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## Design of Domestic Use of PLCC, specifically for central India, a Review

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**Abstract**— our paper aims at introducing an old technology in a new way as an alternative to existing communication systems. Traditional Power Line Communication (PLC) is widely used to provide real-time communications for protection of high voltage transmission lines. PLC is often the most economical and reliable high-speed dedicated channel available for protective relaying. PLC

system is mainly used for managing the high voltage link and for communications between different substations. [1] Power generation and transmission need a good & healthy communication system for proper functioning of the power system and to give uninterrupted supply to the consumers. Power line carrier communication (PLCC) is also used for telecommunication, tele-protection and tele-

**monitoring between electrical substations through power lines at high voltages, such as 110 kV, 220 kV, and 400 kV. PLCC integrates the transmission of communication signal and 50/60 Hz power signal through the same electric power cable. The audio frequency is carried by a carrier frequency [1]. Our paper on domestic PLCC is an approach to utilize the existing power lines in the house or office or any residential premises for the transmission of information.**

***Index Terms*— Power Line Carrier communication (PLCC), Orthogonal Frequency Modulator (OFDM), Liquid Crystal Diode(LCD).**

## INTRODUCTION

PLCC is used for establishing speech/ data communication between two stations using a power line. PLCC is an approach to utilize the existing power lines for the transmission of information. In today's world every house and building has properly installed electricity lines. By using the existing AC power lines as a medium to transfer the information, it becomes easy to connect the houses with a high speed network access point without installing new wirings.

This technology has been in wide use since 1950 and was mainly used by the grid stations to transmit information at high speed. Now days this technology is finding wide use in building as it avoids the need of extra wiring. The data collected from different sensors is transmitted on these power lines thereby also reducing the maintenance cost of the additional wiring. In some countries this technology is also used to provide Internet connection. [2]

This paper is based on data transmission over the power line. The power line modem uses the power line cable as communication medium. The modem at the transmission end modulates the signal from keypad through microcontroller onto the carrier signal in the power line. At the receiving end, the modem recovers the data from the power line carrier signal by demodulation and sends the data to LCD for display. Power line communication modems transmit digital data on the live and

neutral cables of the building power distribution network. Data is typically transmitted at carrier frequencies in the range from 50 kHz to 50 MHz using a variety of modulation techniques, all power line communications systems operate by impressing a modulated carrier signal on the wiring system. a local area network operating at millions of bits per second may only cover one floor of an office building, but eliminates installation of dedicated network cabling.[3]

## I. LITERATURE SURVEY

After carefully studying the various technologies we infer from [4] that Digital Signal Processing is absolutely necessary for the system to function efficiently. Spread Spectrum is found to be having a negative impact on the output and hence should be avoided. OFDM is found to be the most immune to noise and hence chosen in paper. From [5]:we derived an idea of how the PLC can be implemented on small infrastructures, that is on low voltages and how transmission of data is made possible through existing power lines with an example of home automation.

## MARKET SURVEY

A visit to Bicholi substation, Indore zone,(M.P., India.), was indeed of lot of help and support. Technical support crew helped us explaining how PLC Systems work on broader context. He told us that for coupling purpose Current Voltage Transformer (CVT) which costs in lakhs and is used to block the AC Power signal coming into the transmitter/receiver system. With the help of PLCC system one can transmit and receive data as well as voice signals. PLCC is a plug and play kind of system which can be plugged into any electric socket and communication can be established within a same building or nearby areas. The customers will be required to buy PLCC system adapters which are a onetime cost and can be used for lifetime. Also the size of adapters is small which makes it easily portable unlike telephone or intercom. So the user can take these adapters to a new place or new office and the system is established within no time. All the user has to

do is to plug the adapters in sockets in the rooms he/she wants. Considering the above stated merits PLCC system is certainly the best fit in today's modern age. PLCC systems completely fit the need of the customers as it eliminates the shortcomings of the conventional system. Now the only concern according to customer point of view is the cost factor. Let's see the cost wise analysis of PLCC system with telephone and intercom.[5] With other applications like Automatic meter reading , Fire & Security Alarm Systems and Lighting Control this serves as the major Integration for all the tasks that can be computed easily. With the invention of new modems such as PLC Modem, care has been taken that though using a same platform for transmitter and receiver side.[5]

## II. PRODUCT ANALYSIS

The successive step in study of PLCC is to have a glance on devices which are using this technology. Technical Experts from MPSEB, central India, suggested us the device mentioned .This device which supports Windows XP/Pro , Linux OS is like a home plug adapter in the power line network for signal transmission, to achieve any power outlet next to Internet . With data rate 9600bps and working temperature range -20 to -60 degrees , this serves as easy to connect, easy to use, plug and play device for home and small office networking environment. The above device has built-in on board AC isolated coupling circuit, which allows direct and simple connections to mains. Due to isolation on AC part, there is no worry to get shock on the low voltage side when working with it. So it's user friendly device. It has high immunity to electrical noise persistence in the power line and built in error checking so it never gives out corrupt data. It transmits and receives serial data at 9600 bps. Transmission is based on byte by byte basis. Once you give one byte to module for transmission, you will have to wait at least 500ms before a new byte is given to module again since the module waits for zero crossing of AC mains to transfer a bit. For AC 50Hz system the zero crossing of AC signals happens every 10ms and modem needs 50 zero

crossings to transmit one byte with error checking data. That is why it takes 500ms for one byte. As a half duplex system it normally operates in Receiver mode, once your application gives serial data to transmit on its RX-IN pin. It switches over to transmit and transmits the data through power line. Due to low cost, built in error checking, it's mainly used for Home Automation and Process Control.[5]

## III. Block Diagram:

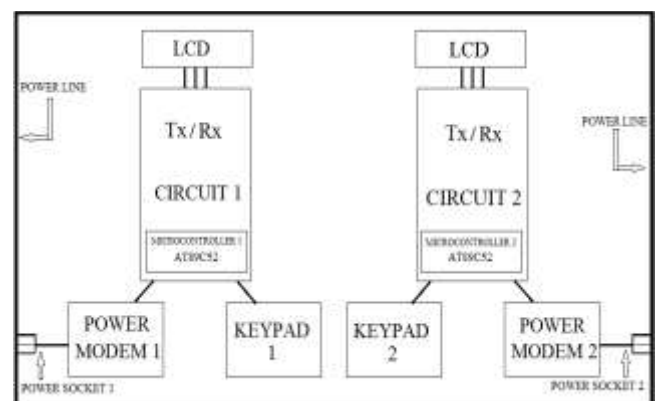


Illustration 1: Block Diagram Of PLCC

## IV. DESCRIPTION

This block diagram explanation will give the basic idea about the flow of data from one user to another. Conversion is done by the microcontroller (AT89C52) into ASCII format as well as the equivalent ASCII codes will be converted into the binary data for transmission using embedded C and keil Software. Thus, the microcontroller takes the bit stream from the keypad and generates the same bit stream from one of its output pin. This stream of bits is now given to OFDM modulator/power MODEM which will convert the digital data to analog form so that it can be sent over a power line. The OFDM modulator uses Orthogonal frequency-division multiplexing (OFDM), method of digital modulation in which a signal is split into several narrowband channels at different frequencies. OFDM is used by power line devices to extend Ethernet connections to other rooms in a home through its power wiring. This modulation is particularly important with such a noisy channel

as electrical wiring. This is done because if digital data is sent over any channel then it will consume lot of bandwidth and the signal will also get corrupted very easily. Now our information is in the frequency in the form of a sine wave. Noise on any channel affects frequency the least. So our data is safe but the power line is of high voltage so care has to be taken so that the high voltage does not enter the transmitter circuitry. Interference is minimized using OFDM modulator.

The functioning of the receiver side blocks is the exact opposite as that of transmitter side. The LCD gives the output information. It is optional that an LCD may also be connected at the transmission end so as it may also act as a receiver. Thus, two way communications would be possible. Connecting the device to computer or laptops, they also may be able to transmit and receive information without any broadband or internet connection.

Table 1 gives a comparison on the basis of basic features of single carrier, spread spectrum and OFDM. It is seen that out of these three, OFDM is much more efficient in terms of noise isolation, channel distortions etc. From Table 1, it is seen that the adaptability to channel changes of OFDM is better as compared to the other two. Also, power lines are chosen as like phone companies, power companies also have lines strung all over the world. The difference is that they have power lines in a lot more places than phone companies have fiber optics. This makes power lines an obvious vehicle for providing Internet to places where fiber optics haven't reached

#### V. POWER MODEM:

Power modems use silicon chipsets specially designed to handle the work load of pulling data out of an electric current. Using specially developed modulation techniques and adaptive algorithms, the power modem is connected to the microcontroller. It consists of four pins. The above circuit is the reset circuit using resistor and capacitor. This is used for resetting the transmitter or receiver circuit to its initial stage where virtually it is waiting for its input. The data displayed on the LCD is cleared on

resetting. Also, the microcontroller and MODEM reset back.[8]

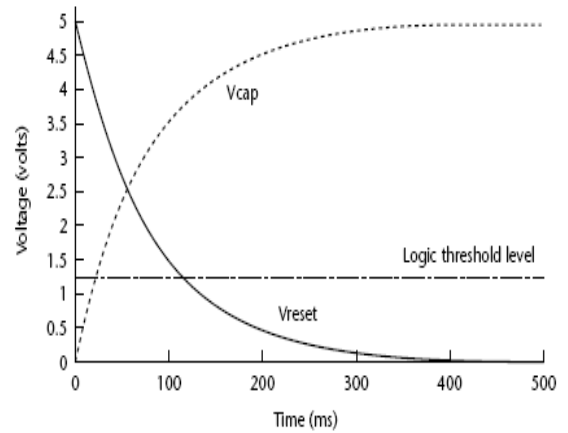


Illustration 2: Operational lookout in voltage vs. time graph

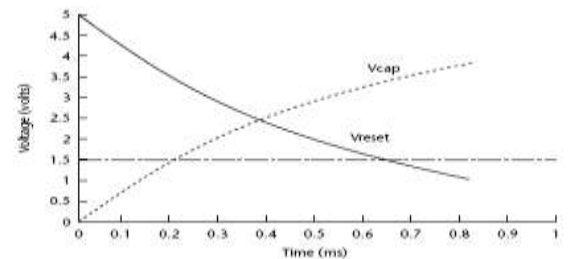


Illustration 3: voltage vs. time graph of reset circuit

The above figure shows the same aspect. As the capacitor charges exponentially, consequently the Vreset voltage drops to below threshold level. It resets the microcontroller below threshold level.[8] The receiver circuit consists of the same components as of transmitter circuit described above. The data to be displayed is given on the LCD. Vice versa, It may also act as transmitter if other end has an LCD to display the data.

#### VI. CONCLUSION

The paper has the capability of transforming the information highway in India. In a way that India has bypassed the land-line telephone revolution, the adaptation of PLCC can help propel India into an elite group of countries with a very deep Internet penetration. This would in turn help in dispelling the superstitions and ignorance that prevails in some of the backward areas of the country. India's image as a low cost development country in the world would get a major boost by

the implementation of this technology on a wider scale.

Power Lines Communication would result in a very large scale savings of the tax payer's money. Efficiency of the existing infrastructure would be enhanced thus giving more value for money. It aims to ensure that the PLCC system can be used as a plug and play device without any major investments on the part of the consumer. PLCC is a technology that has the potential to revolutionize communication and to change the lives of the citizens if factors such as cost, effectiveness and security are carefully handled.

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	<i>Intercom</i>	<i>Telephone</i>	<i>PLCC</i>
<b>Cost/unit( in Rs)</b>	4000	500 + <i>service tax* + installation charges + monthly rental</i>	3500
<b>Cost after one Year/unit (in Rs.)</b>	4250( <i>approx</i> )	12 X <i>(service tax* + monthly rental)</i>	3820 <i>(approx)</i>

Table 1: Cost comparison

	<i>OFDM</i>	<i>Spread Spectrum techniques</i>	<i>Single Carrier</i>
<b>Spectral</b>	<i>Good</i>	<i>Poor</i>	<i>Moderate</i>

<b>Efficiency</b>			
<b>Robustness to channel distortions</b>	<i>Excellent</i>	<i>Not Good</i>	<i>Good</i>
<b>Robustness against impulsive noise</b>	<i>Fair</i>	<i>Fair</i>	<i>Good</i>
<b>Ability to adapt against channel changes</b>	<i>Excellent</i>	<i>Fair</i>	<i>Good</i>
<b>Implementation costs (Equalizer)</b>	<i>Fair</i>	<i>Poor</i>	<i>Poor (equalizers needed)</i>

Table 2: Comparison of OFDM technique with other techniques