

Power Line Communication Can Be a Significant Tool for Building Digital Bangladesh

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ABSTRACT

Bangladesh is going under an internet revaluation right now. People are using internet with various techniques such as mobile communication, optical fiber network, WiMAX. But particularly in the rural and inaccessible area, high-speed internet can't be accessed till now because of infrastructure limitations and bandwidth cost. To overcome these problems, Power Line Communication (PLC) can be an effective technique. The feasibility of PLC to spread high-speed internet will be shown with statistical analysis. By using PLC, broadband facility can be spread to almost 90% of the population within 2021.

Keywords: PLC, Digital Bangladesh, Broadband, Power line, MV and LV line, OFDM.

I. INTRODUCTION

Power line communication is a scheme which is applied by using conventional electrical medium voltage(MV) and low voltage(LV) power line. It is also known as Broadband over Power Line (BPL), Power Line Network (PLN). By using the high-speed scheme internet, voice over internet protocol (VOIP), and other broadband services are done. PLC is also used in smart grid to meter monitoring and line fault detection. Nowadays PLC exists in various part of the world. Only in USA 39 trial deployments have been occurred. PLC is also existing in UK, Spain, Russia, Australia, China, Hong Kong, Indonesia, Malaysia, Philippines [3].

Most of the people in Bangladesh is out of the broadband internet facility, especially in rural areas. In this situation it is quit tough to connect them with the global village and so that they can't survive properly concerning the people of other parts of the world. Mobile Communication is available in all around the country but using internet by the technology is not reliable because of its cost, low data speed and it can't supply proper communication facility in all areas. In this sense, PLC is more attractive technology, especially for rural and inaccessible areas.

In the past, the electrical wire has been used for monitoring. But at present, it also uses for broadband communicating services. In 1838, UK used electric wire line to remote meter and threw a proposal to patent it. Power line signaling was launched in the USA in 1905 [2]. It was used for telemetry and supervision control purpose in 20-30 decade, and modulation technique was AM, FM. The frequency range was 15-900MHz. In the decade of the 90, SCADA was upgraded by using more 5-1500 KHz frequency and used ASK, FSK modulation techniques. During that time voice transmission was possible only by the power line. Voice, data, and internet

for the last mile solution are achieved in 1997 over power line. Data speed also improved and it was up to 14Mbps. Frequency range was 100-2000 KHz for data transmission, OFDM, DSSS were applied. Now in today, deployment of PLC is robust. The communication technology is used BPSK, QAM, OFDM, 32 PAM modulation technique, so that the data speed is increasing up to 5-200 Mbps [1].

Power Line Communication is not available in Bangladesh right now. But there has various scope to use the system. Its deployment will be very effective because of infrastructure setup and low costing relatively another communication systems.

By following the introduction, rest of the paper is arranged with different sections as follows. In section II and III, describe components and their deployments. Modulation and challenges of channels are shown in section IV, and V. Section VI will describe the internet situation in Bangladesh and section VII will be discussed about feasibility of PLC. Finally concludes in VIII section.

II. BASIC COMPONENTS

Broadband access over high voltage power line is not suitable because the line is too noisy and causes to data distortion. For a reason, MV and LV line is preferable for internet access. PLC technique has two part in the communication line, Access PLC and InHouse PLC. Access PLC comprised of 3 modules:

- a. Injector: Injector acts as the medium to connect internet source with the electrical line. By using injector high-frequency signal is injected into the MV and LV line. It has transmitter and receiver. Injector converts fiber signal into the format of MV line signal [3].
- b. Repeater: Data can't travel a huge distance in electrical line because of attenuation problem. To mitigate the attenuation problem, the repeater is used which amplify the data. The repeater is installed after 10002500ft distance in line [3].
- c. Extractor: Extractor consists of couplers, transfer bypass box, and in bridge facility, the wireless access point is used. Couplers and bypass box are needed to bypass data to/from MV line.

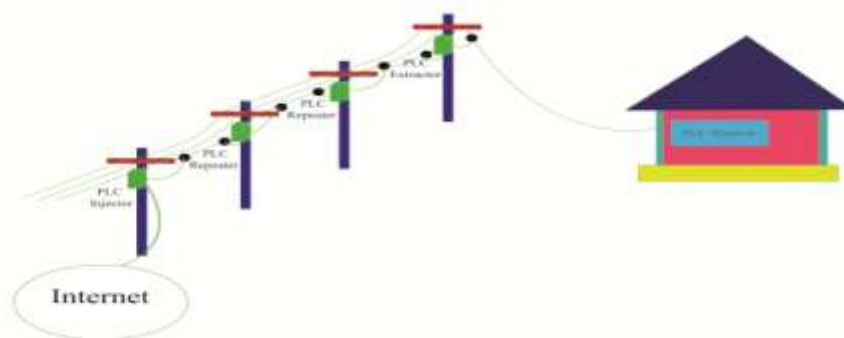


Fig 1. The basic structure of PLC/BPL

In-house PLC has used a modem which can collect proper data from the LV line. In-house or business the modem is also used as LAN connection to the interface device.

III. DEPLOYMENT METHODS

There are three methods to deploy PLC. First of all, is transferred signal to/from MV line by using couplers and bypass box. Signals pass through around the transformer with couplers which are set in MV and LV line. The second method is passed the signal to the transformer. In this method, a coupler in LV line and bypass box are installed. The third option is hybrid. LV line doesn't need any coupler and bypass box to transmit and to receive data to/from a wireless communication device in LV line. Then the users use data from the wireless connection [3].

IV. MODULATION TECHNIQUES

In general, Frequency Shift Keying (FSK), Code Division Multiple Access (CDMA) and Orthogonal Frequency Division Multiplexing (OFDM) are used for modulation.

FSK modulation is popular for its low-cost property. The data rate is also low. It does not need the linear amplifier in the transmitter. But the receiving end requires more complicated demodulator [2].

CDMA technique can offer more data transmission rate than FSK up to 1Mb/s [2]. The bandwidth of CDMA channel is 800MHz to 1.9GHz, and it's mostly used in the cellular phone.

OFDM is hugely used in PLC because of its robustness against channel distortions like impulse noise, multipath feeding, and interference. It's another attractive feature is that it doesn't need guard band which mitigates delay spread and interference between signals. Data speed of OFDM is also high and is up to 10Mb/s [2]. Recently OFDM and discrete multi-tone (DMT) become very well-known due to flexibility in high data rate, bandwidth efficiency and simplifying channel estimation. OFDM modulation technique divides the signals into many sub channels, so interference is mitigated. Assigning bits into the sub channel is directly proportional to sub channels SNRs.

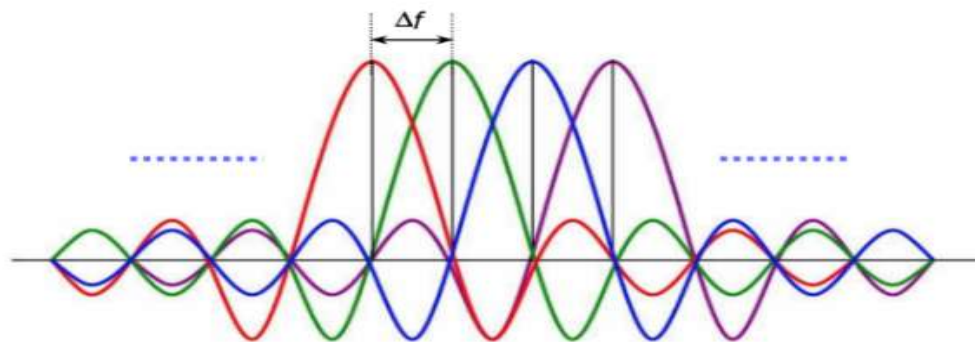


Fig 2. Frequency spectra of OFDM [4]

V. CHALLENGES

Signal Attenuation: In power line communication the signal attenuation is high (100 dB) which limits the actual achievability of PLC. For a 100-150m distance of the power line, the measurements were less affected by attenuation.

Bandwidth carrying the signal from source to destination is limited by signal attenuation due to long distance and high-frequency propagation. It's very important in power line communication, the cable has vital role of carrying the signal from source to destination.

The propagating signals are affected by attenuation increasing with length and frequency. This causes loss in signal which is of mainly three types-

1. Resistive Loss
2. Dielectric Loss
3. Radiated Loss [1].

Interference: The interference level depends on connected load and length of the line and Load connected which vary with time. Broadband PLC system uses to communicate a different frequency band; it always ranges from 1 to 38MHz. The Endeavour is aware of possible interference problem that may impede the free reception of analog, signal as signals as well as of future digital short wave broadcasting. Interference was an issue with earlier generations of PLC technology, but today's third generation system is much improved over earlier versions. Undesirable emission levels have been remarkably reduced over time. The new technology system became very easier to actual problems with interference which should it occurs [1].

Noise: PLC technologies more favorable side is that no need of wire. The serious impediment side is its wide spread used in broadband communication which output is electromagnetic interference and noise. Noise is mainly three types of PLC channel that are

- 1) Colored background noise,
- 2) Narrow band noise
- 3) Impulsive noise [1].

VI. PRESENT STATUS OF COMMUNICATION IN BANGLADESH

3G technology is available in Bangladesh right now, and 4G will be coming in recent future. So the mobile operator can deliver us well internet speed. Also, this communication system is evaluated in our country vastly, and most of the people use it. But every area is not covered by the system equally. That's why people in rural areas are out of high-speed internet facility. On the other hand, optical fiber communication is mostly available in cities only. The recent report of BTRC is that 77.142 million subscribers are using the internet in Bangladesh. 71.883 million people are using mobile communication to access the internet, and only 5.170 million people are covered under optical and PSTN wireline communication to use the internet. Rural people of our country totally depart from broadband wireline internet. But broadband wireline internet is more reliable and

cheap. To establish wireline internet connection, it is a great tension that the channel distribution cost. So alternate way has to be found to extend broadband [5].

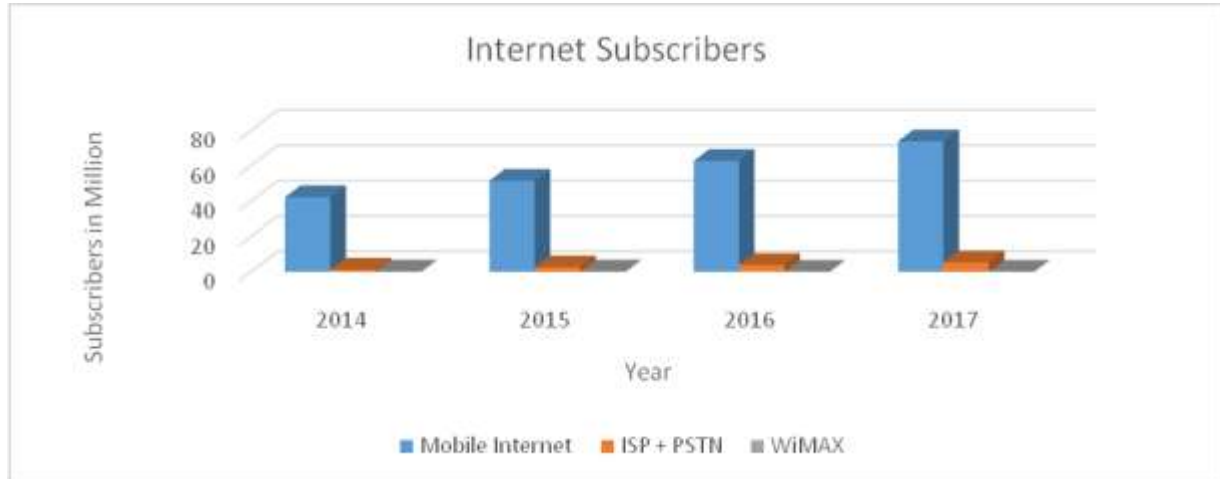


Fig 3 Recent Internet subscribers in Bangladesh [5]

From the graph, it is shown that ISP and PSTN subscriber's number is very poor and also the growth is not so well indeed.

VII. FUTURE OF PLC IN BANGLADESH

Power Line Communication can be the best alternate for optical fiber communication to access internet in our rural and inaccessible areas. MV and LV line has already existed in most of the remote areas in Bangladesh. By using PLC method, high speed internet can extend on those areas easily and mitigate the cost of channel distribution.

To achieve the goal of digital Bangladesh, "Broadband Master Plan" is taken and fixed a target of 50% area will be covered under broadband connection within 2021 [6]. This task is very easy to fill up the target if PLC system will be applied and not only gain it but also more than 50% area will be distributed internet.

BPDB has 3.72K kilometers distribution line and 78% people are getting electric facility [7]. So that huge portion of people will be covered under high-speed internet by using PLC and a revolution will be achieved in our telecom sector.

By using PLC, a smart grid is also formed in our country, so that meter monitoring and fault detection can be possible. At present, 290 number of sub-districts and 1110 unions are under optical fiber line. On the other end, 201 number of sub-districts and 3444 number of unions are out of optical fiber facility. PLC can be applied on that sub-districts and unions area where optical fiber don't access. The sub-districts and unions which already has optical fiber facility also can use LV line PLC to provide internet to their rural people. People of that area can save line charge by using PLC.

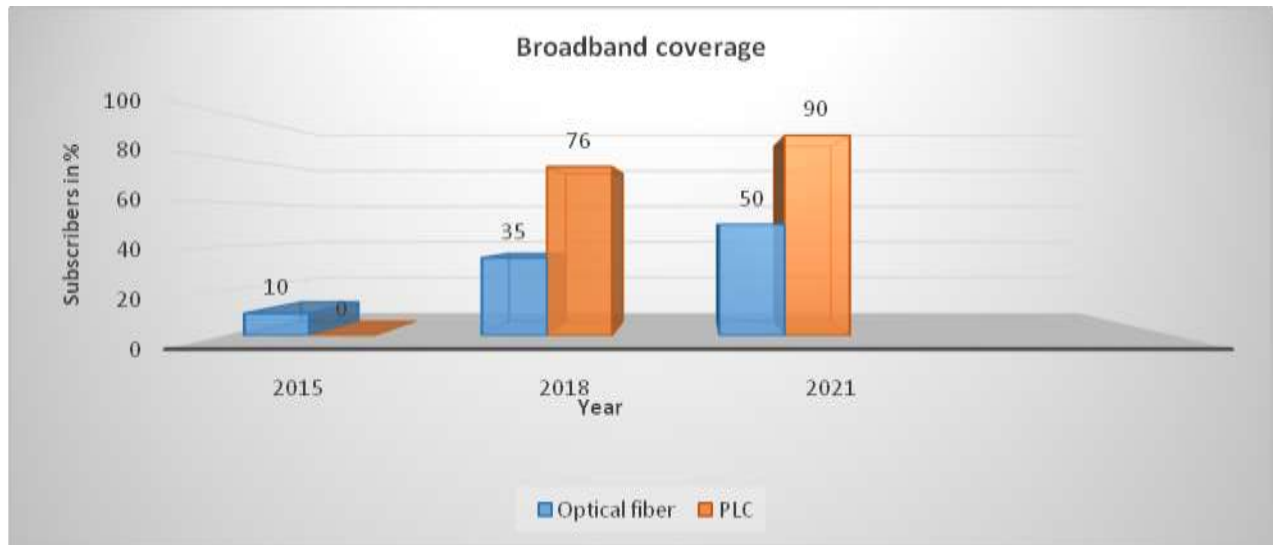


Fig 4. Feasibility of Optical fiber and PLC subscribers [6]

Typical Cost analysis between Optical fiber and PLC for an end user:

Table I. COST COMPARISION [8][9]

Cost purpose	Optical Fiber Communication	PLC
Fiber/cable	12tk/m	-
Converter	1400tk/pair	-
Switch	400tk/pic	-
Router (2 antennae)	1600tk	3000tk
Monthly charge	=	=

VIII. CONCLUSION

Impact of PLC is very strong, and it can make a dynamism in our internet sector especially in rural area. People will show interest because of its cheapness and reliability. ISP companies will also minimize optical fiber cost. Overall PLC can be an epoch-making technology for our country.

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