International Journal of
Science and Engineering Investigations vol. 4, issue 40, May 2015
ISSN: 2251-8843

LAN Network through Power Line Communication

Khalifa Dai Elnour Mohamed[1], Abedl Rahim ElObeid Ahmed[2]
[1]Ph.D student, University of Khartoum, Khartoum, Sudan
[2]Associate professor, University of Khartoum, Khartoum, Sudan
([1]khalifamhmmd@yahoo.com, [2]arobeid52@yahoo.com)

Abstract- PLC is used for transmitting (50/60 Hz 220/110 V) power signal. It is not designed to convey high frequency signal such as 20 MHz communication signals used in the home plug 1 protocol. A power line channel is somewhat wireless channel, both suffer from noise, fading, multipath, and interference. Power line noise is produced by operation of electrical device. Fading, multipath and interference are caused by the imperfection of power line channels. Also limits the available bandwidth for communication purposes. In compliance the usable bandwidth in the home plug standard is 25MHz. There an extensive ongoing studies of power line channel characteristic.

To conquer the above problems, robust signal modulation and data coding are needed.

In this paper, the main purpose of developing local area network LAN through power line communication is because this technology doesn't require extra cabling. It only uses the existing power cable in the house. Hence, the owner of the house doesn't have to restructure their cabling system which is very inconvenient and costly.

Keywords- *Power Line, LAN Network, Communication*

I. INTRODUCTION

The Institute of Electrical and Electronics Engineers (IEEE) defines a LAN as "A data com system allowing a number of independent devices to communicate directly with each other, within a moderately sized geographic area over a physical communications channel of moderate data rates."

In its simplest form a Local Area Network (LAN) is a set of Personal Computers (PCs) and printers connected together in a defined, limited geographic area. The connected PCs are referred to as stations. Technically, two connected PCs next to each other can be considered a LAN-this would be a two-station LAN, the smallest possible configuration.

Almost all computers these days have a network connection of some description. Whether it be a modem connection to an ISP, or an Ethernet connection to a corporate intranet, sending and receiving data to and from other computers is an essential part of day to day operations. A myriad of applications use TCP/IP networking technology - Email, Web browsers and games to name a few popular applications. In most cases, there is one performance factor the user is most concerned with - the speed or transfer rate.

Figure 1. A TWO-STATION LAN

Typical characteristics of a LAN environment:

• The stations on the network are peers-any station can initiate data exchange with any other station.
• Full connectivity among all stations.
• Fully administered by the owner.
• Runs over a shared transmission medium-often, cabling.
• The network is confined to a small area-a single building or a cluster of buildings.
• The data rate is high-several Mbps (million bits per second).

II. Power Line Communication (PLC)

Power line communication is "the technology which provides a way to send and receive voice and data signals through the existing power line network" .Therefore it is a system for carrying data on a conductor that is also used for electric power transmission.

PLC also goes by a few other names and acronyms: Broadband over Power Lines (BPL), Power Line Telecommunications (PLT), Power-line Digital Subscriber Line (PDSL), Power Line Networking (PLN), and Power Line Broadband (PLB) are terms also used. There are a number of types of PLC systems, using different approaches and architecture. All are "carrier- current" systems, a term used to describe systems that intentionally conduct signals over electrical wiring or power lines.

III. The Pass Mark Advanced Network Test

The Pass Mark Advanced Network Test (which is part of Performance Test) is designed to test the data transfer rate between two computers both of which must be running Performance Test. One of the computers must act as the server and will sit waiting for a connection. The other computer acts as a client. It connects to the server machine and sends data to it for the duration of the test.

The network benchmark test will work with any type of TCP/IP connection. Including Ethernet, dial up modems, ADSL, cable modems, local area networks (LAN), Wide area networks (WAN) and wireless networking (Wi-Fi). The software has been optimized to use a minimum amount of CPU time, allowing even high speed gigabit Ethernet connections to be benchmarked. Users have the ability to change the following test parameters.

- The IP address of the machine acting as the server and the port number used for the test to help with firewall issues.
- The size of the data block used for each send request. It is also possible to select variable sized blocks to measure performance deltas as block size increases or decreases.
- The duration of the test.
- The protocol, either TCP or UDP. The TCP protocol is when data integrity is important (Errors are corrected using data re-transmission). UDP is used with applications that are tolerant to data loss such as video streaming.

The results of all completed tests may be graphed using our custom graphing components.

IV. PLC Ethernet Modems

The generalization of network interface cards in computers, network terminals, and electronic devices, even in household appliances, simplifies the building of networks by using the Ethernet board's RJ-45 connectors. This type of modem has become the most widely used PLC device. As well as being simple to use and configure, its price continues to fall. Figure (2) illustrates an Ethernet PLC modem of the companies Ethernet High Speed 85 type. The Ethernet network interface card of PLC modems was the first of the 10 baseT type (10 M bit/s) for HomePlug 1.0 modems providing a maximum useful throughput at the MAC layer level of 8.2 M bit/s, then of the 100baseT type (100 M bit/s) for HomePlug Turbo and AV modems.

Figure 2. Ethernet PLC modem

The increased performance of HomePlug PLC devices will probably lead the manufacturers to use 1,000baseT (1,000 Mbit/s) boards so that the throughput is not limited over the Ethernet interface. It would not be surprising to come across optical fiber PLC devices.

V. Methods and Materials

Power line carrier techniques would appear to be an economical and user friendly method of installing a home network adapter in any building. This system explores such claim, investigating the challenges of using the power line for LAN network and to identify the possible methods to overcome these challenges. I expect to send a data from one computer to another computer through the existing domestic power line (Low Voltage) figure 3.

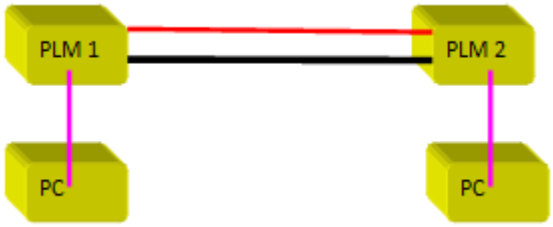


Figure 3. System block diagram

VI. IMPLEMENTATION TESTS AND RESULTS

A. Measurement of communication between PLC modems

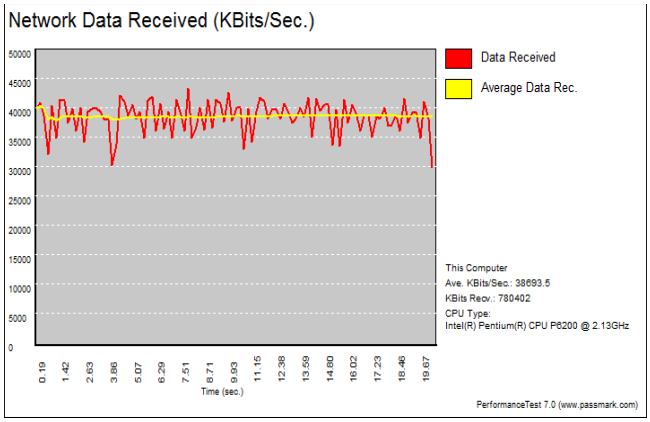
Using two modems, the measurement was performed on the one hand in a household without electric load and on the other hand, in a household with electric load. The subject of long-single term measurement was the rate of communication on the low-voltage 230V/50Hz grid.

1) Measurement of communication rate over small distance

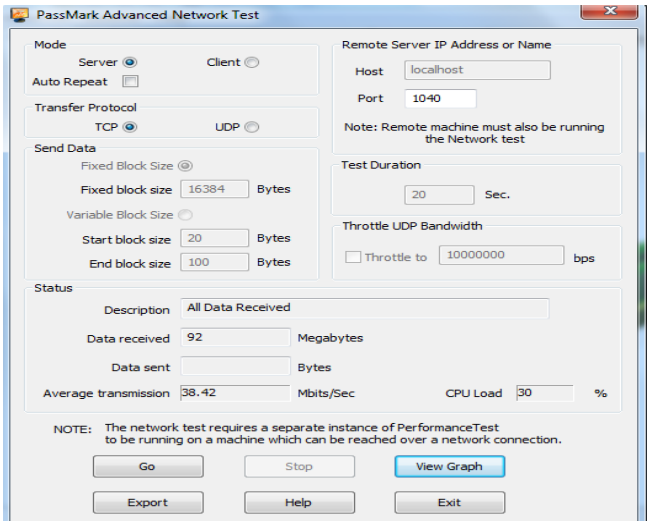
To measure communication rate by means of PLC modems the connection according to the Figure 4 was used. The first PC is connected to the PLC modem by Ethernet line, the other PC is connected via Ethernet to the other PLC modem. The performance test software was used to enable long-term monitoring of the transfer rate at regular distances. This software monitored the communication and every distant it recorded the current transfer rate. In the household without load environment, the modems were connected over small distance.

Figure 4. Connection for communication rate measurement

The measurement result is given in Figure 5-a, and 5-b where it can be seen that the transfer rate is 38.42 M bit/s.



(a)



(b)

Figure 5. (a) A graph of transfer rate of PLC communication in household environment, small distance (b) Transfer rate of PLC communication in household environment, small distance

2) Measurement of communication rate in environment without electric load

The measurement was conducted in different distances environment without any other electric devices between modems. The modems communicated over a distance of 10m, 20m, 30m, 40 m, 50m and 60m. The result of these tests appears in the table 1. The average communication rate obtained is approximately 30.05 M bit/s.

TABLE I. THE RESULT OF COMMUNICATION RATE IN ENVIRONMENT WITHOUT ELECTRIC LOAD

Test number	distance	Bit rate (M bit/sec)
1	10 m	27.89
2	20 m	31.43
3	30 m	28.75
4	40 m	30.40
5	50 m	29.42
6	60 m	32.39

3) Measurement of communication rate in environment with electric load

The same measurement was conducted in different distances environment with some electric devices between modems. The modems communicated over a distance of 10m, 20m, 30m, 40 m, 50m and 60m. The result of this tests appears in the table 2 this environment included machines, stepping motors with control units, and several lambs. The average communication rate obtained is approximately 30.1 M bit/s.

TABLE II. THE RESULT OF COMMUNICATION RATE IN ENVIRONMENT WITH ELECTRIC LOAD

Test number	Distance	Bit rate (M bit/sec)
1	10 m	31.85
2	20 m	31.25
3	30 m	29.48
4	40 m	25.73
5	50 m	31.07
6	60 m	31.20

4) Measurement of communication rate in environment with electric cable

The measurement was conducted in different distances environment through electric cable between modems (figure 6). The modems communicated over a distance of 100m, 200m and 300m. The result of these tests appears in the table 3.

TABLE III. THE RESULT OF COMMUNICATION RATE IN ENVIRONMENT WITH ELECTRIC CABLE

Test number	distance	Bit rate (M bit/sec)
1	100 m	36.70
2	200 m	31.69
3	300 m	25.02

Figure 6. Electric cables used to connect modems

B. Results of communication between PLC modems

The developed system works reliability within a distance of up to 300 meters. As reported, the system is able to work appropriately if some noise generator equipment such as air conditioner is switch on, not affecting the system performance.

Some of the problems encountered in current PLC technologies are discussed in this paper. Measurements were conducted in order to assess the potentials of data communication over power lines. The measurements were carried out in two different environments, namely household without other electric loads environment and household with electric loads environment, where the technology of narrow-band PLC for LAN network is expected to be deployed. The results have been documented and analyzed. It can be seen that under certain conditions this technology can be used for LAN network over power grid elements. The main problem will evidently be the actual range of data communication. It follows from other measurements that this communication is possible over a distance of several hundred meters. In the measurements mentioned above, a distance of some 100-300 m was therefore chosen and thus the measurements were not too much affected by attenuation.

VII. CONCLUSION

Power line communication provides an alternative way of communication. This paper provides an efficient way of for LAN network through the existing power lines as a communication medium. my system is more applicable in large industries, schools or in hospitals where we want to communicate between various departments.

This system of for LAN network over power line communication was successfully designed and implemented. This system is cost less because of the availability of equipment and there is no need to establish a new network since it's already exists for electrical power distribution purposes. This make the electrical network has the ability of data transmission and receiving in addition to the main distribution function. This system is a proof of possibility of using the existing power line as a communication line giving high satisfied result. In the design of the system both software and hardware tools are used together each with its specific function to accomplished the entire job in a flexible manner. One of the benefits of the network through power line communication is the ability to connect to the network just by plug in the PLM to one of the available sockets, so it easy to make a small network in a house or any building using this effective feature. IN this paper a TCP/IP protocol was used for managing the network traffic perfectly since they Simple and robust.

VIII. ADVANTAGES

The advantages of the system are as listed below:

- No need for additional networking:

The power grid is ubiquitous; it constitutes an existing network infrastructure to billions of private consumers and businesses. The power grid offers last-mile conductivity. The power grid supports information based services with strong growth potential.

- High transmission rate:

Right now 40 Mbps in uploading and downloading. The data transmission rate is expected up to 200 Mbps in the future by improving the PLC chip. this technology may be used to provide broad band internet over ordinary power lines.

- Lower investment cost:

Lower costs are achieved because the service is implemented on standard electrical lines. The service is also convenient because it's already in your home.

- Security service:

Greater security (all products are sold with encryption turned on)

- Simplicity

Setup takes just a few minutes - just plug in!

IX. LIMITATION

- The limitation of this system is that it will successfully transmit data only over a single same phase power line thus restricting the range of transmission. With some additional hardware can achieve data transmission over all three phases of power lines thus enabling the transmission over a greater range. Once that is achieved, this concept can be used in various applications like home automation, home networking, street lighting, security system control, control of various remote devices in industry and even internet access.

- The last problem to be faced would be the same faced by all new technologies the absence of any standard protocols. For the technology to a success and for large scale implementation, a body such as IEEE would have to come forward with a set of rules or standards for digital data transmission over power lines.

This would allow various equipment manufacturing companies to produce equipment conforming to the standard valid over all countries and the service providers to transmit and receive data as per a fixed protocol.

REFERENCES

[1] R. Blomseth, Introduction to the ANSI/EIA/CEA-709.1 Control Networking Protocol, Echelon, Embedded Systems Conference (ESC), May 2006.

[2] Insteon, Wikipedia, http://en.wikipedia.org/wiki/INSTEON

[3] INSTEON Compared, SmartLabs Technology, Jan. 2006. http://www.insteon.net/about-home.html

[4] Xavier Carcelle.- Power Line Communications in Practice

[5] Klaus Dostert. Prentice Hall. 2001. Powerline Communications"

[6] Hrasnica, Haidine, and Lehnert. Wiley. 2004, "Broadband Powerline Communications Network Design."

[7] Gotz, Rapp, and Dosert, University of Karlsruhe. IEEE Communications Magazine. April 2004. Power Line Channel Characteristics and Their Effect on Communication System Design"

[8] Jerry Ramie. Conformity. October 2005. Review of FCC Report & Order 04-245 on Broadband Over Power Lines (BPL)."

[9] www.powerlineworld.com