MIMO-OFDM Based Power Line Communication Systems Using 50Hz Transmission Technique

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Abstract

Power line communication is basically meant for carrying not only the electric power but also the data over the conductors and as the application alters so do the need to change the technologies, like the requirement to alter the technology in case of home automation and for internet access and in order to create a sufficient level of separation between them, they are usually differentiated by means of frequency alteration. In general the transformer present at the substation usually prevents the propagation of signal. Data rates and the distance vary in accordance with power line communication standards. Power line communication has been emanated as one of the most enduring means of communication for smart grid applications therefore sending out the control information over the same network will add only a little cost and hence opens the door for a plethora of applications. The communication over Power Line is when we are concerned about generation, transmission or deliverance of power but here our main concern is control and management of power rather than transmission or deliverance of power and this purpose can only be accomplished if we are utilizing the available resources in an efficient manner which in turn is dependent on the fast and effective transmission of data or control information over these channels. To ensure the fulfillment of these requisites there is a requirement to analyses the basic topological connections and the circuit modeling and thus determined the various control and traffic problems associated with the transmission of this information which usually varies according to applications. Therefore OFDM (BPSK, QPSK, and QAM) has been utilized for the purpose of analysis of the channel performance while ensuring the speed and robustness of the channel to be the main criteria for any kind of services or applications .Moreover there usually arises a problem of power failure and reliable communication over remote locations and therefore the solution for it is an interfacing between wired and wireless communication technologies.

Keywords—*PLC, Channel model, Smart Grid, Multiple scheme.*

I. INTRODUCTION

Electricity is generated in huge power plants and transmitted by interconnected high voltage transmission lines in today's electrical grid systems. But there is not a very cost-effective control system on the lines. Because of nonexistence of effective transmission, a possible power cut on high voltage transmission lines can affect other grids negatively. For these reasons, the request for a new network is emerging but it will be used in network communication system will be much more important concept. Traditional grid includes energy centrals which are connected with long transmission lines and they has a connection structure that can be cause blackouts, also if there were any other connected countries, by cut-offs. Smart grid systems improve the reliability of electrical power systems, provide more power quality, reduce time delays, can control resist attacks and etc. A variety of candidate technologies such as fiber optic, wireless and power line communication (PLC) is available for the smart grid communication infrastructure [1], [2]. Power line communication systems include all the advantages of fiber-optic cable and fast data communication along with the security of wireless communication methods. Communication is meaning that not just only internet connection, it means also every device connected to the network on power line. PLC can also control active and passivity of distribution lines. This is essential especially for substations located in countrified areas where there isn't any communication infrastructure. PLC technology usually uses for data communication medium and low voltage power lines [3]. PLC uses the existing wiring, so it is suitable for use in HAN and NAN [4], [5]. PLC technology provides high data transmission on short field. For example, in a building as LAN network, bits per second data transmission rate can rise up to million bits per second with PLC. However, the data transmission must be made with the appropriate of PLC technology. Different technologies of PLC use different frequency band scales and provide different data transmission rates. Data communication technologies which used in PLC can be divided into BPLC and NBPLC.

- Broadband Power Line Communication (BPLC):

BPLC uses a standard for high-speed, which has over 100 Mbps speed at the physical layer, communication assets by electric power lines. This standard [6] uses transmission frequencies below 100 MHz. It is applicable for all classes of BPLC devices,

including BPLC devices used for the first-mile/last-mile connection, which under the 1500 m to the premise, to broadband services as well as BPLC devices used in buildings for LANs, smart grid applications and other data distribution which has less than 100 m distance between devices [6]. A wide area communication is available from home automation to access the internet through the power lines.

- Narrowband Power Line Communication (NBPLC):

NBPLC technology uses standard specifies communications for low-frequency, which has less than 500 kHz frequency value, assets through alternating current and direct current electric power lines. This standard [7] supports indoor and outdoor communications with low voltage and medium voltage power lines through incorporating transformers in both long distance rural and urban applications with transmission frequencies less than 500 kHz. Application requirements and network conditions effected to data rates will be measured to 500 kb/s [7]. This technology can be used with grid automation applications and within HAN communications scenarios. NBPLC is used with frequency spectrum from 9 to 140 kHz for PLC applications [8]. NBPLC technology seems to be cost-effective, has more security and reliability, can appropriate to meet the bandwidth requirements of especially in large scale smart grid communication applications [9]. In the below diagram Fig. 1 seems a BPLC and NBPLC technologies use in different length of transmission lines.

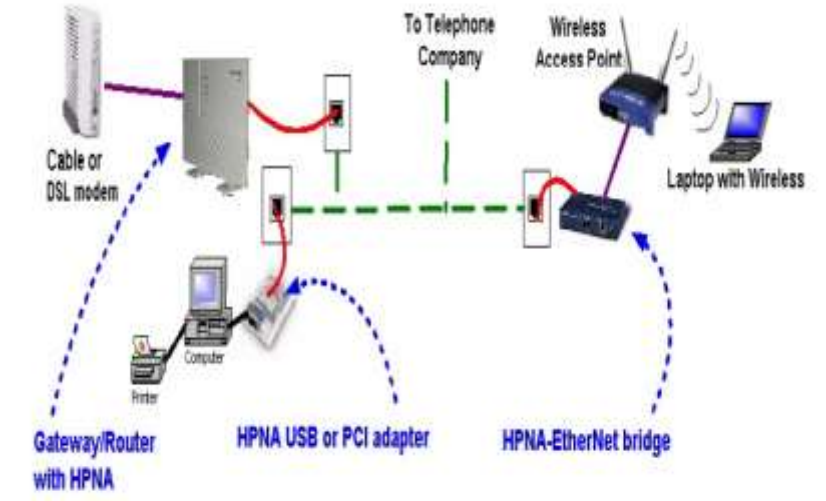

Fig. 1: Power Line communication

II. RELATED WORK

Shukla et al.[10], Power line distribution networks are mainly used for electrical power supply. The ever-increasing demand of low cost telecommunication, broadband and access to internet services has applied a driven force leading to further research in the field of power-line communication. Different multiplexing techniques, OFDM, CDMA, MC-CDMA, has been already used with power line communication. In this paper coded IDMA is being used with power line communication. *Kishore et al. [11]* Power line communication is basically meant for carrying not only the electric power but also the data over the conductors and as the application alters so do the need to change the technologies, like the requirement to alter the technology in case of home automation and for internet access and in order to create a sufficient level of separation between them, they are usually differentiated by means of frequency alteration. In general the transformer present at the substation usually prevents the propagation of signal. Data rates and the distance vary in accordance with power line communication standards. Power line communication has been emanated as one of the most enduring means of communication for smart grid applications especially while considering the biggest advantage i.e. an already established infrastructure, therefore sending out the control information over the same network will add only a little cost and hence opens the door for a plethora of applications.

Sanjana and Suma [12] Narrowband Interference (NBI) and Impulsive Noise (IN) jointly occur in power-line networks and underwater acoustic communications. In these applications,[12]OFDM (Orthogonal Frequency Division Multiplexing) is used as the modulation technique for efficient communication. It is observed here that the combined effect of NBI and IN on the performance of OFDM has been highly destructive. In order to reduce the adverse effect of NBI and IN, frequency domain identification and cancellation technique and joint time-frequency domain approach are made use in OFDM respectively. The performance of OFDM system is evaluated in terms of Bit Error Rate (BER) versus Signal to Noise Ratio (SNR) curves.

Zhang et al. [13] proposed an in-vehicle power line communication (PLC) system which provides an in-vehicle communication for the video and vehicle messages transmission as a reliable alternative networking medium. The proposed invehicle PLC system adopts an existing in-vehicle 12-V battery power system, which means we don't need an external DC power supply for in-vehicle communication equipment to achieve the purpose of video and vehicle message transmission for driving safety.

Bernacki et al. [14] used home automation, intelligent home controls or remote controls in the office, electronic equipment is moving away from wireless communication in favor of Power Line Communication (PLC). In the standard PLC solutions, the corrections that result from error transmissions are based on complex digital modulation methods and algorithms for validating the transmitted data without paying attention to the causes of the errors. This article focuses on the implementation of a filtering system for interference and signals in the 120–150 kHz band (CENELEC band C), which is injected into the network by

transmitters. Such a filter separates the desired signal from the interference that is occurring in the network, which can result in communication errors. Moreover, when used properly, the filter can be used as a subsystem separation element. The paper presents the requirements, design, construction, simulation and test results that were obtained under actual operating conditions. It is possible to use less complex methods for correcting errors in transmission signals and to guarantee an improvement in the transmission rate using the proposed filter system.

Lopez et al. [15] Power Line Communications (PLC) have been an active research area for many years and it is still the case, mainly because they present economic and technical natural advantages for a wide range of applications using the existing electrical grid as transmission medium. In this paper, the authors provide an update on PLC technologies and their applications in Smart Grids, the main challenges they are currently facing, how they can be addressed, and the current research initiatives.

III. PROPOSED METHODOLOGY

Methods and strategies selected for achieving the stated aims. In doing so, researches and publications related to the OFDM and power line communication systems have been classified into three groups based on their topics. Such classification of the publications provides assistance in selecting the best methods for the current project. Although the above presented research and publications, by some means, follow the same method or technique In order to achieve the stated aim and objectives, a high-level technical computing language called MATLAB® is used in order to design and implement the outlined OFDM communication system. The codes for these algorithms are written using the guidelines provided in The codes for design and its implementation employed in this project are provided in both the appendices and the enclosed CD. MATLAB® is very powerful software that is widely used across all engineering disciplines, supporting various graphical input and outputs. Therefore producing efficient codes and making the simulation results easily illustratable in different graphical formats. MATLAB is also known an interpreted language for numerical computation as it allows one to perform numerical calculations without the need for complicated and time consuming programming. Another important advantage of using MATLAB is that it supports several file formats and extensions (for either Image or audio files). This will greatly help and validate the judgments with respect to the achieved results. Future work will enhance using this software in the form of its Simulink representation; it provides visual graphical control with easy changeability mechanism allowing parameters to be altered and outcomes can be graphically compared. Beside all the stated advantages, MATLAB software has other advantages, in comparison to other programming languages such as C or C++, making it a better programming platform to use for this research. Unlike C or C++ programming, MATLAB uses standardized built-in routines, allowing it to be simulated on any MATLAB installation. In C programming, loops are often used, whereas MATLAB uses vectors which reduces the code lines and makes the codes simpler and easier to read. MATLAB is a good platform for developing algorithms from scratch, allowing the user to write the code and analyse it line by line. The main research aim of this project is to design and implement an OFDM system for power line based communication, by simulating the operation of virtual transmitter and receiver. The performance of the system design is then analysed by adding additive AWGN and Power line Coloured noise, in an attempt to corrupt the signal. This principal aim can be achieved by considering and completing seven objectives which are methodically explained below. Basic structure of an OFDM modem using the binary Phase Shift Keying (PSK) will be designed, containing three main elements of transmitter, channel and receiver. Figure4.6 illustrates these three main elements as well as the two other important sub-units, modulation/ de-modulation and IFFT and FFT, in the transmitter and receiver respectively. The method of modulation and demodulation of the BPSK OFDM modem design.

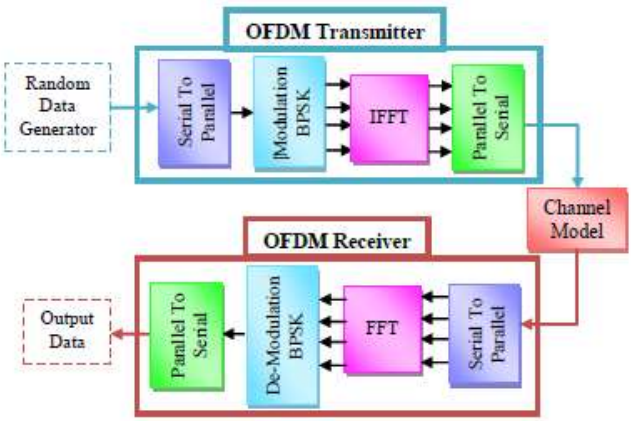

Fig. 3: Block diagram of a basic structure OFDM transceiver

Following the design of a basic structured OFDM modem, it will be tested in order to understand the fundamental blocks of modulation and demodulation used in such digital modems. It is important to state that this research project will be based on a general assumption of having a perfect timing synchronization between the transmitter and receiver. Subsequent to obtaining an exact replica of transmitted signal in the receiver unit and using the knowledge gained.

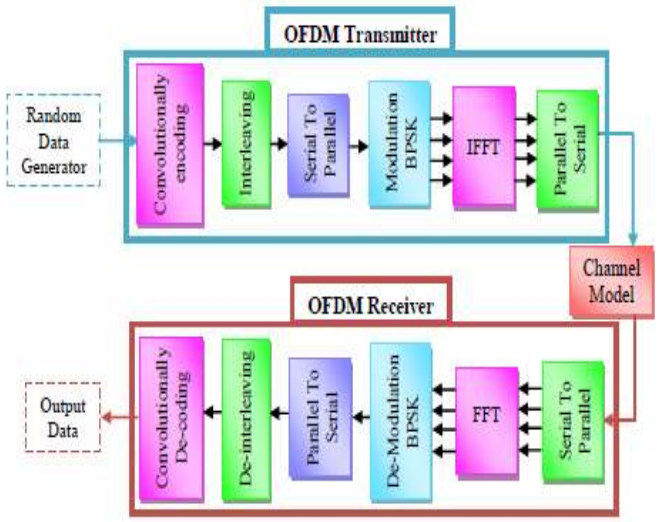

Fig. 3: Block diagram of a more comprehensive OFDM transceiver

IV. SIMULATION OF IMPLANTATION

OFDM Modulation Scheme

Within each sub-band, an OFDM modulation scheme is used to convey the information OFDM System Implementation For continuous time implementation as in it needs *N* oscillators and DACs, which is of very high complexity. So, discrete time implementation IDFT is implemented by using IFFT and the frequencies are orthogonal because the basis function of Fourier transform is orthonormal. The modulation and demodulation of OFDM using FFT's. Orthogonal frequency division multiplexing (OFDM) has recently become a key modulation technique for both broadband wireless and wire-line applications. It has been adopted for digital audio broadcasting (DAB) and digital terrestrial television broadcasting (DVB). OFDM is a special case of Multicarrier transmission, where a single data stream is transmitted over number of lower rate Subcarrier. The problem of intersymbol interference (ISI) introduced by multipath channel is significantly reduced in OFDM by using the cyclic prefix (CP) as a guard interval between OFDM blocks. The proposed work would be a brief overview of IFFT & FFT algorithm to be effectively used in OFDM system. OFDM is a special case of multicarrier transmission, where a single data stream is transmitted over a number of lower rate subcarriers. The main reason to use OFDM is to increase the robustness against the selective fading or narrowband interference. In single carrier system if signal get fade or interfered then entire link gets failed whereas in multicarrier system only a small percentage of the subcarriers will be affected. The total signal bandwidth, in a classical parallel data system,

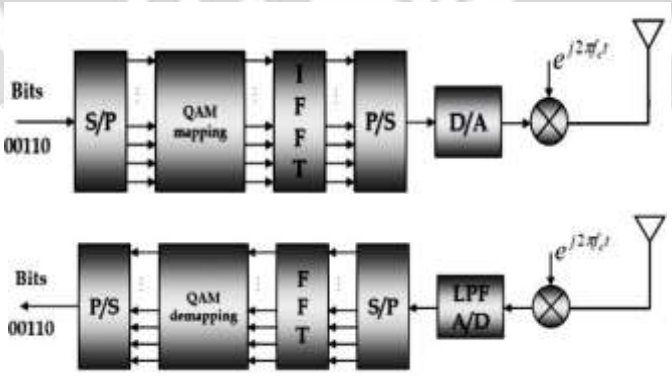

Fig. 4: OFDM Modulator and Demodulator using FFT

Fast Fourier transform (FFT) is an algorithm to compute discrete Fourier transform. A Fourier transform converts time domain signal information into frequency domain. As a result, FFT is a widely used in DSP technique and in many applications such as communication. FFT has been described as most important numerical algorithm. FFT is one of the rudimentary operations in the field of digital signal and image processing. Using FFT is indispensable in most signal processing application. In this thesis we propose to use efficient multiplication technique to reduce the partial product which is happened in conventional multiplication technique therefore the FFT and inverse fast Fourier transform (IFFT) with efficient multiplication and with increased speed is used for Orthogonal Frequency Division Multiplexing (OFDM) Modulator and Demodulator blocks. In many applications high speed and efficient multiplication is desired. For this purpose conventional multicarrier technique are usually chosen, but this results in lower spectrum efficiency. So, the principles of OFDM are used. This proposed work will be processing block of an OFDM system, which are applied to FFT and IFFT. Actually, in entire architecture all the mathematical

manipulation takes place in transmitter and receiver block i.e. IFFT and FFT block respectively. The speed enhancement is the key contribution of the main processing blocks in OFDM system.

Bit Error Rate Performance in Power Line Communication Channels

The Power Line Communication (PLC) technology is emerging as an alternative to the broadband access network with the advantage of using the existing infrastructure of power line networks which results a great cost reduction. However the PLC channel is not conducive to high speed data transmission due to attenuation and interferences from various sources In different types of PLC noise sources are modeled in Matlab/Simulink, among these the background and impulsive noises are the main source of interference resulting in signal distortion. The background noise can be modelled as an Additive White Gaussian Noise (AWGN) and the impulsive noise is based on the Middleton Class A noise model The Bit Error Rate (BER) performance of a Wireless Local Area Network (WLAN) channel in presence of Middleton Class A noise is investigated in The results suggest that impulsive noise has more effect in comparison with AWGN and degrades the BER performance of such a system more. In the performance of using Orthogonal Frequency Division Multiplexing (OFDM) modulation for a PLC channel is analysed and compared with a single carrier modulation system and is found that the former enhances the BER performance over the later. The performance of PLC OFDM system in the presence of impulsive noise is simulated in It is observed that an Impulsive noise can degrade the performance of OFDM-based on PLC systems significantly. Therefore, channel coding is important to combat the impairments in this hostile medium, where the encoding and decoding of convolution codes over generated symbols for the transmission over impulsive noise channels. From the simulation results it can be observed that the excellent performance of the Viterbi decoder. The BER performance of bit-interleaved convolutionally coded OFDM under PLC channel characteristics and impulsive noise is investigated in The obtained simulation results show that, in the presence of impulsive noise, combination of convolutional coding and interleaving minimizes the effect of impulsive noise and improves the performance of PLC based on OFDM. In an analytical approach is carried out to examine the performance of PLC channel in presence of fading and impulsive noise. The comparison results show that there is significant improvement in using OFDM over Binary Phase Shift Keying (BPSK). quantifies the BER performance of PLC channel for 16-Quadrarture Amplitude Modulation (QAM) with OFDM and Hamming Code in presence of impulsive noise modelled as the Middleton Class A noise source. Simulations are under taken in Matlab gives a brief overview of the basic concept of data transmission over PLC. Noise in the PLC channel Noise in PLC can be classified as a background and impulsive noise. Background noise is stationary and can be modeled by the Gaussian distribution An impulsive noise originates from variation sources such as heating processes, microwave ovens, electric motors and any other electrical sources. There are number of statistical models for characterization of an impulsive noise such as the Bernoulli-Gaussian and Poisson- Gaussian model An accurate model which is widely used is the Middleton Class A based on the Poisson- Gaussian model. As it reported in the probability of impulsive noise with *m* impulsive noise events in a time interval *T,* for Poisson distribution parameter can be simulations undertaken in Matlab to quantify the BER performance of a PLC system using a higher modulation constellation of 16-QAM with Hamming code in presence of impulsive noise are given in this.Fig.5.2. illustrates the diagram of the OFDM system used for simulation. A forward error correcting (FEC) code such as the Hamming code is used to enhance the data rate. An interleaving block is used to arrange the coded bits in a way that erroneous bits will be randomly distributed over many code-words rather than only a few code-words, subsequently the data bits are sent to the QAM modulator for mapping. Next is the OFDM stage which uses pilot signals to detect the channel response. The data stream is split into 64 parallel streams (by use of serial to parallel converter) that modulate 16 subcarriers using the Inverse Fast Fourier transform (IFFT). The Cyclic Prefix (CP) is inserted to reduce Inter-symbol interference (ISI). The multipath channel model has been used a Background and impulsive noise are injected through the Channel modeled as.

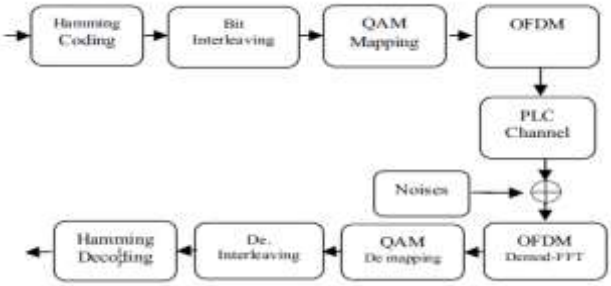

Fig.5: Diagram of an OFDM system consisting of a transmitter, a PLC channel and a receiver

The effect of background and impulsive noise on the signal amplitude are given in Fig.5.2 As observed the impulsive noise distorts the signal amplitude while propagating through the channel. For 16 QAM the effect of variation in the impulsive Main sources of noise in a power line are caused by the interference due to electric appliances connected to it which affect the data transfer over PLC channels. The main sources being the background and impulsive noise are modeled and BER performance investigated for 16- QAM constellation using OFDM technique. It is observed that BER Applying methods to mitigate and reduce the effect of impulsive noise over PLC systems for higher constellations to increase the data rates could be by means of alternate forward error correction convolution codes and suitable.

Power Line Communication for Cost Effective Smart Metering

Major hindrances to power line communication (PLC) are cable characteristics, impedance variations and noise signals from various sources. Most importantly, noisy characteristics of power line channels make it difficult to transmit data in an effective and reliable way. More often data transmitted through power line channels is corrupted by three main types of noise, the background noise, the impulse noise and the permanent frequency disturbances. Also Attenuation as a result of multipath fading effects is one of the major setbacks in power line communication over a long distance. In view of this most smart metering research works reviewed, propose wireless and/or fiber optics as transmission media at one point or the other. In this paper, we propose to improve PLC channels to make them viable alternative to other channels in smart energy metering and smart grid networks. Studies and simulations of low order modulation techniques and high order techniques have been conducted. Results show that high-order modulation scheme such as 16 QAM or higher-order QAM, when combine with Convolution error correction coding and orthogonal frequency division multiplexing (OFDM) is a promising as modulation scheme of choice in PLC channels. Electricity utility companies distribute electricity to households and industries and with the help of energy meters, appropriate electricity bills are sent to consumers. Considering the numerous households and industries being supplied with electricity, manually reading energy meters by utility companies will require a lot of human resources which perhaps could have been invested in other sections of the company. A smart meter is usually an electrical energy meter that records consumption of electric energy in intervals of an hour or less and communicates that information at least daily back to the utility company for monitoring and billing purposes. Unlike the traditional automatic meter reading system, smart meters enable two-way communication between the meter and the central system Smart meters require a means of communication between the smart meter and the utility company to enable the desired two way communication. Global System for Mobile communication (GSM) , zigbee , Radio and power line communication (PLC) are all possible means of communication employed by the smart metering communication network on power line communications has pointed out major hindrances such as cable characteristics, impedance variations and noise signals from various sources. Most importantly, noisy characteristics of power line channels make it difficult to transmit information data in an effective and reliable way. More often data transmitted through power line channels is corrupted by three main types of noise, the background noise, the impulse noise and the permanent frequency disturbances Also Attenuation as a results of multipath fading effects is one of the major setbacks in power line communication over a long distance.

In view of this most smart metering research works reviewed propose a GSM or a hybrid communication network which uses power line communication on the Low Voltage side that is from the smart meter to a data concentrator (shorter communication distance involved) and other orthodox communication methods like GSM, Fiber optics, etc. from the data concentrator side to the Utility side for the simple reason being PLC is susceptible to impulsive noise (including multipath reflections introduced by impedance mismatching, time-varying due to switching of the electrical devices, and complicated noise environment) in addition to the Additive White Gaussian Noise (AWGN) most channels can be modeled with[8]. Due to the relatively long distance involved in the Medium and High voltage sides, PLC along MV/HV becomes unfavorable. overcoming the high bit error rates (BERs) associated with PLC channels without losing the opportunity of using multiple techniques for bandwidth improvement. The research work seeks to improve PLC channels to make them viable alternative to other channels in smart energy metering and smart grid networks. Studies of low order modulation techniques and high order techniques are conducted and a typical technique.

64-QAM and MIMO Systems

Higher Order Modulation (64-QAM) and Multiple Input Multiple Output (MIMO) transmissions are two key features introduced in the systems to improve downlink performance. focuses on the performance analysis of 64-QAM and MIMO in the UWB system. We describe the equalizer design for supporting these features as well as the simulation results demonstrating the higher system throughput and better user experience provided by these features.

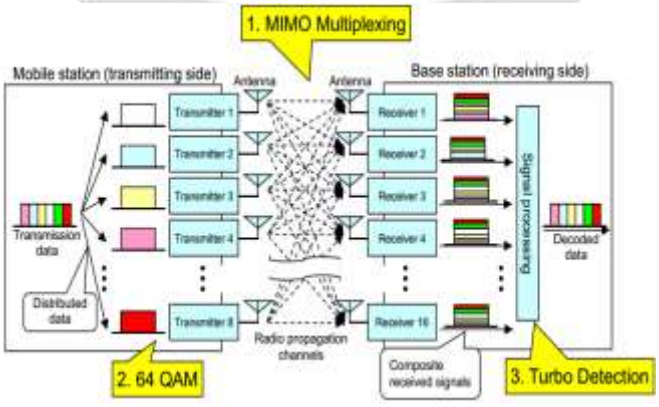

Fig.6:MIMO QAM System

Evaluates the performance of 16 QAM & 64QAM in MIMO channel when the channel wireless communications, when multiple antennas are employed at both the transmitter and the receiver, such a system is commonly known as a multiple-input

multiple-output (MIMO) system. MIMO techniques can be effectively used to increase system throughput over hostile wireless channels. It is well known fact that with the number of transmit antennas and number of receive antennas the capacity of MIMO systems increases linearly with MIMO increase the channel link range and data throughput without increase in transmit power & no additional bandwidth providing. MIMO systems can improve the spectrum efficiency over single antenna transmission systems, this can be achieves by spreading the same total transmit power over the antenna array that improve the array gain. Quadrature Amplitude Modulation (QAM) schemes like 16-QAM and 64-QAM are used in typical wireless digital communications and 256-QAM, 512-QAM, 1024-QAM are used in Wifi. At the modulator, the data bit stream is split into the in phase (I) and quadrature (Q) bit streams. The I and Q components together are mapped to complex symbols using Gray coding. The demodulator splits the complex symbols into I and Q components and puts them into a decision device (demapper), where they are demodulated independently against their respective decision boundaries. Performance Comparison of MIMO-OFDM Transceiver Wireless Communication System using QAM and QPSK Modulation Schemes Multiplexing (OFDM) is a promising technique to perform multicarrier modulation with maximum utilization of bandwidth and high performance characteristics profile against fading in multipath communication. On the other hand, MIMO (Multiple Input and Multiple Output) in combination with other schemes which can increase capacity, reliability, support to internet services and multimedia application. MIMO with OFDM reduces the equalization complexities by transmitting different data on different frequency levels to gain spectral efficiency and error recovery features, which will offer high spatial rate by transmitting data on multiple antennas and transmission in Non-Line-of sight (NLOS). Thus the MIMO-OFDM technique is used to achieve diversity. It will utilize the three basic parameters that is frequency (OFDM), time (STC) and MIMO (Multiple Input Multiple Output) in spatial (MIMO). The MIMO-OFDM is the reproductive and highly famous services for Wireless broad band access. The combination of MIMO and OFDM accumulates the purpose of each and every scheme that will provide the high throughput. Proposed that Orthogonal Frequency Division Multiplexing (OFDM) is predicted to be implemented in future broadcasting and Wireless Local Area Network (WLAN) systems due to its robustness in transmitting a high data rate. presents the design and implementation of an OFDM transceiver system for high speed Wireless Local Area Network (LAN) using MATLAB simulation. The bit error rate (BER) performances for DQPSK, D16PSK and D256PSK have been evaluated in additive white Gaussian noise (AWGN) channel and compared to the theoretical BER. The system performance has been evaluated on AWGN channel and BER versus signal to-noise (SNR) ratio has been measured for each modulation scheme.

PLC enhanced wireless access networks

The integration of Power Line Communication (PLC) is of interest to future broadband communication systems. These communication systems will be mostly wireless but the use of non-dedicated wired infrastructure will help to reduce costs. PLC uses the highly developed infrastructure of the electrical energy distribution network for data transmission. So it is possible to enlarge the capacity of communication systems without additional wiring and additional costs for this wiring for outdoor applications, for example to bridge the last mile, as well as indoor, for example to establish or enlarge LANs without new data cables. To evaluate the potential of PLC an analysis of the channel capacity of the power line at higher frequencies is needed. In wireless communication systems the use of antenna arrays leads to Multiple Input Multiple Output (MIMO) radio channels. These radio channels promise high channel capacities for future wireless communication systems The capacity of such a broadband communication system can be enhanced by the capacity of existing power lines cost-effectively. PLC transfer functions; they are roughly classified in the categories good average and below average With increasing distance between two measured sockets the attenuation of higher frequencies increases more than the attenuation of lower frequencies But the attenuation not only depends on the distance between the used sockets but also on the supply of these a typical power supply of a house in Germany: it is supplied by three-phase current, 3 phase conductors (L1, L2, L3) and a neutral conductor A normal socket is connected to one of the three phase conductors and to the neutral conductor (null); in our measurements a PLC signal is transmitted between phase and null. For constant distance the lowest attenuation between two sockets is found if the sockets are supplied by the same phase conductor and protected by the same fuse; the loss increases in the case of different fuses. If different phase conductors supply the sockets usually the attenuation is high. In addition the frequency selective attenuation depends on the environment, which means open-ended sockets and devices that are connected to the power line near the tested pair of sockets. This is a result of the reflections generated at the open-ended sockets and at those devices because their loads are not matched to the frequency dependent impedance of the power line net. So, the characteristics of the transfer function, above all the often periodic for different modulations data rates are presented that can be achieved at a bit error probability below 10(- 4). The transmitting power still is 0.4 V2 or 8 mW at 50 Ω, the bandwidth 29 MHz; constant power density of 1.38 · 10-8 V2/Hz is assumed. The following symbol alphabets are considered: 2-PSK, 4-PSK, 8-PSK, 16-QAM and 64-QAM. For each sub-channel the signal to- noise ratio and then the bit error probability is calculated If it is below 10(- 4) the data rate is increased according to the considered symbol alphabet the attainable data rates for the three categories of PLC channels under the assumption that in every sub-channel that symbol alphabet is used which leads to the maximal data rate with a bit error probability below 10(- 4) (adaptive modulation; transmitter needs channel knowledge). This leads to data rates between 168 and 174 Mbit.

V. RESULT ANALYSIS

Results

The proposed Analysis of Channel Speed Power Line Communication Using OFDM (BPSK, QPSK, and QAM) Interfacing between Remote Locations System is simulated by using MATLAB 7.8.0. MATLAB is a strong mathematical tool which provides help to engineers to solve, model, simulate the problems and find solutions assuming environment in to

mathematical equations. It is standard engineering tool as it perform many different tasks using different tool box relevant to different particular cases e.g. Control systems, signal processing, image processing, communication systems, and support complex matrix manipulation, simulink etc. In different research field it provides platform for learning and comparison of theoretical hypothesis and simulated values. It even provides support to nonlinear system calculations and result. This chapter presents performance of the Power Line Communication Using OFDM (BPSK, QPSK, and QAM) Interfacing between Remote Locations System; simulation MATLAB In the process, the goal was to reach.

Table.1 parameters Power Line Communication

Modulation scheme	BPSK, QPSK, and QAM
Number of sub carrier for OFDM	128
Symbol length	64 bit
Channel estimation	Perfect estimation
Signal estimation	Correlated
Channel	PLCC
Scrambling code	Random code of length 63

A new closed-loop Analysis of Channel Speed Power Line Communication Using OFDM (BPSK, QPSK, and QAM) Interfacing between Remote Locations System The receiver of the scheme checks the output signal-to-noise ratio (SNR) of the Power Line Communication against an output threshold and requests the transmitter to plcc channel resulting in the poorest path with an used power cable if the output SNR is below the threshold. We provide some interesting statistical analysis and obtain closed-form expressions for the cumulative distribution function the probability density function and the moment-generating function of the received SNR. We show through scheme offers a significant gain plcc OFDM BPSK, QPSK, and QAM transmit system

Table.2 A brief view for various simulation parameters are listed in the following table

Bandwidth	14Mbps
Number of sub carrier for OFDM	128
Information length	242.5
OFDM Symbol Length	312.5ns
Data Transmission rate	55,200,and 480 Mbps
Pilot Carrier	500
FFT size	128
No of data tone	100
No of pilot tone	12
No of guard tone	10
Constellation	BPSK, QPSK, and QAM

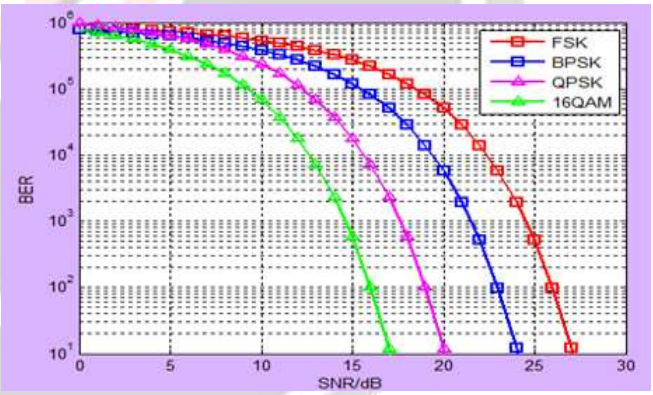

Fig.7 :Analysis of PLCC- FSK 26 SNR/db, BPSK, 24 SNR/db and QPSK 20 SNR/dB with 16QAM 16 SNR/db proposed

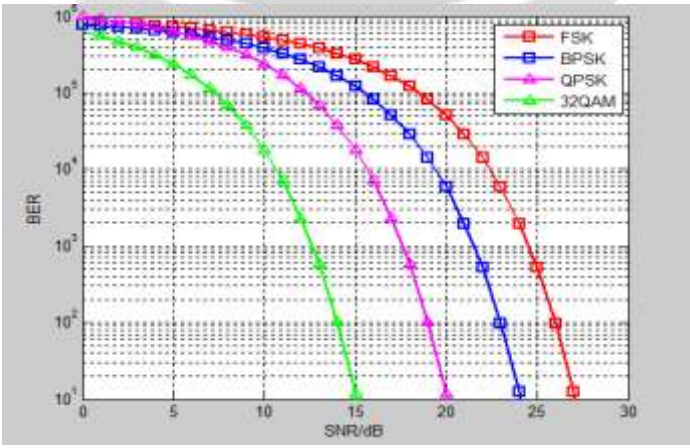

Fig.8: Analysis of PLCC- FSK 26 SNR/db, BPSK, 24 SNR/db and QPSK 20 SNR/dB with 32QAM 15 SNR/db proposed

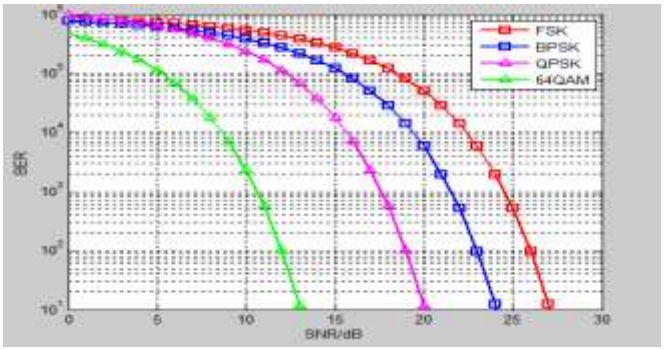

Figure.6.3 Analysis of PLCC- FSK 26 SNR/db, BPSK, 24 SNR/db and QPSK 20 SNR/dB with 64QAM 15 SNR/db proposed

Power line communication provides a new and exciting opportunity for high-bandwidth data communications. We discuss about a Analysis of Channel Speed Power Line Communication Using OFDM (BPSK, QPSK, and QAM) Interfacing between Remote Locations System show we can improve the performance of system with such a simple system. Using power line at the transmitter and receiver can decrease BER of the system and increase data rate of it. Also we discuss about the channel capacity of the OFDM (BPSK, QPSK, and QAM) We use 64 QAM in the receiver and show it's equation for estimation of channel and symbol Also we discuss about plcc link budget and the importance of it in designation. Finally we show the results of our simulations and we show that according to our simulation, we can improve the performance of the PLCC system.

VI. CONCLSUION

It is obvious that the application of broadband, cable TV, smart monitoring system PLC will be a useful completion of future communication systems the channel capacity of PLC channels is promising. our measurements for PLC channels found in an apartments or in an office .PLC can enhance the capacity of wireless networks cost effectively using transmitting power Perhaps PLC as suitable for outdoor networking as for indoor networking. Because the power line is a shared medium and for outdoor PLC the capacity is frequencies can be used for the longer distances in the outdoor application. In future, Load management is a technique employed by the power company to maintain a stable grid. For a distribution system to function, the load must be matched by the generation. Currently, large kilowatt generators must adjust instantly to shifts in load. However, load management could be used to instead redirect current over different transmission lines and to different grid sections. A signal can be sent over the power line to a switching station or capacitor bank to make required adjustments that would otherwise require a secondary form of communication. This improves the overall grid stability and reduces operating costs. Automatic metering is another practical PLC Rather than having an employee manually go from house to house and business to business reading the electric meter, the meter sends a signal back to a receiver. Its unique identification number and current usage to date is broadcast and consequently recorded. Although cost to the power company is reduced significantly, the communication speed data transmission with a high rate of data transmission, the power line could provide internet access, voice over IP, and other broadband services. This is beneficial to the consumer because the common power outlet becomes a gateway to the Internet and a home LAN.

REFERENCE

[1] Guzelgoz, S. "Characterizing wireless and power line communication channels with applications to smart grid networks", PhD Dissertation, University of South Florida 2010.
[2] Shawkat, A. B. M. "Smart Grids: Opportunities, Developments, and Trends", IEEE-2013.
[3] Ma, R., Chen, H., Huang, R., & Meng, W. (2013). Smart grid communication: Its challenges and opportunities. IEEE Transactions on Smart Grid, 4(1), 36-46.
[4] Ginot, N., Mannah, M. A., Batard, C., & Machmoum, M. (2010). Application of power line communication for data transmission over PWM network. IEEE Transactions Smart Grid, 1(2), 178-185.
[5] Bumiller, G., Lampe, L., & Hrasnica, H. (2010). Power line communication networks for large-scale control and automation systems. IEEE Communications Magazine, 48(8), 106-113.
[6] IEEE Standard 1901™. (2010). IEEE Standard for Broadband over Power Line Networks: Medium Access Control and Physical Layer Specifications.
[7] Korki, M., Hosseinzadeh, N., Vu, H. L., Moazzeni, T., & Foh, C. H. (2011). A channel model for power line communication in the smart grid. Proceedings of Power Systems Conference and Exposition (pp. 1-7).
[8] NIST Framework and Roadmap for Smart Grid Interoperability Standards. Release 1.0.
[9] Galli, S., Scaglione, A., & Wang, Z. (Jun. 2011). For the grid and through the grid: The role of power line communications in the smart grid. Proceedings of IEEE, 99(6), 998–1027.
[10] M. Shukla, Nutan Sharma, Shashi Tiwari, "Performance Analysis of Iterative IDMA Scheme in Power Line Communication Using Random Interleaver", National Conference on Emerging Trends in Electrical, Instrumentation & Communication Engineering, ISSN 2224-610XVol.3, No.3, 2013.

[11] Bansh Kishor, Dr. Parvinder Banger, "Wireless Transmission of Electricity by using Various Technologies", (IJETR) ISSN: 2321-0869, Volume-3, Issue-5, May 2015.
[12] Sanjana T , Suma M N, "Combined NBI and Impulsive Noise Cancellation in OFDM System", (IJAIST) ISSN: 2319:2682 Vol.31, No.31, November 2014.
[13] Zhang, Y.-H., Lin, S.-X., Chen, L.-B., Chang, W.-J., Hu, W.-W., Tang, J.-J., & Yu, C.-T. (2017). An implementation of an in-vehicle power line communication system. 2017 IEEE 6th Global Conference on Consumer Electronics (GCCE). doi:10.1109/gcce.2017.8229422.
[14] Krzysztof Bernacki , Dominik Wybra ´nczyk , Marcin Zygmanowski, Andrzej Latko , Jarosław Michalak and Zbigniew Rymarski, "Disturbance and Signal Filter for Power Line Communication", Electronics 2019, 8, 378; doi:10.3390/electronics8040378.
[15] Lopez, G., Matanza, J., de la Vega, D., Castro, M., Arrinda, A., Moreno, J. I., & Sendin, A. (2019). The Role of Power Line Communications in the Smart Grid Revisited: Applications, Challenges, and Research Initiatives. IEEE Access, 1–1. doi:10.1109/access.2019.2928391.