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Designing and Implementing a Power Line Communication Network for Seamless Data Transmission and Reception

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ABSTRACT: Low voltage electrical wiring in homes has largely been dismissed as too noisy and unpredictable to support high-speed communication signals. However, recent advances in communication and modulation methodologies as well as in adaptive digital signal processing and error detection and correction have spawned novel media access control and physical layer protocols, capable of supporting power line communication networks at speeds comparable to wired local area networks. In this article we motivate the use of power line LANs as a basic infrastructure for building integrated smart homes, wherein information appliances ranging from simple control or monitoring devices to multimedia entertainment systems are seamlessly interconnected by the very wires that provide them electricity. In this paper we proposed a novel scheme to provide sufficient data rate in worst situation in channel. It will work sufficiently and seamlessly for data transmission and reception.

KEYWORDS: PLCC, seamless transmission, micro controller, MODEM

I. INTRODUCTION

Power line communication provide a convenient and cost effective option for data transmission because power lines are most widely distributed medium in the world, but electrical wiring in homes has largely been dismissed as too noisy and unpredictable to support high communication signals. Many next-generation appliances are being equipped with processors featuring sophisticated communication capabilities. For instance, on April 7, 2001, IBM and Carrier announced plans to produce an air conditioner with Java support that can email manufacturers regarding errors, and will allow users to remotely send commands to the unit to adjust temperatures or shut it down. Smart homes will eventually have many types of information appliances (IAs) communicating among themselves and with the outside world. Soon, many of these IA devices are expected to have multimedia capability. Supporting multimedia communication for these IA devices will be of crucial importance for the intelligent homes of the future.

Providing the right infrastructure for connecting these IA devices will be a major need. For home applications, this infrastructure must be easy to set up, inexpensive to install and maintain, and must perform well. Homeowners are generally not network experts, and a typical high-performance network is too complicated for casual daily usage. The supporting infrastructure should be as easy as possible to set up, and the effort to maintain this infrastructure should be minimal. Many existing networking technologies compete to support this mission. For example, a comprehensive Ethernet network can be constructed by installing UTP-5 special cabling around the house. Alternatively, wireless networks such as 802.11x, Bluetooth, and HomeRF can be constructed by installing multiple interconnected wireless access points(WAPs) and base stations within the home. However, the IA devices themselves would need wireless capabilities, and the above three infrastructures all require significant effort and cost to build up the networks externally. Phone line networks such as HomePNA may seem attractive, but the convenience of mobility is limited by available phone sockets in a home.

Power line needs no extra charge for building a network connection. In spite of this advantage, it is difficult to apply data network applications, which require high communication capability and speed because of high noise levels and attenuation of frequencies of interest. Also regulations of power line communication vary widely from nation to nation and a common standard do not exist. But is power line communication is carefully designed, it can be applied to various low rate applications and home automation through adaptive signal processing and well developed protocol.

Present theories and practices

- Various technologies are used for the effective power line communication. Selecting the best technology for suitable practice is important:-
- X-10 protocol: it is first introduced in 1978 for Sears home control system and the radio shack's plug and power systems. In this standard signal is modulated over 120 kHz carrier wave. It is popular standard in USA.
- Universal Power Line Bus (UPLB): it is protocol for communication among devices used for home automation. It uses power line wiring for home automation. It has improved transmission rate reliability than X-10.
- Insteon: it is dual band mesh home area network topology employing AC power lines and RF protocols to communicate with devices.
- Lon Works: it is network platform specifically created to address the needs of control applications. The platform is built on protocol for networking device over media such as twisted pair, power line and RF.

II. LITERATURE SURVEY

In [1], the direct use of the existing electrical wiring and outlets as the medium for data communication within the home is advocated. Using power lines as the network infrastructure has many advantages over other technologies. First, no new wires are needed since the IA devices will communicate over the very wires which provide them electrical power. Second, there are many access points (power sockets) in a home (4 or more per room). Currently, Power Line Communication (PLC) as specified by the HomePlug 1.0 standard [3] provides a 14 Mbps raw data rate, which is adequate for daily IA device communication. It also has a built-in QoS protocol, making it attractive for real-time streaming applications and it is planned to provide 100Mbps PLC services to support high quality digital multimedia. Finally, the cost to build a power line network is low when compared with other technologies. For example, it was observed that the 802.11x wireless network card has approximately the same street price as the HomePlug network card (about \$120). It is expected that with mass production requiring no expensive RF components, the cost of the PLC cards will be about 50% less than comparable wireless cards. Moreover, the cost of a required 802.11x base station is high (more than \$250). 100 Base T Ethernet has the highest performance/cost ratio, but requires new cables and expensive installation. Table I shows costs and other various characteristics of a home network technologies. Installation costs which are high for 10/100 BT are not shown.

In [2], E. Mainardi et al presented a feasible Home Automation System scenario based on a very cheap distributed microcontroller architecture, rather than on devices interconnected by an expensive commercial bus. The means used for data communication is the home powerline, so that the system doesn't require placing other cables in addition to standard electrical facilities.

Power line communication is a valid technique that allows the exchange of data by means of the powerline cables that are present in every dwelling and in every building. Even if there are some problems of noise and possible interferences, modern modulation methods make PLC systems in general affordable and reliable. Information transmitted through the powerline can be used to share data with high bit rates (generally used for home intranets, for the last mile problem or for in-home music distribution), or also to control home and building automation systems, that typically need lower bit rates, up to a few kbps (kilo bit per second) [3].

In [4], a discussion of security issues for power line networks (PLC) is provided. The home network based on power line communication has been used widely however security of PLC has not been discussed sufficiently. Though PLC uses power line as medium it has similar characteristics with wireless communications in the view of security. The authentication and cryptographic scheme used in PLC standard are discussed. Also the usage of Intrusion Detection system (IDS) for PLC is discussed.

In [5], power line communications (PLCs) in the context of Smart Grid is surveyed. The specifications G3-PLC, PRIME, HomePlug Green PHY, and HomePlug AV2, and the standards IEEE 1901/1901.2 and ITU-T G.hn/G.hnem are discussed.

III. PROPOSED SYSTEM

To investigate the performance of power line, we will analyze channel for text type of data initially. Thus data which is to be communicated is in text form initially which is used to control or regulated any information appliances. Apart from the different type of data (text or image), on channel a basic data rate is second thing which is of our interest. Minimum 14 Mb/s datarate is initially expected which is adequate for daily information appliances communication.

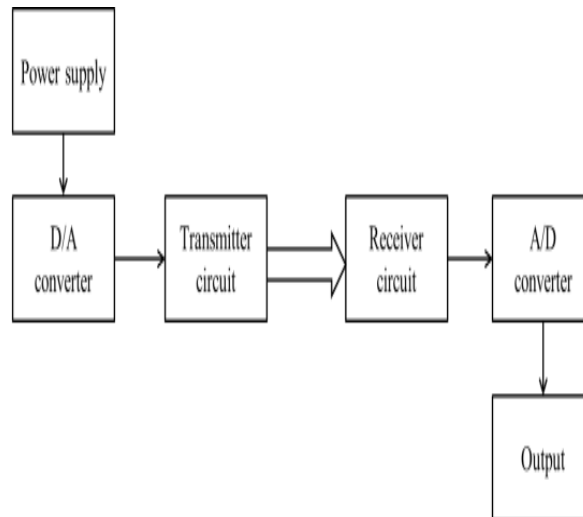


Fig 1 Block diagram for power line communication network

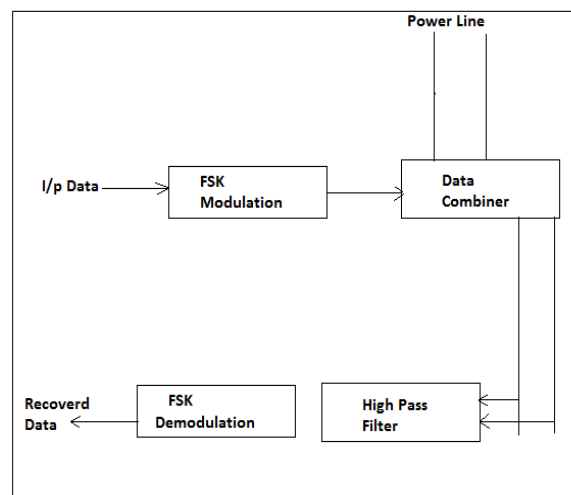


Fig 2 block diagram for typical application with power line communication

Proposed system consist of MODEM, microcontroller, final control element like triac or relay and information appliances which is to be controlled (shown in fig 2). Network simulator generates various types of data traffic such as text, image or audio. This data is the applied to simulation model. A real time power line communication network is designed for effective transmission and reception of data with adequate baud rate.

IV. RESULTS

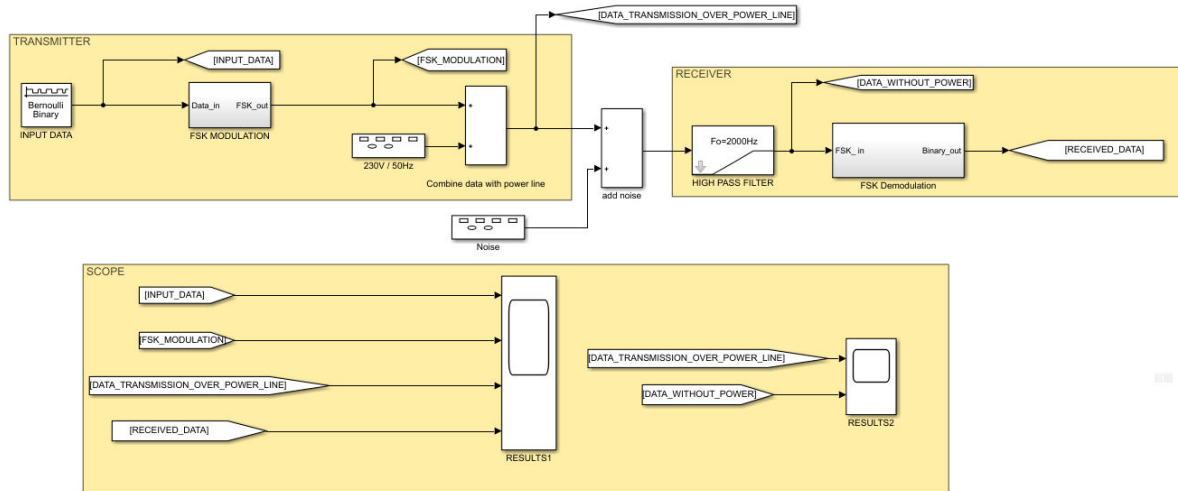


Fig.3.FSK Simulation

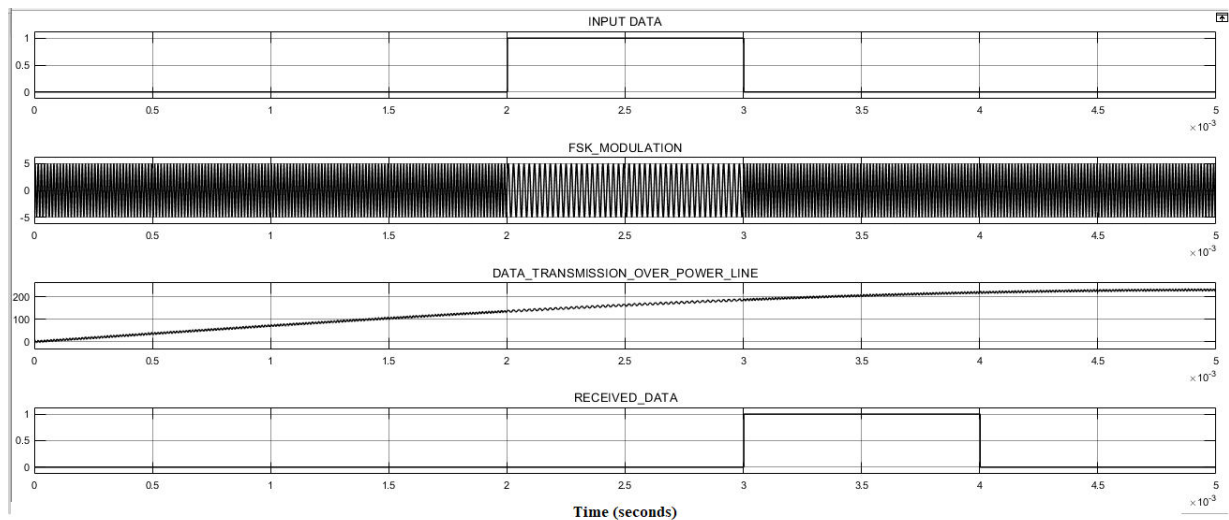


Fig 4 FSK Result

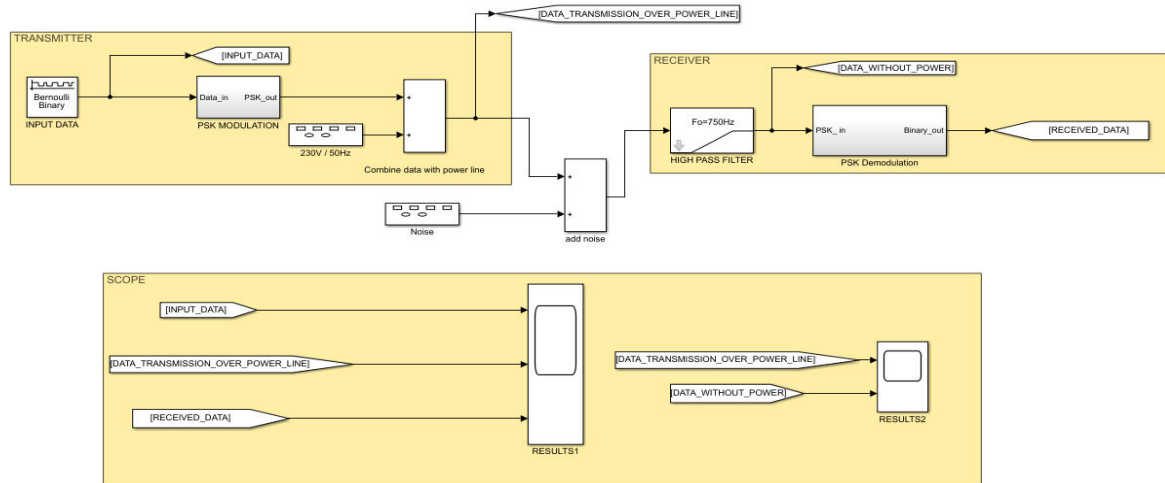


Fig 5 PSK Simulation

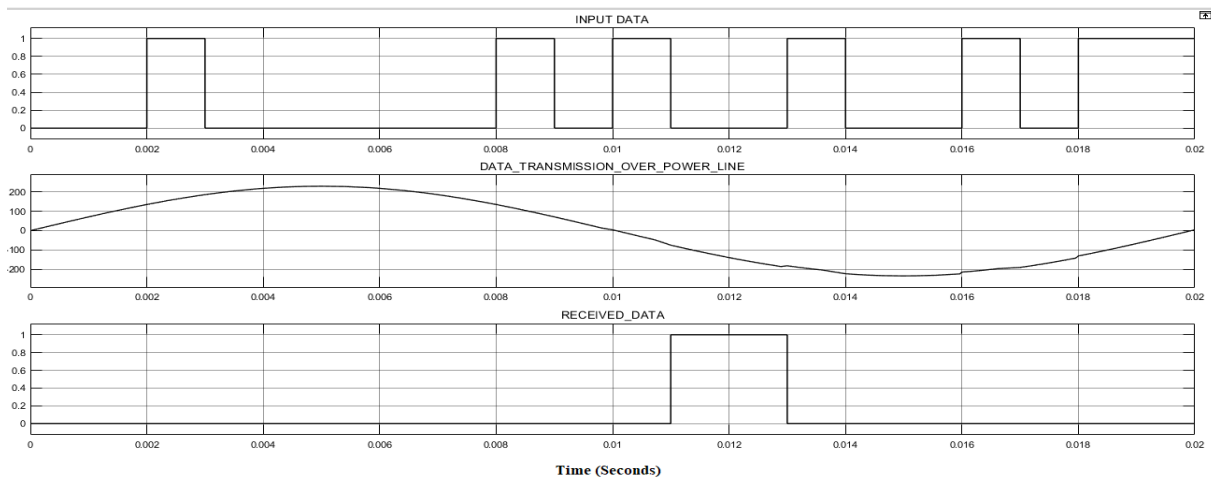


Fig 6 PSK Result

	without noise	with noise
PSK	0.00024	0.03834
FSK	0.00059	0.00071

Table 1. Bit Error Rate for 100000 bits transmission

V. CONCLUSION

The emergence of information appliances for the smart homes of the future will undoubtedly make our lives much more comfortable than ever. However, the infrastructure that supports multimedia traffic and conventional elastic data traffic for communication among IA devices is a critical component of a smart home. We advocate power line as the infrastructure for smart homes based on the convenience of the power sockets and the layout of the power line network existing in every home. At present, 6 Mb/s of bandwidth was measured through real- world PLC network experiments. Our studies showed that the PLC network can provide three low-bit-rate or three medium-bit-rate multimedia streams concurrently with no packet drops and jitters. It also successfully delivered one lowbit-rate multimedia data stream and

two large FTP file transfers concurrently with no packet drops and jitters. In this article we discuss only PLC networks for communication within the smart home, but the ultimate goal could be the ability to connect to the Internet without dialing up to an Internet service provider's server, using electrical wiring only.

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