



A REVIEW ON POWER LINE COMMUNICATION

Manmeet Bhatia¹, Reshmita Sharma²
^{1,2}Department of EEE SSGI Bhilai

Abstract

Currently in the age of Information Communication Technology, emphasis is given on higher fast and high data transfer methods. Traditional information transmission techniques have its limitations of cost and availability to reach the maximum number of users. The powerline communication is a solution to fulfill demands of today's requirement in the field of information communication. In this paper, a survey on basics of powerline communication, their classification, advantages, issues and applications are presented.

Index Terms: Communication, Powerline, Channels,

I. INTRODUCTION

Power-line communication (PLC) is a communication method that utilizes existing public and private powerline to carry both electric power and data simultaneously [1]. Powerline are usually classified as high (>100kV), medium (1 to 100 kV) and low (<1kV) networks. The advantage of using electric power lines as the data transmission medium is that every building and home is already equipped with the power lines that are connected to the power grid. Utilization of powerline for transmission of power and data can also be referred as power-line carrier, powerline communications, power-line digital subscriber line (PDSL), mains communication, power-line telecommunications, or power-line networking (PLN). PLC can be achieved through premises wiring within a single building and or can be between two levels i.e. both the distribution network and premises wiring.

In PLC, powerline is transformed into a channel through the superposition of a low energy information signal to the power wave. Figure 1 shows the powerline communication system. It shows the basic structure of PLC model.



Figure 1 Powerline communication system.

Functional blocks of a system system are shown in Figure 2.

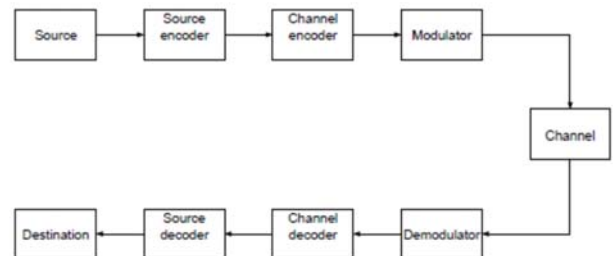


Figure 2. Functional blocks of a PLC system

The frequency range used for PLC narrowband applications is 3 kHz to 148.5 kHz and from 1 MHz to 30 MHz for PLC broadband applications. PLC can be categorized on the basis of their applications as narrowband PLC and

broadband PLC. There are four basic forms of PLC [2] [3]:

- In narrow band, In-house power wiring can be used for low bit rate services like home automation and intercoms.
- Narrowband outdoor applications are mainly used by the utility companies for automatic meter reading, remote surveillance and control.
- Broadband In-house networking which utilizes mains power wiring for transmission of data in home networking.
- Broadband over powerline (BPL) systems provide high-speed communications capabilities by coupling radio frequency (RF) energy onto the powerline and offers broadband internet access.

The biggest problem for PLC is interference as the power wiring is unshielded and untwisted. The wires act as an antenna which emits large amounts of radio signal. This will cause interference to the existing users of the same frequency band. Noises/disturbances are unwanted signal introduced to PLC at any stages [4]. These signals reduce the performance and reliability of PLC. There are many different sources of noises and disturbances in power line networks. In general, it is very difficult to predict noises present in networks. On high voltage networks, channel noise may be due to atmospheric or static discharges, lightning, circuit breaker operations or transients within a power station. On medium voltage networks, the on and off switching of capacitor banks used for power factor correction may cause high noise peaks. On low noise voltage networks, some household devices or office equipment contribute the noise [5]. Second issue with PLC is that of security. PLC also suffers from data attenuation problem due to the presence of numerous elements on a power line network. The cost of a power line network modem is high as compared with modem used to connect phone line with network.

II. APPLICATIONS OF PLC

PLC systems as already stated are classified on the basis of services provided by them i.e. Communication over high voltage grid, access to an internet provider, in-home networking with high data rate and in-home simple control application with low bit rate. These are few key areas where PLC is utilized [6] [7] [8]:

- PLC was first adopted for transmission of electrical signals and information data at a fast rate.
- PLC finds applications in controlling home appliances and automation. The technology can be applied to reduce the resources.
- Multimedia contents can be distributed through PLC throughout the home.
- Data transmission for different types of communications like telephonic communication, audio, video communication can be made with the use of PLC technology.
- In monitoring houses or businesses through surveillance cameras, PLC technology is far useful.
- Automatic Meter reading applications use the PLC technology to send the data from home meters to Host Central Station.

III. ADVANTAGES OF PLC

PLC systems are associated with a number of advantages [9] [10]. Few of them are listed below:

- PLC uses the existing electrical network for communication. So the cost of installation is lower than other communication system.
- Availability of communication service can be everywhere outlets exist.
- For internal communication of electrical utilities, remote measuring and control task high, medium and low voltage supply have been used.
- High data transfer rate (up to hundreds of Mbps) can be achieved through PLC.

IV. ISSUES IN PLC

The performance of any PLC system is found to be

Dependent upon time, location and wiring topology. Even Communication signaling can only be implemented within the area serviced by one transformer [11] [12].

- Design Issues: The power line carrier was not designed for data transmission and provides a harsh environment for it. Variable impedance, noise and high levels of frequency-dependent attenuation are the main issues.
- Security Issue- powerline are actually not meant for secure data transfer.
- Lack of global standards: there are several different standards for PLC.
- Varying Channel Model: The channel may be described as random and time varying model.
- Dependency over location of transmitter and receiver: The location of the transmitter or the receiver could also have a serious effect on transmission error rates.
- Reflection, Multi-path Fading and Attenuation: Reflection due to various impedance mismatches, multi-path fading and attenuation/transmission losses are other issues with PLC which affects their performance and implementation.

V. MODELING THE POWERLINE CHANNEL

A power line model is considered as a black box described by transfer function and the method to modeling the transfer function the PLC uses the chain parameter matrices describing the relation between input and output voltage and current of two-port network. Actually channel modeling consists of investigating the characteristics of the power network as a communication channel. Bridge taps with different cable lengths and cable types which exists along the transmission line forms a power line network made of sections [13]. For a PLC network with several sections, the transfer function for the whole network will be same equation; however, the transmission matrix for the system differs. PLC

channels suffer from a number of technical problems, chief among them are:

- High interference due to noisy loads,
- Time and frequency varying attenuations offered by the medium,
- Dependency on location, network topology and connected loads,
- High non-white background noise and impulsive noise and
- Electromagnetic compatibility (EMC) issues that limit available transmitted power.

Since PLC differs considerably from other well known channels, so special care is required to select a modulation scheme that uses potentially high capacity of these channels optimally and also offers robustness against noise. The selection of modulation mainly depends upon: noise/ impulse disturbance, frequency selective nature of channel and regulatory constraints [14].

VI. CONCLUSION

The idea of using the powerline for exchange of information is not new at all. PLC is a medium that allows the exchange of information by means of the powerline that are present in and around us. The use of this medium made it possible to compete against the traditional data service provider. Information can be transmitted through the powerline with high bit rates. However, the main purpose of PLC is management, control, and supervision of power plant and distribution facility operation. The issues associated with PLC can be overcome by modern modulation methods and by setting global standard for using it.

VII. BIBLIOGRAPHY

- [1] L. Lampe, J. Newbury, and T. Swart, Eds., H. Ferreira, *Powerline Communications*: New York, NY: John Wiley & Sons, 2010.
- [2] K Dostert, "Telecommunications over the Power distribution Grid- Possibilities and Limitations," in *Power Line Comms and its Applications*, 1997, pp. 1-9.
- [3] R. Broadridge, "Power line modems and networks," in *Second IEE National Conference on Telecommunications*. London UK, 1997, pp. 294-296.

- [4] M. Rapp and K. Dostert M. Gotz, "Power line channel characteristics and their effect on communication system design," *IEEE Communications Magazine*, vol. 42, no. 4, pp. 78-86, 2004.
- [5] H. C., Grové, H. M., Hooijen, O., & Han Vinck, A. J. Ferreira, *Power line communication.*: John Wiley & Sons, Inc., 2010.
- [6] A. Majumder and Caffery J, "Power line communications;," *Potentials*, vol. 23, no. 4, Nov-Dec 2004.
- [7] D. B., Koc, A. H., Yalcinoz, T., & Onaran, I. Unsal, "Medium voltage and Low Voltage applications of new power line communication model for smart grids," in *IEEE Energy conference*, 2016.
- [8] Hakki C., "Performance analysis of FSK power line communication systems over the time-varying channels: measurements and modeling," *IEEE Transactions on Power Delivery*, vol. 19, no. 1, pp. 111-117, 2004.
- [9] E., & Bonfè, M. Mainardi, "Powerline communication in home-building automation systems.," *In Robotics and Automation in Construction. InTech*, 2008.
- [10] K. M. Dostert, "ower lines as high speed data transmission channels – modeling the physical limits," in *Proceedings of the 5th IEEE International Symposium on Spread Spectrum*, 1998, pp. 585-589.
- [11] Yasser Fathi, "An Enhanced Direct Sequence Spread Spectrum," MSc Thesis Cairo University, 2004.
- [12] Tamer A. Kawady, Ahmed Husein, Mohamed El-Geziry Yasser Fathi, "Practical Issues of Power Line Communication for Automatic Meter Reading Systems," in *Proceedings of the 14th International Middle East Power Systems Conference (MEPCON'10)*, Cairo University, Egypt, 2010, pp. 634-640.
- [13] Dostert K Zimmermann A, "A multipath signal propagation model for the channel line in high frequency range," in *Proceedings of 3rd International symposium on power line communication*, Lancaster UK, 1999, pp. 45-51.
- [14] "Modelling and estimation of OFDM based powerline communication channels," *International journal of advance research in computer science*, vol. 7, no. 7, pp. 103-107, 2016.