Initial Model Based Malaysia Regulations Broadband Technology over Power Line Networks

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ABSTRACT

Broadband over Power lines (BPL) is a technology that works by transmitting high frequency signals through the same power cable used for carrying electricity to households for high speed transmission of data. Currently, there are trials on BPL and commercial deployments underway and completed in several countries such as Europe countries, Australia and Korea. Even though, broadband technology is no longer considered as a new technological invention. But, the broadband adoption rate in Malaysia is still below expectation level as compared to many countries. Furthermore, there is lack of study that explores the BPL technology in Malaysia. Therefore, this paper is built an initial BPL network system model based on Malaysia BPL regulations and related researches in order to construct affordable communication technology that can increase household internet access penetration rate up to 75% as recommended in Malaysia National Broadband Initiative 2010.

Keywords: Broadband PLC, narrowband PLC, ICT, Last Mile Connectivity.

I INTRODUCTION

Technological developments continue to bring about significant changes in cultural and economic life in Asian Nations. The most significant changes are coming through three linked areas of innovation: broadband, convergence and wireless. Those technologies change the social and economic opportunities that are available in the online environment (Digital Review of Asia, 2008). Since the late 1990s, high speed internet access over broadband infrastructure has growth rapidly globally (Czernich, Falck, Kretschmer, & Woessmann, 2011). The scene of the last-mile is swiftly growing in various countries under the force of require for broadband Internet and new services requested by the business subscribers and residential (Moeyaert, & Maier, 2011).

Broadband is a wide band frequencies used to transmit information in which the information can be multiplexed and sent on many different frequencies or channels within the band concurrently, allowing more information to be transmitted in a given amount of time (A Report on Broadband Growth and Policies in Malaysia, 2010). The demand for high capacity broadband is being driven by always on services such as video conferencing, high definition video streaming and interactive gaming (Koonen, 2006). Broadband access in urban areas is already provided by Passive Optical Networks (PON) and Digital Subscriber Line (DSL) technologies. However, the much higher cost of network deployment in rural areas (Riding, Ellershaw, Tran, Guan, & Smith, 2009).

There are several facts about Malaysia must take into account such as, the rural areas are often remote and lower income levels, geographical dispersion of population, hilly terrain and dense trees area and difficulties to acquire suitable sites for wireless solution (Malaysian Communication and Multimedia Commission, 2008). That means, Malaysia case is difficult regard to broadband deployment for all remote areas household. With those tough difficulties, one of Malaysian Communications and Multimedia Commission (MCMC) roles is as regulator for communications and multimedia industry. MCMC's vision is to make Malaysia as globally competitive with efficient and increasingly self-regulating communications and multimedia industry. In

addition, some of MCMC's missions are recommended for promoting access to communications and multimedia services, ensuring consumers enjoy choice and a satisfactory level of services at affordable prices.

Based on the previous discussion, there is an important need to study new alternatives for old telecommunications technologies to be more cheap and reliable. That could help to build a competitive industry and achieved high penetration rates for communications services in an environment of a very open economy. Therefore, this paper is built BPL communication model. BPL is a carrier current system installed and operated on an electric power lines as an unintentional radiator that sends radio frequency energy on frequencies between 1.705 MHz and 80 MHz over medium voltage lines, or over low voltage lines to provide broadband communications and is located on the supply side of the electricity service provider's points of interconnection with customer premises.(Federal Communications Commission, 2010), (Qiu, 2007).

The use of electrical networks for broadband communications last mile connectivity arose in the 1990's along with the development of the Internet and digital signal processors (Hrasnica, Haidine, & Lehnert, 2004), (Ntuli, Muyingi, Terzoli, & Rao, 2006), (Ahola, 2001). Broadband PLC systems provide significantly higher data rates than narrowband PLC systems. Where narrowband PLC networks offer only a small number of voice channels and data transmission with very low bit rates, broadband PLC offer more sophisticated telecommunication services, multiple voice connections, high-speed data transmission, transfer of video signals, and narrowband services as well (Tinarwo, 2008).

II MALAYSIA'S BPL REGULATIONS

A set of general guidelines and requirements have been rolled out by MCMC corporate with MTSFB members, which aim to give clear understand for whom have attention to provide BPL services. MCMC Guidelines on BPL Communications (2005), the guidelines have been developed in collaboration with the Malaysian Technical Standard Forum Berhad (MTSFB). The guidelines are intended as a reference to establish clear understanding of the general requirement to facilitate potential BPL service providers in rolling out their services. The MTSFB members that worked in developing the contents of these guidelines are comprised representatives from telecommunication service providers, government related bodies, manufacturers, system developers and integrators, and higher learning institution.

The synopsis of guidelines is to provide a guided approach for the introduction of BPL communications service by licensed service providers. It is intended to facilitate parties interested to understand the procedure of provisioning this service in Malaysia. In addition, the guidelines also outline possible technical configurations of the equipment with regard to the technical capabilities. The covered areas that recommended in those guidelines are four; the BPL system compliance, allowable operating frequency, and permissible operating power and equipment standards, general requirement for the operational of BPL physical network layer applicable to Malaysia, general requirement for the deployment of BPL physical network layer applicable to Malaysia and Licensing is the forth area.

III MCMC BPL NETWORK REQUIREMENTS

The BPL network is integrated with the electricity distribution system and is utilizing the electric power lines for broadband access communications. The BPL system should have Network Management System (NMS) as parts of the network moreover; the BPL system should only be deployed on the MV and LV distribution systems.

A. BPL Physical Network Layer Structure

A number of electronic devices (or nodes) are deployed at various points in the electricity distribution network to overlay a communications network on the electric power lines. These devices are characterized as Physical Network Layer components and are designed to accomplish specific tasks along the BPL network. The deployment of BPL on the MV and LV electricity distribution network in Malaysia should follow the minimum guidelines and requirements of electromagnetic compatibility and interference requirements. The BPL equipments should have features to perform efficiently under the electrical environment and they should be electromagnetic compatible to work with surrounding equipment

and immune to the electromagnetic interference radiations.

Figure 1 shows BPL network model based on (Held, 2006) Held gives general an overview about BPL, discusses power line operators, data over power line, interference issue and between those chapter there are an explanation about, protocols and modulation mechanisms. This study shows an initial BPL model with function of each node is:

- ISP: Internet Service Provider.

- Power Plant: generates electric.

- Transmitter: converts power from High Voltage to Medium Voltage.

- BPL modulator: is mechanism in order to bypass frequencies that would adversely affect data transmission. There are several modulation techniques that enable information to be transferred as changes in information carry signal such as Amplitude Modulation (AM), Frequency and Phase Modulation. Modulation is used both for analog and digital information.

- BPL Error Check: to protect the integrity of data over unstable lines. Transmission errors in a digital communications system can be reduced through the use of two main techniques Automatic Repeat Request (ARQ) and Forward Error Correction (FEC). In ARQ system, error in any data block is corrected by circuit of receiver when is request to retransmitted the data block. FEC system encodes the transmitted data which then receiver can be correct errors. These mechanisms are considers as channel coding since they are used to correct the errors through channel noise.

- BPL Repeater & Extractor: receives signal transmitted from another repeater and performs error correction operation to minimize the effect of noise and to amplifying the signal. There is an important need to use repeater in case of large signal attenuation.

- Transformer: converts Medium Voltage to Low Voltage. There is a challenge still phase the BPL technology producers that how to send data over medium to low voltage without any loss or damage.

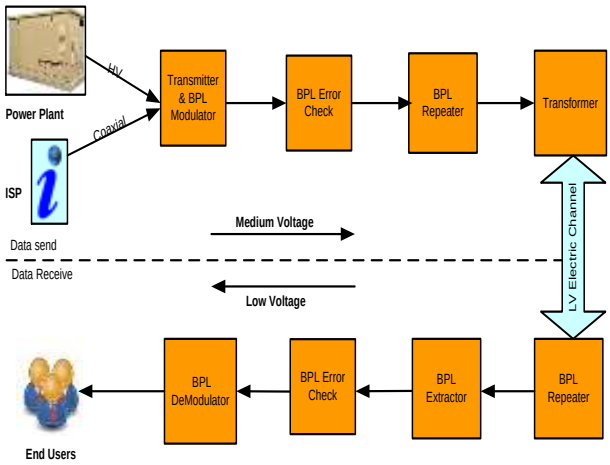

Figure 1. BPL Model. Adapted from (Held, 2006).

After we have showed functions of each node in this paper model, now we have to confirm our model with the Malaysia BPL deployment requirements. BPL system should also support duplex, broadcast and multicast communications in an efficient way. Second thing, BPL system installed in MV and LV distribution system should operate within the frequency band from 1 MHz to 40 MHz. The operating frequency used should not cause any interference to other licensees frequency. Should have the capability to limit the output power to–50 dBm/Hz or below, and the aggregated output power to not higher than 13 dBm.

BPL system must have frequency notching, frequency band blocking and power adjustment. Which will enhance the service performance and reliability, and also to inhibit possible interferences to other frequencies users. MCMC focuses on electromagnetic compatibility; BPL system must work with surrounding equipment without effect their performance or causes any harm interference. The radiated emission limits for BPL installation should follow the Federal Communications Commission (FCC) Part 15 & 15.209 specified as follows:

Table 1. Radiated emission limits.

Frequency Bandwidth	**Radiated emission limits**
1 to 30 MHz 9KHz	30 µV/m(29.59 dBµV/m)at 30 meters
30 to 88 MHz 120KHz	100 µV/m(40 dBµV/m)at 3 meters

IV CONCLUSION

Several cables are present in most households, BPL might appear as an advantageous solution compared to conventional technologies such as DSL. This is particularly true in many underserved nations, in which large sections of the population are still without telephone lines. BPL model is constructed based on previous researches, MCMC guidelines and MTSFB members as an access transmission medium that provides higher bandwidth capable of supporting multiplex information transmission and allowing more information to be transmitted within a given period of time. In future work, we will implement our model through simulation modeling and testbed environment in low and medium voltage using electrical measurement instruments and BPL devices.

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