International Journal of Engineering & Extended Technologies Research (IJEETR)

|ISSN: 2322-0163| www.ijeetr.com | A Bimonthly, Peer Reviewed, Scholarly Indexed Journal |

| Volume 8, Issue 2, March - April 2026 |

DOI:10.15662/IJEETR.2026.0802343

Channel Chara Identification using BAC Method

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Publication History: Received: 25.02.2026; Revised: 20.03.2026; Accepted: 25.03. 2026; Published: 28.03.2026.

ABSTRACT: This paper deals with the problem of improving SNR.Modulating signal is the output of optical OFDM and is bipolar in general.It cannot be used for intensity modulated direct detected systems that is unipolar in general.Biasing followed by clipping to simply transform bipolar to unipolar.This work is not focussed on eliminating all the clipping but to provide sufficient bias,so that clipping is not the dominant source in the system.This suggests that provide sufficient bias,so that clipping is not the dominant source in the system.

KEYWORDS: BAC, CP, NLCD

I. INTRODUCTION

Recent years, the idea of networking is attracting much attention. Mobile users are able to enjoy the same service as they have in a wired network. Next generation network environment will be constructed of high capacity backbone network and a large number of acess networks. In order to realize such acess network high speed wireless network are required. Therefore demand for wireless communication technology and number of mobile users has grown tremendously in recent years. For this reason exhaustion of frequency response has been a problem and utilized frequency bands are highly allocated.

As a method of realizing high speed wireless networks optical wireless are capturing the spotlight. On the other hand optical wireless communication have the following advantages.Optical carrier has wide bandwidth available and is suitable for high speed networks.The device for optical wireless communication are low in cost,.A light wave cannot penetrate the opaque objects such as walls. It is thought that light wave is secured against eavesdropping and therefore cell planning in network is simple and easy.Optical wireless network occupy no radio frequency spectrum and it can be used where electromagnetic interference is strictly prohibited, such as in hospitals, airplanes.The light waves are worldwide unregulated by any law.Because of these features optical wireless communication attracts much attention as a medium which can realize high speed networks. An optical wireless communication is a candidate for media of wireless networks. For wireless transmission , infrared medium is an attractive alternative to radio in several environments as it posses an enormous amount of unregulated bandwidth and because of the absence of interference between links operating in adjacent rooms. Moreover because of short wave length, optical radiation is confined within a room since the radiation is either reflected or absorbed by the walls. Over long distance up to 5 km optical wireless solutions can offer very rapid provision of exceeding high bandwidth atleast 1 to 10Gbper sec is easily achievable. This flexibility is brought at the price of increased downtime due to occasionally un favourable atmospheric conditions but would be invaluable where bandwidth was either needed rapidly ie disaster recovery or temporarily ie sporting event. OFDM is now the basis of many practical telecommunications standards including wireless local areanet works (LAN), fixed wireless and television and radio broadcasting in much of the world.OFDM is also the basis of most DSL standards, though in DSL applications the baseband signal is not modulated onto a carrier. Orthogonal frequency division multiplexing (OFDM) is used extensively in broadband wired and wireless communication systems because it is an effective solution to intersymbol interference (ISI) caused by a dispersive channel. This becomes increasingly important as data rates increase to the point .A major advantage of OFDM is that it transfers the complexity of transmitters and receivers from the

analog to the digital domain.Data is transmitted in parallel on a number of different frequencies, and as a result the symbol period is much longer than for a serial system with the same total data rate. Because the symbol period is longer, ISI affects at most one symbol, In most OFDM implementations any residual ISI is removed by using a form of guard interval called a cyclic prefix. As the IFFT block is the main component in the transmitter and the FFT in the receiver, and these are the functions which distinguish OFDM from single carrier systems. OFDM is a Multicarrier Transmission technique which divides the available spectrum into many carriers each one being modulated by a low data rate stream. OFDM is similar to Frequency Division Multiple Access (FDMA) in that the multiple user access is

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achieved by sub-dividing the available bandwidth into multiple channels, which are then allocated to users. This is achieved by making all the carriers orthogonal to one another, preventing interference between them. The subcarriers in an OFDM signal are spaced close as is theoretically possible which maintain orthogonality between them. The orthogonality of the carriers means that each carrier has an integer number of cycles over a symbol period. Due to this the spectrum of each carrier has a null at the center frequency of each of the other carriers in the system. This results in no interference between the carriers allowing them to be spaced as close as possible. To generate OFDM successfully the relationship between all the carriers must be carefully controlled to maintain the orthogonality of the carriers. For this reason, OFDM is generated by firstly choosing the spectrum required, based on the input data, and modulation scheme used. Each carrier to be produced is assigned some data to transmit.

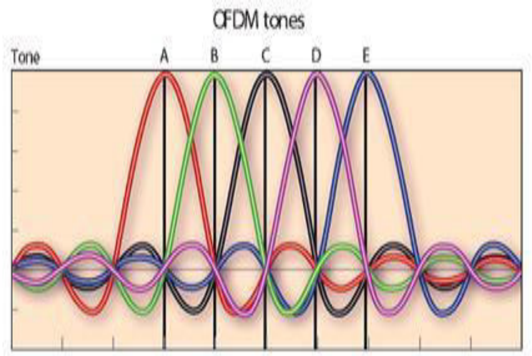

Fig.1.Orthogonal Frequency Division Multiplexing Signal.

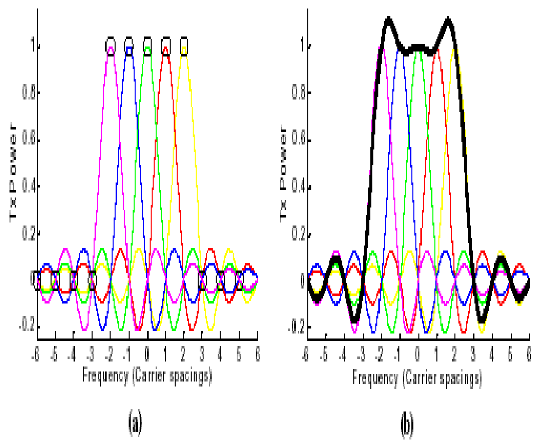

Fig 2 Orthogonality in frequency domain

Each carrier is modulated using BPSK / QPSK / M-ary QAM. Frequency response for each carrier is a Sinc(X) . Overlap of frequency response is possible as against FDM where inter-carrier spacing is a must.Frequency responses of the carriers overlap at zero crossings avoiding Inter Carrier Interference.

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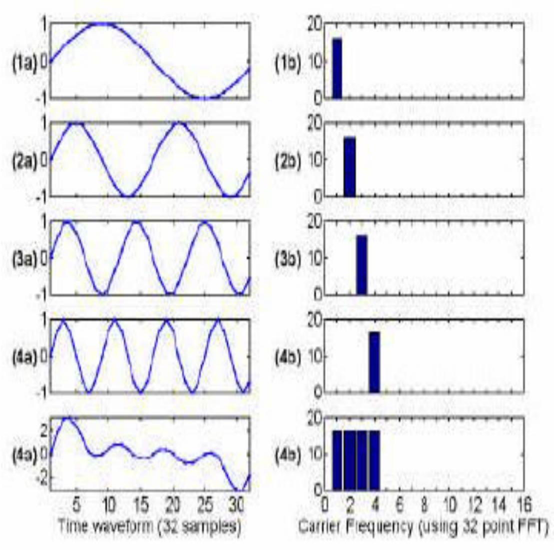

Fig 3Orthogonality in time domain…

The orthogonal carriers required for the OFDM signal can be easily generated by setting the amplitude and phase of each frequency bin, then performing the IFFT. Since each bin of an IFFT corresponds to the amplitude and phase of a set of orthogonal sinusoids, the reverse process guarantees that the carriersgenerated are orthogonal allowing them to be spaced as close as theoretically possible. Orthogonal frequency division multiplexing (OFDM) allows high-speed data transmission across a dispersive channel, so is used in many new and emerging high-speed wired and wireless communication systems. However, OFDM is not used in commercial optical communication systems. This is because OFDM signals are bipolar, while in optical systems that use intensity modulation (IM),only unipolar signals can be transmitted. A large DC bias is usually added to OFDM signals requiring a high mean optical power with a low modulation depth. This is very inefficient. We show how optically power efficient OFDM signals can be designed. We describe the new technique applied to a baseband signal, but it is also applicable to passband signals. In OFDM, signals are transmitted in parallel on a number of subcarriers at different frequencies. Usually quadrature amplitude modulation (QAM) modulates each subcarrier. The transmitter uses an inverse fast Fourier transform (IFFT) to generate a sampled waveform. A new technique for using OFDM in IM optical wireless or fibre systems has been described. A conventional bipolar OFDM signal is generated but this is then clipped at zero togenerate clipped OFDM.

Clipped OFDM has an optical power efficiency approximately 8 dB better than than DC biased OFDM .Because the modification from standard OFDM involves quite small changes in the signal format, most of the well established OFDM techniques for equalisation, synchronisation, errorcoding, etc., can be applied with little modification. OFDM has proved to be a simple and effective solution to signal dispersion in wired and radio applications; clipped OFDM promises to provide a similar, optically power efficient solution in the optical domain. In this case, the distortion is orthogonal to the wanted signal and so the technique causes no degradation to the useful signal.

II. SYSTEM DESCRIPTION

Fig. 2 shows the block diagram of the intensity modulated direct detection (IM/DD) optical communication system. OFDM cannot be used in optical communication systems.This is due to the fact that output of OFDM is a modulating signal which is bipolar signal.Optical communication systems is unipolar in nature because it use intensity modulation.

A large dc bias is added to convert bipolar to unipolar ,resulting in significant performance penality.In intensity modulated direct detection systems first modulate the data onto electrical signal.The output of modulating signal is bipolar .Electrical signal may be either current or voltage. Also optical intensity modulator convert electrical signal into an optical signal with intensity.Current or voltage signal can take only positive values so modulation techniques cannot be used without any modification.Signal passed through optical channel.Signal is received by receiver.Direct detection receives convert optical signal into electrical signal in the receiver.

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A model of optical OFDM is shown in fig 3.At the transmitter section incoming high speed data is firstsplit into large no of lowerspeed by S/P into parallel streams and each one mapped o a symbol stream using some modellation constellation.IFFT is performed,so that complex symbol transformed into time domain samples.

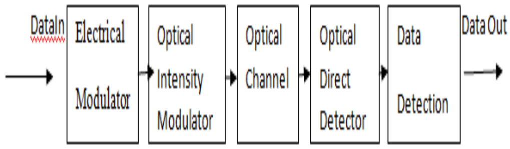

Fig.4 Intensity modulated direct detection system

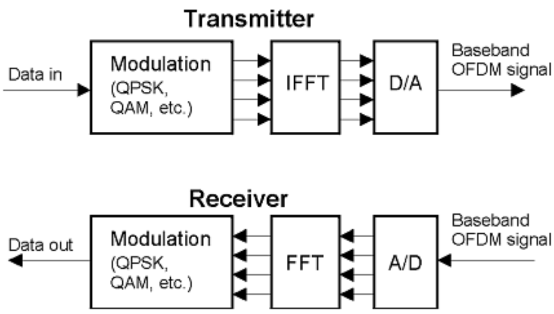

Fig 5. System Architecture ofoptical OFDM

These samples are quadrature mixed and output ofIFFT is transformed into digital data sequence by P/Sconverter. DAC is used to convert digital to analog which is bipolar .IFFT is biased using optimal bias then clipped to eliminate any remaining negative peaks.BAC process is employed so signal can be delivered by unipolar signal intensity modulated direct detection system.Intensity modulation is used here.Unipolar is used to drive linear optical modulator.Output power is replica of corresponding drive signal.Photodiode is used to detect background clipping noise.Analog signal are used to modulate sine and cosine wave.These signals are summed to give transmission signal.Reciever pick up the signal which is then quadrature mixed down to baseband using cosine and sine wave at carrier frequency.Baseband signals are sampled and digitiyed using ADC and FFT is performed to convert back to frequency domain.Detected signal passing through FFT result in attenuated signal.

DC BIAS

The traditional method of converting bipolar OFDM into uni polar is to add a bias. The amplitude of required bias depends on peak to average power ratio of the OFDM symbol and since it has high peak to average power ratio, the amount of dc bias is significant. The large dc bias makes optical power inefficient. On the other hand, the use of lower dc bias makes negative time samples clipped which may result in inter symbol interference and out of band optical.OFDM signals are in bipolar and have both positive and negative amplitudes.One common method that can be used to guarantee non negativity of transmitted signal is to add dc bias to the bipolar ofdm signal as in the required dc bias to satisfy non negativity is equal to the maximum negative amplitude of ofdm signal.For very large number of sub carriers amplitude can be approximated by a zero mean Gaussian distribution through law of large numbers.

III. EFFECTS OF BAC

Modulating signal is the output of optical OFDM and is bipolar in general.It cannot be used for intensity modulated direct detected systems that is unipolar in general.Biasing followed by clipping to simply transform bipolar to unipolar.BAC process is employed sosignal can be delivered by unipolar signal.If the bias is too low received signal suffer from spectral spreading due to nonlinear clipping distortion.In order to minimise clipping a large bias is required.Excessive biasing increase driving power is not useful.Due to nonlinear nature error probability is difficult to derive.Due to large dc bias adding in during BAC signal power is increased.Purpose is to find optimal biasing point that

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achieve maximised SNR with both an electronic and optical power constraint. Because bipolar cannot transmitted over intensity modulated direct detected systems its assumed that bias component is large so that when added to OFDM signal resulting sum is non negative.we proposed two scheme clipped OFDM and unclipped OFDM.

CLIPPED OFDM

Clipped OFDM is based on single sideband transmission and clipping OFDM signal after bias addition. Bias is varied in order to find optimum one for fixed optical launched power.

UNCLIPPED OFDM

Unclipped OFDM is based on single sideband transmission. To avoid distortion due to clipping at transmitter information mapped to optical domain. Both positive and negative portion are transmitted to photo detector.

Proposed optimiyation is not focussed on eliminating all clipping but provide sufficient bias so that clipping is not the dominant noise source in the system.

For small biasing dominant noise source is clipping due to BAC. SER is negligible. Most effective way to improve system performnance in this case is to increase the biasing power. Value of optimal bias that maximize effective SNR is independent from the choice of constellation size. Hence we proposed fast searching algorithm. Receiver sensitivities can be improved by around 4 dB and 2 dB.

For large biasing power dominant source become receiver noise. This algorithm is not focussed on eliminating all clipping but rather to provide optimized bias so that clipping distrotion is no longer the dominant noise soure. For low biasing level strong clipping results in most of the received symbol flowing out of decision region. The improvement is steady around 25% and the receiver noise become dominant performance limiter.As a result improvement increase linearly to its maximum pointand then quickly drops to zero for large bias.Due to large bias signalpower is reduced.By increasing biasing power SNR increases SER decreases.For each system there exist optimal biasing point.With increased reciever SNR ,optimal biasing point is increased aswell. Fig 6shows that OFDM signal is very sensitive to nonlinear clipping distortion. Transmission is limited by linearity constraint in mod/demod process. To avoid frequent Non linear clipping of negative pea c offset is added to eliminate clipping.

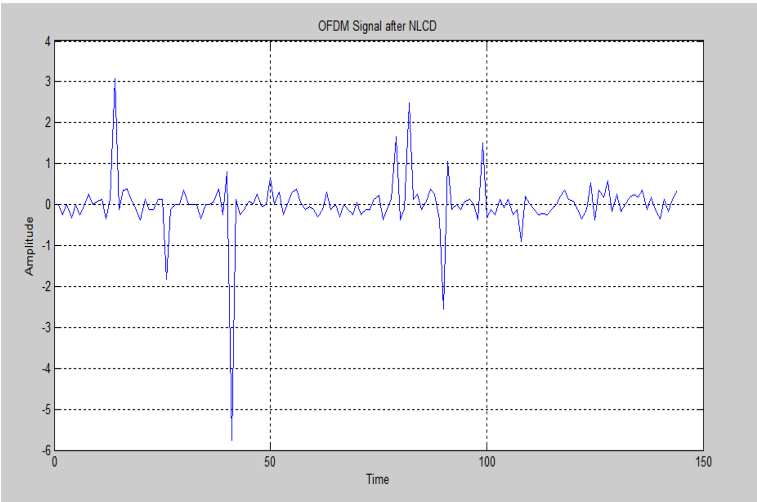

Fig6 OFDM signal after NLCD

Fig 7 shows system performance is limited by nonlinear clipping at transmitter and noise at receiver detected signal passing through OFDM FFT result in attenuated signal and 2 noise term in each sub channel.Clipping attenuation cause significant change insystem performance.

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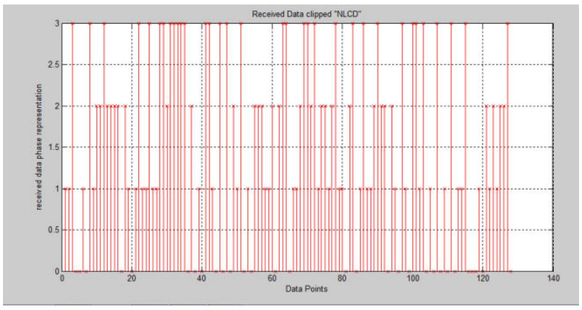

Fig 7 Received data clipped NLCD

IV. SIMULATION RESULTS

This paper deals with channel chara identification. If the bias is too low received signal suffer from intermodulation, harmonic generation due to nonlinear clipping distortion. In order to minimises clipping a large bias is needed which will not contribute to signal quality. This is due to the fact that IFFT and FFT can be treated as vector sumation. With a specified modulation format and receiver sensitivity figure there exists optimal biasing point where SNR increases BER and SER decreases.

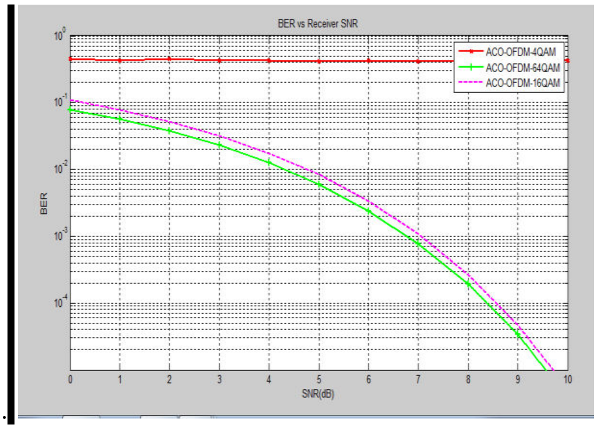

Fig 8 BER versus SNR for different biasing strategies

V.CONCLUSION

The performance of an IM/DD optical OFDM system with 1024 subchannels, is analyzed each loaded with 16-QAM complex symbols. The maximum electrical power at the transmitter is set to unity. To determine the optimal biasing level, 1,000,000 random binary bits are tested with various biasing powers. The optical attenuation and dispersion is fully compensated so that we can focus on the effect of the BAC process. Compared the power efficiencies across systems with different biasing strategies for systems loaded with 4/16/64QAM. For all systems loaded with 4-QAM symbols, ACO-OFDM systems requires the least amount of power, in order to achieve a same bit rate without increasing the bandwidth, a larger constellation of 16-QAM is required.

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| Volume 8, Issue 2, March - April 2026 |

DOI:10.15662/IJEETR.2026.0802343

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