

VOICE AND DATA COMMUNICATION OVER POWER LINES.

PROJECT NO. 069

PRESENTED BY

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Voice and data communication over power lines

OBJECTIVES

- ✓ To discuss a power line carrier network highlighting the major technical and design issues involved.
- ✓ To compare cost effectiveness of the power line carriers with respect to other broadband providers.

Voice And Data Communication Over Power Lines

TOPICS COVERED:

- What is voice and data communication over power lines/BPL?
- Why broadband over power lines?
- Components of a power line carrier/BPL.
- PLC structure and Principle of operation.
- BPL Architectures.
- Technical Challenges.
- Techno-economic Analysis.
- Conclusion.
- Recommendations & Further Work.

What is PLC/ BPL?

- ❖ BPL communications sends digital signals in the 2-80MHz band across existing distribution power lines: medium voltage (11kv/66kV) & low voltage (110/240v) .
- ❖ PLC, a new technology that sends data through existing electric cables alongside electrical current, is set to turn the largest existing network in the world, the electricity distribution grid, into a data transmission network
- ❖ Power line communications (PLC) uses the energy cables as the communication channel and the digital data are transferred via energy cables.

Why Bpl?

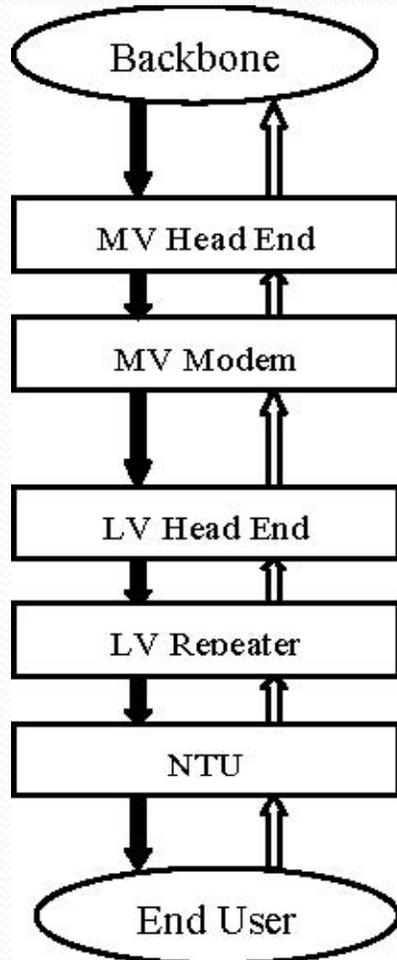
This new technology in the Kenyan market comes along with:

- ❖ Provision of high-speed Internet access.
- ❖ Make it possible industrial control .
- ❖ Home automation of TV sets, fridges, lights among others ,over power lines with economical and reliable solutions.
- ❖ Long-distance monitoring of alarms and air-conditioning systems.
- ❖ Comfortable control of intelligent household appliances.
- ❖ Off-site reading of electricity meters will all become feasible- simply via the power grid. Facilitate use of the SCADA system.

Components of a Power line carrier Network

- ❖ A typical BPL system consists of four basic functions:
 1. The **injector** is used to put **the Internet Protocol signal** onto the power line.
 2. The **repeater/concentrator** is used to boost the signal (to re-time and regenerate the signal)
 3. The **extractor** is used to **take the Internet Protocol signal** off **the power line**.
 4. The **modem** is used to transfer the Internet signal from the power outlet to the computer via the customer premise equipment.
- ❖ Other BPL components include: **transmitters, receivers, line tuners, filters, line traps & couplers**

Structure



Medium Voltage Head End: It enables the communication between the Backbone or the main communications network and the PLC network.

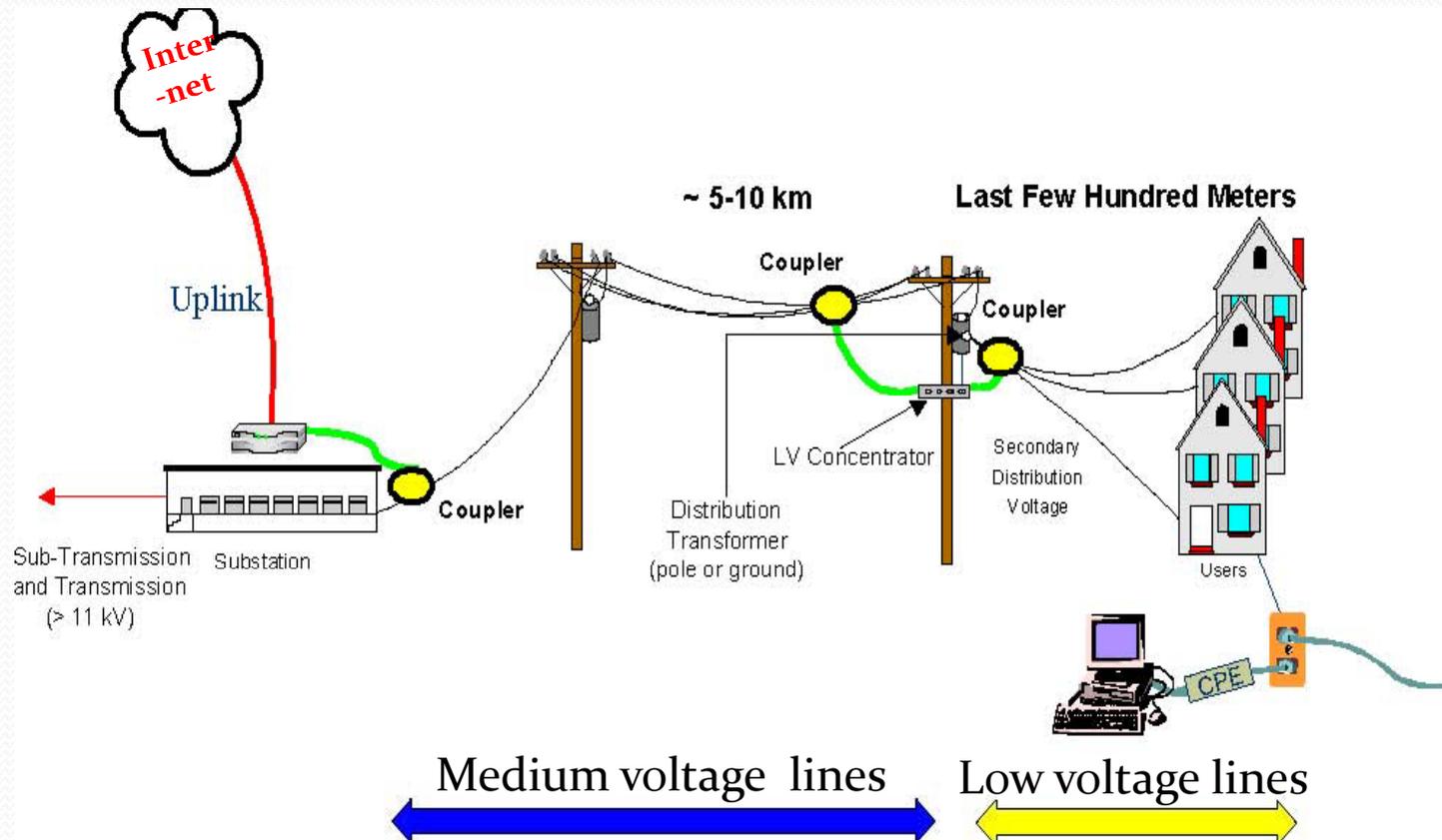
Medium Voltage Modem- The interface between a MV PLC Network and a LV PLC network on the MV side.

Low Voltage Head End: This is the end of the LV PLC network and is a gateway to the MV network. The repeater regenerates the signal.

Network Termination Unit (NTU): It is the interface between the client equipment and the LV PLC network placed at the client premises.

Principle of operation

Power Line Carrier communication systems consist of a high frequency signal injection over the electrical power lines



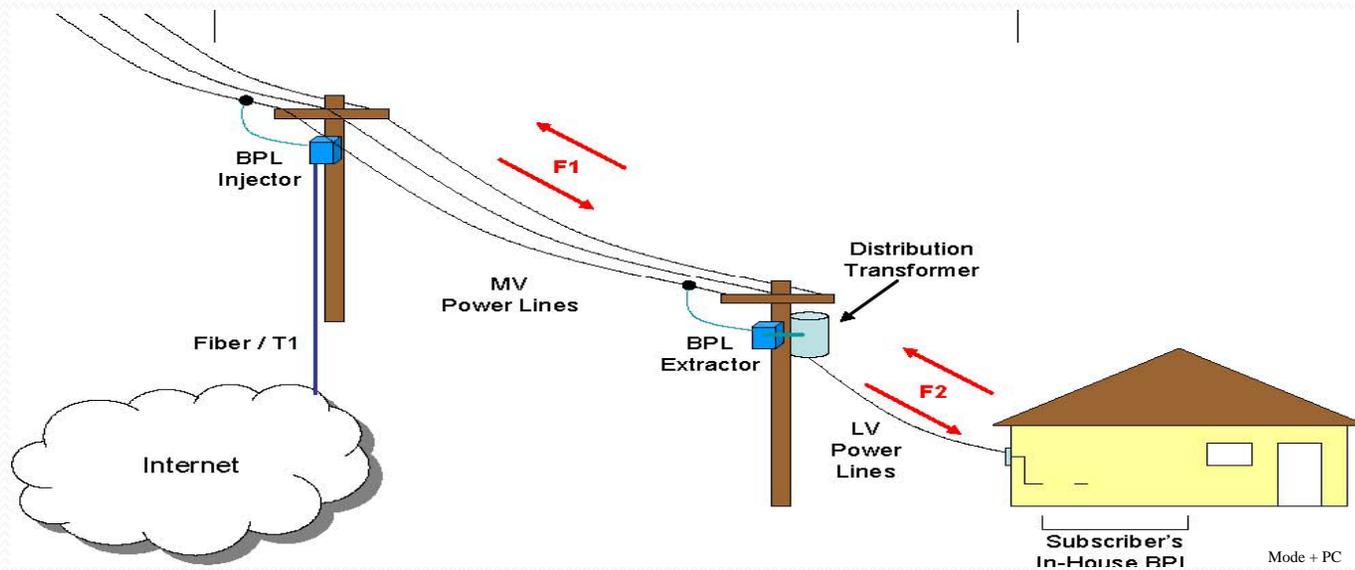
Discussion

- ❑ Data from the Internet enter (or leave) at the substation level, where **injectors** generates the data signals that are **coupled** onto the MV wire. The signals traverse the grid network over medium-voltage and LV lines to the home or business of the end user.
- ❑ **Repeaters** are employed to maintain the required BPL signal strength and fidelity through signal regeneration.
- ❑ **Extractors** provide the interface between the MV power lines carrying BPL signals and the households within the service area. BPL extractors are usually located at each LV distribution transformer feeding a group of homes. Some extractors boost BPL signal strength sufficiently to allow transmission through LV transformers and others relay the BPL signal around the transformers via couplers on the proximate MV and LV power lines. Other kinds of extractors interface with non-BPL devices (*e.g.*, Wi-Fi) that extend the BPL network to the customers' premises.

BPL Architectures

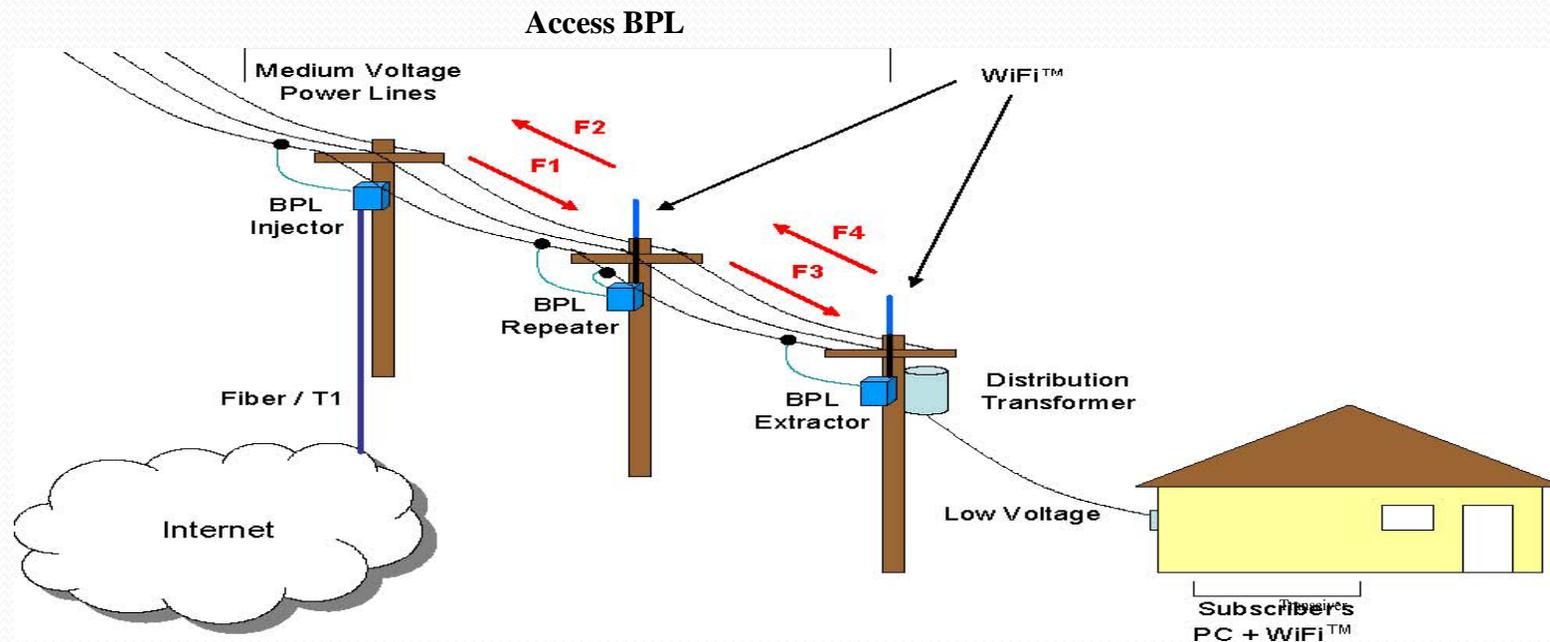
System 1- employs Orthogonal Frequency Division Multiplexing (OFDM) to distribute the BPL signal over a wide bandwidth using many narrow-band sub-carriers. At the BPL injector, data from the Internet backbone is converted into the OFDM signal format and is then coupled onto one phase of the MV power line.. The two-way data are transferred to and from the LV lines, each feeding a cluster of homes, using BPL extractors to bypass the LV distribution transformers. The extractor routes data and converts between access and in-house BPL signal formats. The subscribers access this BPL signal using in-house BPL devices.

Access



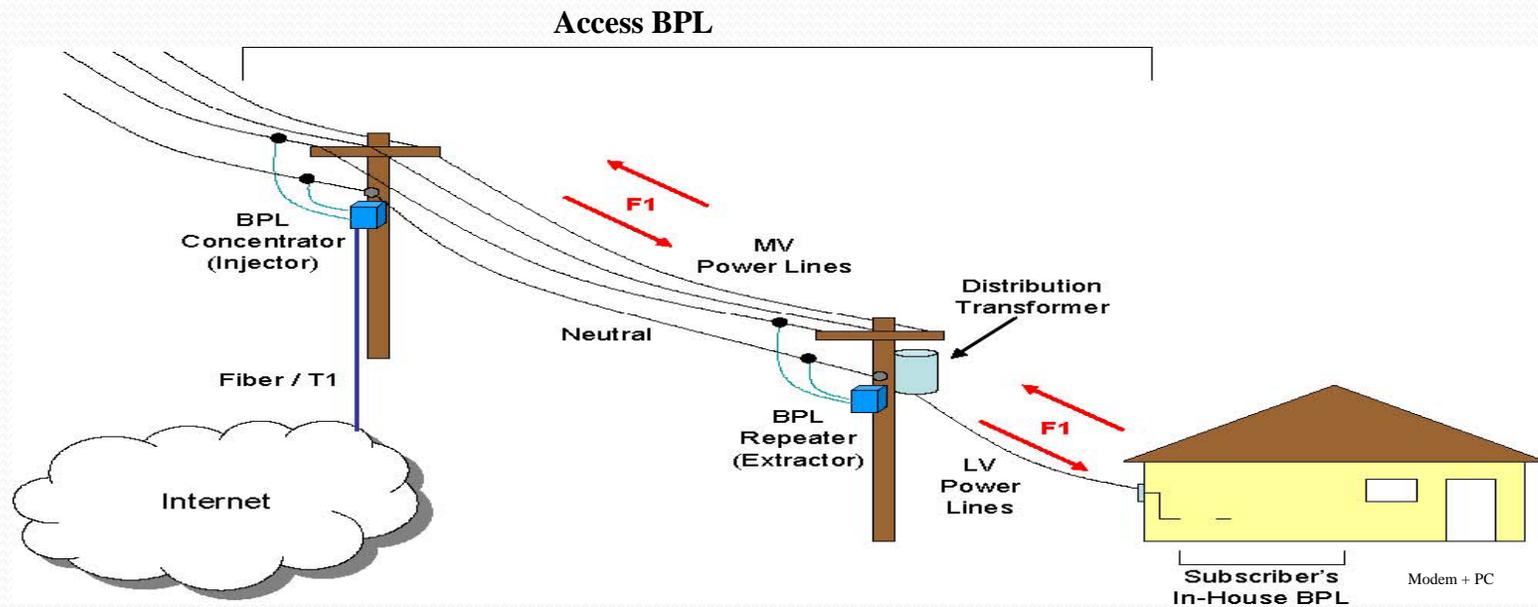
BPL Architectures cont.....

System 2 also uses OFDM as its modulation scheme, but differs from in the way it delivers the BPL signal to the subscribers' homes. Instead of using a device that uses LV power lines, System 2 extracts the BPL signal from the MV power line and converts it into an IEEE 802.11b Wi-Fi™ signal for a wireless interface to subscribers' home computers as well as local portable computers.



BPL Architectures cont....

System 3 uses Direct Sequence Spread Spectrum (DSSS) to transmit the BPL data over the MV power lines. All users within a BPL cell share a common frequency band. In order to minimize contention for the channel, Carrier Sense Multiple Access (CSMA) is used. Like System 1, this type of system is designed to accept some amount of co-channel interference between cells, as all devices operate over the same frequency band.

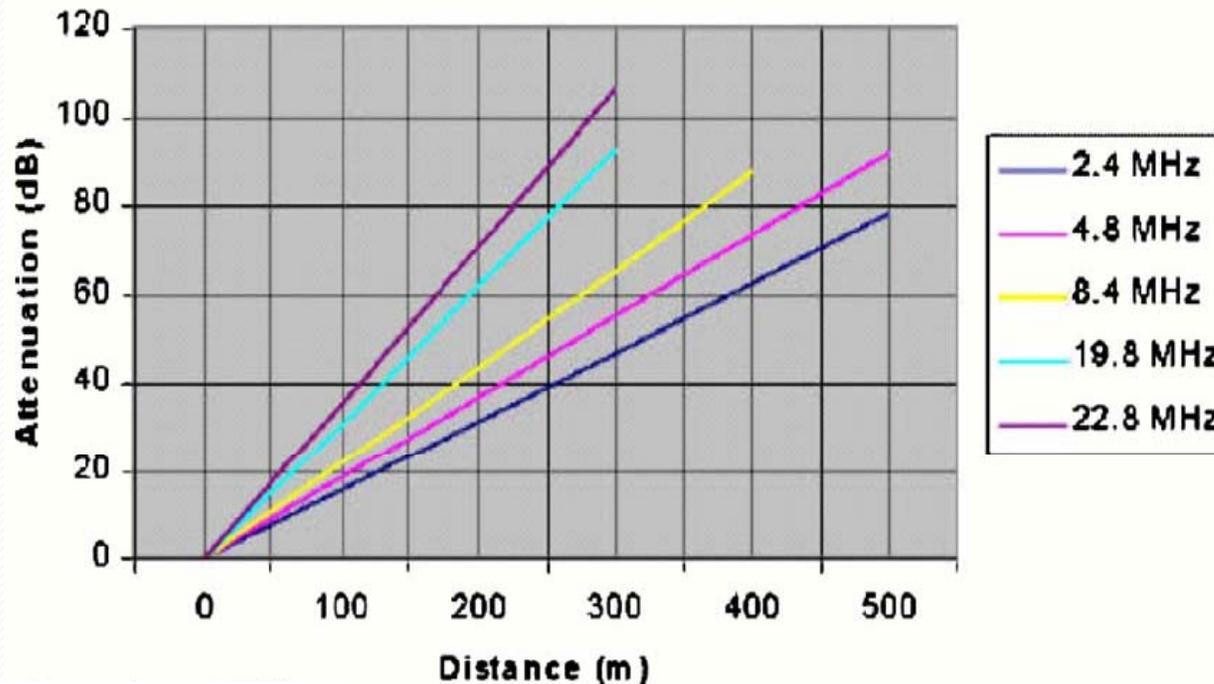


Technical Challenges

However good the technology is, it suffers the following drawbacks:

- Data attenuation, this include Line attenuation and Signal attenuation .
- Minimum -security levels and Threat to data security .
- High costs of residential appliances.
- Lack of global standards.
- Noise and Interference to other data signals.
- Cable, DSL, and competition .

Effects of frequency on Attenuation and distance



Line losses will increase as the frequency goes higher. This is primarily because of the fact that most losses are due to shunt capacitance which becomes lower impedance at higher frequencies

Techno-economic Analysis

BROADBAND PROVIDER	DATA SPEED	DATA RATES(Kshs) PER MB	MONTHLY CHARGES(Ksh.)
BPL	100kbps - 85Mbps	<1	➤ Approx.Ksh. 1,500/=
ORANGE	128kbps - 512kbps	1 to 7 (depending on the data bundle)	Sh. 5,990/= or Sh.10,990/= (also as per the data bundle)
SAFARICOM	128kbps- 512kbps	Sh. 8	➤ Between sh.999 to sh.30,000 (depending on the tariff plan & data bundle) pus Sh. 4,999 ➤ Sh. 2,999-or Sh.5,999 (plus sh. 5,800 installation cost)
ZUKU	256kbps -512kbps		
ACCESS KENYA	128kbps or 256 kbps		➤ Sh. 4,000 or Sh. 6,000 (plus Sh. 12,500. Installation cost.)
YU		Sh.3	➤ Not yet set
AFRICA ONLINE	128kbps or 256 kbps	-	➤ Sh.3,447,7,999 or 19,999(depending on the data bundle)
ZAIN	-	20	-

Conclusion

- ❖ Broadband over power lines is a viable technology in Kenya due to the need for internet in our rural. Since there is no greater cable network in the Kenyan communication network as compared to the power system network (the Kenyan grid). This implies that once the project is implemented over fifteen million people who currently rely on electricity as a source of power will benefit from cheap and accessible internet services.
- ❖ Power line communication is a valid technique that allows the exchange of data by means of the power line cables that are present in every dwelling and in every building.
- ❖ The cost comparison of power line carriers with other broadband providers in Kenya shows that although there is high initial (installation) cost incurred, the running cost for Broadband over power lines is low. It is also found out that broadband over power line is cheaper as compared to other broadband providers. Thus broadband over power line is a technology worth implementing.

Further work/ Recommendations

- I recommend that a detailed research on the solution for the diverse challenges to broadband over power line be done (this is in the Kenyan market).
- Also a research on the viability of using fiber optic to replace copper cables and aluminium conductors should be analyzed technically. This will aid in increasing the bandwidth for data and voice transmission.
- A detailed cost analysis of this technological product should be carried out once embraced especially on how the regulated power business will interact with the unregulated telecommunication business.

Voice and data communication over power lines

END

THANK YOU

QUESTIONS?