

# QUALITY OF SERVICE (QOS) FEATURES FOR POWERLINE ETHERNET ADAPTER

ZHYAR DYAR

Diploma of Network Department - Computer Institute of Sulaymaniah  
Email: Zheargsm@gmail.com

**Abstract:** Broadband over Power Line (BPL) is an alternative means of providing high-speed Internet access, Voice over Internet Protocol (VoIP), and other broadband services to homes and businesses by using the existing medium voltage (MV) and low voltage (LV) power lines due to the growing use of the internet. The power-line communication over the low-voltage grid which has interested several researchers and utilities during the last decade tries to achieve higher bit-rates and more reliable communication over the power lines. The main advantage with power-line communication is the use of an existing infrastructure of the electrical wire found inside and outside doors and these Wires exist to every household connected to the power-line network. This thesis starts with a general introduction to power-line communication. Then an existing application, communicating on a low-voltage grid, is investigated in order to obtain some knowledge of how the power line acts as a communication channel. Moreover this work provides a comprehensive understanding about BPL with its implementation prospects.

**Keywords:** Broadband, BPL, Communications, Power-line, Ethernet, Voltage, Services

## I. INTRODUCTION TO BROADBAND POWERLINE COMMUNICATION

The communication flow of today is very high. Many applications are operating at high speed and a fixed connection is often preferred. If the power utilities could supply communication over the power-line to the costumers it could make a tremendous breakthrough in communications. Every household would be connected at any time and services being provided at real-time. Using the power-line as a communication medium could also be a cost-effective way compared to other systems because it uses an existing infrastructure, wires exists to every household connected to the power-line network. The deregulated market has forced the power utilities to explore new markets to find new business opportunities, which have increased the research in power-line communications the last decade. The research has initially been focused on providing services related to power distribution such as load control, meter reading, tariff control, remote control and smart homes. These value-added services would open up new markets for the power utilities and hence increase the profit. The moderate demands of these applications make it easier to obtain reliable communication. Firstly, the information bit rate is low, secondly, they do not require real-time performance. [1] During the last years the use of Internet has increased. If it would be possible to supply this kind of network communication over the power-line, the utilities could also become communication providers, a rapidly growing market. On the contrary to power related applications, network communications require very high bit rates and in some cases real-time responses are needed (such as video and TV). This complicates the design of a communication system but has been the focus of

many researchers during the last years. Systems under trial exist today that claim a bit rate of 1 Mb/s, but most commercially available systems use low bit rates, about 10-100 kb/s, and provides low-demanding services such as meter reading. The power-line was initially designed to distribute power in an efficient way, hence it is not adapted for communication and advanced communication methods are needed. [2]

## II. DETAILS EXPERIMENTAL

### 2.1 Tests and Measurements

In order to present the best properties of the broadband powerline the following tests and measurement were implemented for the following:

1. Powerline. (200Mbps)
2. Wi-Fi. (300Mbps)
3. Lan cable. (1Gbps)

These sections were first implemented in home network without internet, the second one was about testing distributing the internet. The internet speed was 24 mbps for upload and download it came from Fiber optic.

### A) Home Network



Figure 2.1: Testing 50m LAN Cable

First test is LAN Cable we used 100m LAN cable between two routers and the speed is less than 5 mbps also it wasn't reliable because most of time Network connections wasn't available. Also we used 100m wireless channel between routers but hasn't any connection, but for Powerline speed is 4.4 mbps which was reliable, connection always was available. Then we used 50m as shown below,



Figure 2.2: Testing Wireless LAN



Figure 2.3: Testing Powerline

At the research paper in which the speed was increased after that we tested and recorded the measurement (Table 2.1) as seen below.

Distance(m)	TP Link Router 300Mbps		Power Line Adapter 200Mbps
	LAN Cable	Wireless	Power Lines
5	100.8	80.8	79.2
20	99.2	28.6	72
50	50.4	8.9	53.6
100	2.2	0	4.4

Table 2.1

### III. RESULTS AND DISCUSSION

#### 3.1 How does BPL work?

In order to provide data communication, the initial BPL systems coupled radio frequency (RF) data signals into the existing electric power lines. The high

frequency data signals are transmitted through the same power lines that carry low frequency electricity to the household or business. This enables both signals to coexist on the same wire. From the specific technological perspective, the basic idea of BPL technology is to modulate a radio signal with data and send it through power lines in a band of frequencies which are not used for supplying electricity. The frequencies used and the encoding scheme have a significant influence on the efficiency and the speed of BPL service. [3]

The encoding scheme which is used by most of the BPL providers is Orthogonal Frequency Division Multiplexing (OFDM). OFDM is a technique used for transmitting large amounts of digital data over a radio wave. OFDM splits the radio signals into multiple smaller sub-signals that are then transmitted at different frequencies to the receiver. The transmission of data by OFDM along several of the carrier frequencies simultaneously increases speed and reliability. Data loss occurs when electrical distribution is interrupted by electrical devices turned on and off. OFDM uses small packets to deliver data within the home, losing only small amounts of data rather than the whole signal. [3]

Figure 3.1 shows the simplified Medium Voltage (MV) BPL access network. The BPL signal in this network is transmitted over the MV system from a head-end in the local network, and for the purpose of final distribution of BPL service to the end user, either a local repeater to counter the signal-blocking effect of the local transformer, or alternatively a Wi-Fi wireless LAN access point can be used. [4]

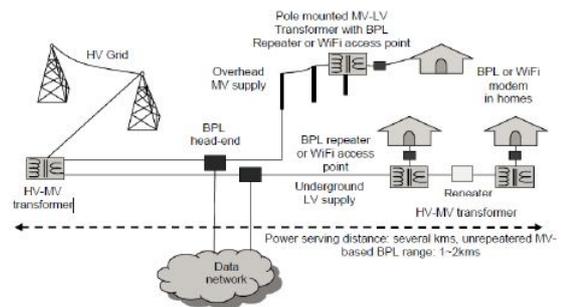


Figure 3.1: Medium voltage BPL Access Network

#### 3.2 Advantages of BPL

BPL has the ability to provide internet service by means of transmission line control protocol/ Internet protocol (TCP/IP) which can support voice, Data and video services the advantages therefore are; [5]

1. Wide Coverage: BPL can provide wide coverage, since the power lines are already installed almost everywhere. This is advantageous especially for substations in rural

areas where there is usually no communication infrastructure.

2. Cost: The communication network can be established quickly and cost-effectively because it utilizes the existing wires to carry the communication signals. III. Reliable: BPL is most reliable in data rate because most of time it remains as a stable data rate speed
3. BPL is a good solution for Home Networking than other available solutions as no other infrastructures is required.
4. BPL systems have also been identified as a means of improving the quality and reliability of electric power delivery and creating a more intelligent power grid. BPL technology could allow utilities to more effectively manage power, perform automated metering and monitor the existing power grid for potential failures

### 3.3 Disadvantages of BPL [5]

1. High noise sources over power lines: The power lines are noisy environments for data communications due to several noise sources such as electrical motors, power supplies, fluorescent lights and radio signal interferences. These noise sources over the power lines can result in high bit error rates during communication which severely reduces the performance of BPL
2. Open circuit problem: Communication over the power lines is lost with devices on the side of an open circuit. This fact severely restricts the usefulness of PLC for applications especially involving switches.
3. Signal attenuation and distortion: In power lines, the attenuation and distortion of signals are immense due to the reasons such as physical topology of the power network and load impedance fluctuation over the power lines. In addition, there is significant signal attenuation at specific frequency bands due to waves.

### CONCLUSIONS

This thesis is about power-line communication, communication over the existing powerlines. The main advantage of this kind of communication system is the existing infrastructure, which simplifies the implementation. BPL operates at higher frequencies than traditional power line communications, typically in the range between 2 and 80 MHz the modulation technique of choice for BPL is Orthogonal Frequency Division Multiplexing. OFDM is superior to Spread Spectrum or Narrowband for spectral efficiency. This technology has great aspect as future point of view provide the

various issues concerned with security and other aspects could be removed.

This project provides a comprehensive understanding about BPL with its implementation prospects. The BPL system functionality with its components and its benefits over other access technologies was pointed out. A simple comparison was made between the BPL system and another two networks. The first one was a network of two computers connected using LAN cable type (FSTP) Category 6, with different lengths. The second network was a two computers connected using WIFI devices type (TP-Link Router) with different distances between them. A remarkable difference had been noticed when sending a data between these networks. Finally this thesis gives the best network that can be used to transmit an internet signal for a distance between five meter and 100 meter. Finally, as a result the power line communication could definitely become an easily adopted alternate for communication system. The market of PLC devices will continue to grow in the near future with the integration of PLC interfaces like Wi-Fi, Ethernet, cable T.V. and so on, to fulfill the aim of both network engineers and telecommunication engineers. Although the bit rate of the wireless device and the LAN cable is better than the bit rate of the broadband powerline, the quality of the data distribution of powerline was better than the wireless and the LAN cable.

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