

Power Line Communication Frequencies

Power line communication (PLC) transmits by injecting signals onto household wiring and the electrical power lines. PLC is used for computer networks, wired smart meters and other purposes. There are many types of PLC systems, operating at a wide variety of frequencies. Knowing the frequency is important when investigating and mitigating problems.

Keywords: Power line communication, power line carrier, power line networking, broadband over power lines, frequency, PLC, PLT, PLN, BPL, PLC smart meter, wired smart meter

Ultra narrow band / low frequency PLC

These systems operate at frequencies below 3 kilohertz and are very limited in their transmission speed. They are mostly used for remote communication with electrical meters, including some smart meters.

These types of systems are popular for meter reading in North America as the low frequencies are not blocked by transformers, which on this continent typically serve only a few households. Examples of systems are TWACS and Turtle (TS1 and TS2).

The Turtle TS1 system operates at frequencies as low as 5 hertz.

The utilities often refer to their PLC systems as Power Line Carrier.

Examples of other uses of this frequency band:

- the human brain (below about 40 hertz)
- infrasound (below 20 hertz)
- audible sound (20 hertz to 20,000 hertz)
- Schumann resonance (important for human health)
- U.S. Navy deep-sub communication (76 hertz)
- alternating current (50 or 60 hertz)

Narrow band PLC

Narrow band PLC operates from 3 kilohertz to about 500 kilohertz. In the United States and Asia, there are no restrictions on who can use these frequencies. In Europe, the CENELECT standard reserves some frequencies:

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Band	Frequencies	Use
A	3 – 95 kHz	Utilities / smart grid
B	95 – 125 kHz	Unrestricted
C	125 – 140 kHz	In-home networks
D	140 – 148.5 kHz	Alarm and security

PLC smart meters in Europe usually transmit in the CENELECT A band, though some models can also use the C band. These frequencies are dampened by transformers, so a bypass must be installed on each transformer. This is not a problem in Europe, where one transformer can serve over a hundred households.

In North America, many households have their own transformer, making it more costly to install the bypasses, so these technologies are rarely used. The new G3-PLC standard does not need these bypasses, so G3-PLC products may become common in North America for smart meters.

The transformer issue is not a problem for PLC networks inside a house. The bandwidth of the systems is suitable for security alarms, remote control of lights and communication with “smart” appliances inside a house. It is not sufficient for network computers.

Utilities have used these bands for decades to communicate with remote switch yards through their high-voltage transmission lines.

Examples of narrow-band systems: PRIME, G3-PLC, INSTEON, X10 and HomePlug C&C. Note that other HomePlug products use higher frequencies.

Examples of wireless uses of the 3 kilohertz to 500 kilohertz frequency range:

- navigation systems for ships and airplanes
- military submarine communication
- maritime radio
- Ground Wave emergency Network (USA)
- long wave AM radio (Europe and Asia)

Broadband PLC

Often called “Broadband over Power Lines” (BPL), these technologies can deliver network speeds of 100 megabit-per-second or faster. They are used to bring internet service to homes and small businesses over the electrical distribution system, or as in-house networking.

BPL typically operates in the band from 2 megahertz to 30 megahertz, though some go to 50 MHz or even higher.

Since these frequencies are also widely used for radio transmissions, the amount of radiation from the power lines is restricted in Europe. In Japan, there is currently a total ban on BPL for this reason. The United States has essentially no restrictions on BPL emissions.

Examples of BPL/PLC products are most of the HomePlug network devices, HD-PLC and Spidcom.

Examples of wireless uses of the same frequency band (2–30 MHz):

- ship communication
- aircraft communication
- military communication
- law enforcement, customs, etc.
- emergency services, Red Cross, etc.
- short-wave broadcasts (BBC World Service, etc.)
- radio amateurs
- embassies
- communication in remote areas

Bands not used for PLC

To avoid interference with reception of AM radio, no PLC systems operate in the 500 kHz to 1800 kHz band.

Few PLC systems go above 30 MHz, due to increasing problems with line losses. The upper limit is probably 80 MHz, as FM radio reception could then be impacted.

Sources:

For the grid and through the grid: The role of power line communications in the smart grid, Stefano Galli et al., Proceedings of the IEEE, June 2011.

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Task 1 Deliverable: Create list of existing PLC technologies, Stefano Galli and Brad Singletary, National Institute of Standards and Technology (NIST), PAP-15, March 23, 2010.

The lists of wireless uses are compiled from a variety of sources.

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