image impedance absolutely Anyway it diminishing the aggregate force of those noise also ISI element in the yield.

The main dominance of zero forcing technique (ZFE) is that the solution to the set of comparison is reduced to a simple matrix contradiction.

That significant detriment of zero forcing handguns will be that those channel sentiment might frequently show exhaustion in high frequencies around one-half those examining rate. Since the ZFE will be essentially a banter filter, it applies more addition will these upper prevalence, that has a tendency should overstate commotion. In turn weakness will be that the preparation sign furthermore it is low vitality indicator which brings about and considerably bring down acknowledged indicator on clamor proportion over manage Eventually Tom's perusing different preparing sign sorts.

By assuming a linear filter has a impulse response fn and hand gun having a impulse response Cn.

$$q_n = \sum_{j=-\infty}^{\infty}(c_j)f_{n-j} \quad (1)$$

Here q_n simply the convolution of c_n. "The equalizer is assumed to have an infinite number of taps. Its output at kth sampling instant".

$$I_k = q_0 I_k + \sum_{n-k} I_n q_n^{-k} + \sum_{j=-\infty}^{\infty} c_j \eta_{k-j} \quad (2)$$

The first term represents scale edition of the required symbol and take $q_0$to unity. The second term is inter symbol interference (ISI). D (c) is the peak value of this interference called peak distortion

The peak value of this interference is called Peak distortion D(c).

$$D(c) = \sum_{n=-\infty, n\neq 0}^{\infty} |q_n| \quad (3)$$

D (c) is the unction of equalizer tap weight

At a equalizer hosting an limitless number about taps, it is time permits on select those tap weights something like that that D(c) = 0 i. E. qn= 0 for all n but n=0. I. E. Those bury vivos trust image obstruction could be totally wiped out. With the goal the quality for tap weight.

$$q_n = \sum_{j=-\infty}^{\infty}(c_j)f_{n-j} = \begin{Bmatrix} 1 & (n=0) \\ 0 & (n\neq 0) \end{Bmatrix} \quad (4)$$

The above equation (4) has Z transform

$$Q(z) = C(z) * F(z) = 1 \quad (5)$$

$$C(z) = F\frac{1}{\quad}\frac{1}{\quad}(z)F*(z_{-1})X(z) \quad (6)$$

Where C(z) is simply the inverse filter to the linear filter model F(z) or simply say complete elimination of the ISI requires the use of an inverse filter to F(z). This type equalizer is called Zero Forcing equalizer.

Minimum Mean Square Error (MMSE) Equalizer

Minimum Mean Square Error (MMSE) handgun reduces inters symbol intrusion (ISI) with noise improvement. MMSE linear equalizer completes better than Zero Forcing Equalizer (ZFE) but its implementation complication same as ZFE. The MMSE linear handgun use a filter with linear feedback Ck, but the choice of filter impulse feedback Ck is different than the ZFE. In MMSE design, the goal is to minimize the connected error of Additive White Gaussian Noise (AWGN) and ISI. "In Mean square error (MSE) criterion, the tap weight sufficient Cj of the hardware are adjusted to decrease the mean square value of the error"

$$e_k = I_k + I_k \quad (7)$$

Here K_{th} signal interval transmitted and f_k is the estimate of the symbol at the output of the equalizer. I_k is the transmitted information symbol

$$I_k = \sum_{j=-K}^{K} c_j v_{k-j} \quad (8)$$

So the performance index, J, is the *MSE criterion*

$$J = E|e_k|^2 = E\,|I_k - I_k|^2 \quad (9)$$

Here the case of infinite number of taps. The tap weight coefficient C_j, this minimizes J then the equalizer has an infinite number of taps.

$$I = \sum_{j=-K}^{K} c_j v_{k-j} \quad (10)$$

Substitute equation for $I_k$in equation for J then expand the result yield a quadratic function of the coefficients Cj. This quadratic function can be easily minimized with respect to the Cj, that yield a set of linear equation for the Cj. Set of linear equation obtained by using the orthogonality principle in mean square estimation.
Here the coefficient Cj provide the error e_k orthogonal to the signal series

$$V^*_{k-l} \text{ for } -\infty < l < \infty. \text{ Thus } E\,(e_k v^*_{k-l}) = 0 \quad (11)$$

Substitute the value of ek.

$$\mathbf{E}\left[(I_k - \sum_{j=-\infty}^{\infty} C_j V_{k-j})V_{k-l}^*\right] = 0 \qquad (12)$$

(or)

$$\sum_{j=-\infty}^{\infty} C_j \mathbf{E}\,(V_{k-j}V_{k-l}^*) = \mathrm{E}(I_k V_{k-l}^*) \qquad (13)$$

Then find the Z transform of this equation

$$C(z)[F(z)F^*(z^{-1}) + N_0] = F^*(z^{-1}) \qquad (14)$$

Transfer function of the equalizer

$$C(z) = F(z)/(F(z)F^*(z^{-1}) + N_0) \qquad (15)$$

The main difference between equation (6) and equation (14) noise spectral density factor N_0. When the N_0 is very small in comparison with the signal, the coefficients that minimize the peak distortion D(c) and is approximately equal to the coefficients that minimize the mean square error performance index J. When N0=0, the minimization of the MSE results in complete elimination of the ISI.

Power Allocation

Water filling is a technique used in digital publicity systems for apportion power in different channels in multicarrier schemes. Water filling algorithm used for apportions the power to the channels so as to enhance the quantity of the network. By knowing the channel parameter of together transmitter and acceptor, then we have to increase the quantity of the system. It also accredit extra power at the transmitter by allocating the power confer to water filling algorithms to all the channels. The action of water filling is like to discharging the water in the vessel. The algorithm has this name because contemplate a communication intermediate as if it was like a water bottle with an uneven bottom. Each of the accessible channels is then a section of the package having its own depth. To apportion power, assume pouring water in to this package and the amount depends on covet maximum average broadcast power. After the water level complete, the largest amount of water is in the deepest sections of the package; this implies that appropriation more power to the channels with most agreeable SNR. The power appropriation to each channel is not a fixed dimension, it varies nonlinearly with the maximum average broadcast power.

The total amount of power appropriate or total amount of water filled is reciprocal to the signal to noise ratio of the channel. Power apportion to each channel by using the below formula

$$\textbf{Power allocation} = Pt + \sum ni1i \qquad (16)$$

Pt may be the power budget of the framework which is allocated in the separate channels also H may be channel matrix of the framework. By using the allocated power we have to find the capacity of the system. The ability of a system is the algebraic sum of all channels and it is given by

$$\textbf{Capacity} = \sum_{i=1}^{n} log_2\,(1 + \textbf{powerallocated} * H) \qquad (17)$$

Optimal power allocation scheme among sub carriers exploit the overall throughout put of the system.

DESIGNED SYSTEM

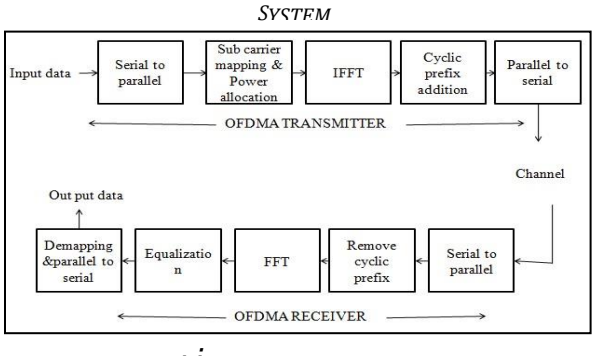

Figure 1: Block diagram overview of designed system

The above figure 1 shows scheme model. The physical layer techniques for LTE and LTE-A consist of "orthogonal density division multiplexing" (OFDM) as the down link (DL) transmission design and SC-FDMA (Single Carrier-OFDMA) as the uplink (UL) multiple approach scheme that improve spectrum adaptability and communication rate. But it reduce uplink communication rate. So here composition OFDMA as the uplink and down link multiple connection scheme with advisable PAPR contraction method, this will advance spectrum adaptability and communication rate. Also use power appropriation for the uplink communications with the formation of relay stations. The use a power allotment arrangement between subcarriers at together user apparatus and relay stations to augment the on the whole over put of the system. Here we use in band amplify and leading (AF) type-II full double relay, this will reduce the intricacy. In band relay allows the same set of density subcarriers for concerted transmission with each user's furniture (UE) [2]. Relay station accept a signal from user furniture, it will first exaggerate the signal then retransmits to the base station (eNB). At the acceptor side use comparison technique "Zero Forcing (ZF) and Minimum Mean Square Error (MMSE) to diminish ISI". Then analyze ZF and MMSE equalization.

In system model first disciple the serial data in to parallel. After subcarrier aligning apply power allocation. Water dressing algorithm used for power allotment. Then calculate the converse Fourier transform. OFDMA in uplink explanation high PAPR so apply PAPR contraction techniques. Here apply Hadamard convert to diminish PAPR. Then apply cyclic prefix and convert it in to serial form. After passing through a channel, here channel is considered as AWGN, it convert to parallel form and remove cyclic prefix. Then calculate the Fourier transform. Equalization techniques applied in the receiver section. "Here use two linear transform techniques zero forcing (ZF) and minimum mean square error (MMSE) equalization techniques". Then convert the data in to serial form. After demapping get the decoded data.

SIC

SIC receiver is a collection of linear receivers bankswhich successively cancels the interference which in this case are MMSE receivers, as shown in the Fig. 2.

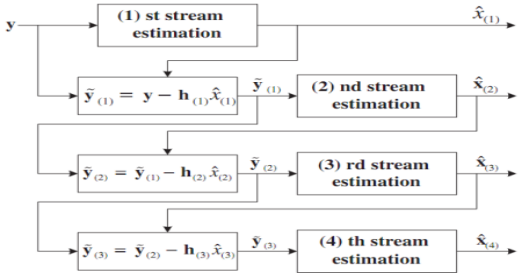

Fig. 2: SIC Receiver

CONCLUSION

Physical layer techniques for LTE-Advanced system use "Orthogonal Frequency Division Multiple Access" (OFDMA) as the downlink transmission and "Single Carrier Frequency Division Multiple Access" (SC-FDMA) as the uplink transmission scheme. But this will reduce transmission rate in uplink. The proposed system is designed using OFDMA in both uplink and down link and a multi user joint resource allocation applied. It is seen that the achievable rate and power allocation improves by deployment of amplify and forward relays. That is, the cooperative transmission scheme improves the transmission efficiency. The work analyzed the equalization techniques and power share methods to develop the transmission efficiency. For equalization techniques "Minimum Mean Square Error" (MMSE) and Zero Forcing (ZF) and SIC techniques are used. After equalization and power allocation is done, the uplink OFDMA system with ZF equalization and power allocation and SIC

provides maximum achievable rate and throughput. In future, this scheme is expected to provide high data rate services under limited bandwidth and power resources in wireless communication.

REFERENCES

1. Xiaoxia Zhan, Xuemin Shen et. al, "uplink achievable rate and power allocation in cooperative LTE-Advanced Networks", IEEE transactions on vehicular technology, vol-9, pp. 1564–1570, January 2015.
2. Ahammad, S. H., Rajesh, V., Neetha, A., Sai Jeesmitha, B., & Srikanth, A. (2019). Automatic segmentation of spinal cord diffusion MR images for disease location finding. Indonesian Journal of Electrical Engineering and Computer Science, 15(3), 1313-1321, pp1313-1321.
3. M. S. Alam, J. W. Mark, and X. Shen, "Relay selection and resource allocation for multi-user cooperative OFDMA networks," IEEE Transactions on Wireless Communications, vol-2,pp.1347-1352, May 2013.
4. Raj Kumar, A., Kumar, G. N. S., Chithanoori, J. K., Mallik, K. S. K., Srinivas, P., & Hasane Ahammad, S. (2019). Design and analysis of a heavy vehicle chassis by using E-glass epoxy & S-2 glass materials. International Journal of Recent Technology and Engineering, 7(6), 903-905.
5. M. S. Alam, J. W. Mark et. al, "Relay selection and resource allocation for multi-user cooperative OFDMA uplink," IEEE Transactions on Wireless Communications, vol. 12, pp. 5092- 5096, June 2013.
6. Sharath Kumar, D.R.V.A., Srinivas Kumar, Ch., Ragamayi, S., Sampath Kumar, P., Sai Kumar, K., Ahammad, S.H., "A test architecture design for SoCs using atam method", International Journal of Electrical and Computer Engineering,10(1), pp. 719-727.
7. Kuldeeep Kumar, Manwinder Singh "Proposed water filling model in a MIMO system" in International Journal of Emerging Technology and advanced Engineering, vol-1, pp.2250-2257, December 2011.
8. Qilin Qi, Yaonqing Lamar Yang "An Efficient waterfilling Algorithm For power allocation in OFDM based Cognitive radio system" International Conference on Systems and Informatics, January 2012.
9. Mohamed Saleem, T.S., Basha, S.D.Red wine: A drink to your heart(2010) Journal of Cardiovascular Disease Research, 1 (4), pp. 171-176.
   DOI: 10.4103/0975-3583.74259
10. Danilo Zanatta Filho, Luc Fety et. al " A Hybrid Single Carrier/Multi carrier Transmission scheme with power allocation", EURASIP journal on wireless communications and networking,vol-2008,pp.1-11, August 2007.
11. Ahammad, SK Hasane, V. Rajesh, and MD Zia Ur Rahman. & quot; Fast and Accurate Feature Extraction-Based Segmentation Framework for Spinal Cord Injury Severity Classification. & quot; IEEE Access 7 (2019): 46092-46103.
12. Yi Jiang, Mahesh K. Varanasi etl. al," Performance analysis of ZF and MMSE equalizers for MIMO system An in-depth study of the high SNR regime", IEEE transaction in information theory, vol-57, pp. 2008-2026, April 2011.
13. Mithun Rudrapal and Dipak Chetia. "Plant Flavonoids as Potential Source of Future Antimalarial leads." *Systematic Reviews in Pharmacy* 8.1 (2017), 13-18. Print. doi:10.5530/srp.2017.1.4
14. Myonghee Park, Heeyoung Jun, Jaecheechoetl. al, "PAPR reduction in OFDM transmission using Hadamard transform", Communications IEEE international conference, June 2000.